United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122,
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2015-F-0025

JUL 3 1 2015

Captain Joseph A. Campbell
Deputy Director, Joint Guam Program Office
Office of the Assistant Secretary of the Navy (EI&E)
Joint Guam Program Office, ASN (EI&E)
201 12th Street South, Suite 700
Arlington, Virginia 22202

Subject: Biological Opinion for the Department of Navy's Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam

Dear Captain Campbell:

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) addressing the effects of the subject action as proposed by the Department of the Navy (DON) to the threatened Mariana fruit bat (*Pteropus mariannus mariannus*), and the endangered Mariana crow (*Corvus kubaryi*), Guam Micronesian kingfisher (*Todiramphus cinnamominus cinnamominus*), Guam rail (*Gallirallus owstoni*), and *Serianthes nelsonii*. The Opinion also addresses adverse effects to critical habitat for the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher. The Opinion was prepared in accordance with the requirements of section 7 of the Endangered Species Act (ESA) of 1973 as amended (16 U.S.C. 1531 *et seq.*). The DON is the designated lead Federal agency for this consultation. This Opinion completely supercedes and replaces the 2010 DON Biological Opinion (2010-F-0122).

In addition, pursuant to the requirements identified in the Cooperative Agreement between the U.S. Air Force, DON, and the Service for the establishment and management of the Guam National Wildlife Refuge, we have provided coordination regarding potential impacts to the Guam National Wildlife Refuge Overlay from the proposed project. This consultation reviews anticipated effects to the listed species and their terrestrial habitats, including listed species habitat, on Guam. In this consultation, habitat is defined as the habitat that is currently suitable to support the survival and recovery of listed species.

Your October 1, 2014 letter, requested our concurrence with your determination that the subject action is not likely to adversely affect the endangered Mariana swiftlet (*Aerodramus bartschi*),

threatened green sea turtle (*Chelonia mydas*), and endangered hawksbill sea turtle (*Eretmochelys imbricata*) pursuant to section 7 of the ESA. Our assessments of project effects to these species are addressed in Appendix A.

This Opinion is based on information provided in your October 1, 2014, letter and biological assessment; updates to the biological assessment; email correspondence and discussions between the Service and DON; and our files. A complete project file for this consultation is in the Pacific Islands Fish and Wildlife Office (PIFWO) in Honolulu.

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A. CONSULTATION HISTORY

September 8, 2010. The Service issued the Biological Opinion (BO) for the Joint Guam Program Office (JGPO) Relocation of the U.S. Marine Corps (USMC) from Okinawa to Guam and Associated Activities on Guam and Tinian (2010-F-01222; hereafter, 2010 DON BO) to the DON.

March 13, 2012. The DON informed the Service that they were proposing changes to the project as described in the 2010 DON BO. The DON discussed that the proposed live-fire training range complex (LFTRC) may be located along Route 15 or within the Naval Munitions Site (NMS) on Guam. The DON explained that they were in the process of preparing a draft supplemental environmental impact statement (Draft SEIS) that would include potential locations for the LFTRC on Guam.

September 17, 2012. The DON submitted their annual report on the implementation of conservation measures for the 2010 DON BO. The DON explained to the Service the implications of the 2012 National Defense Authorization Act (2012 NDAA) on the 2010 DON BO. The DON stated there would be a reduced force and number of dependents moving to Guam; and that the 2012 NDAA did not affect the existing awards for military construction but affected all future military construction projects, including some of the conservation measures in the 2010 DON BO. The DON provided a draft letter requesting an amendment to the 2010 DON BO.

September 20, 2012. The DON provided the Service with a draft conservation measure tracking sheet which showed the project activities (as described in the 2010 DON BO) that were affected by the 2012 NDAA.

October 11, 2012. The DON modified its Draft SEIS to accommodate changes to the proposed force structure and number of dependents being relocated to Guam, and the proposed alternatives for the LFTRC changed from information provided in March 2012 to include the LFTRC at Northwest Field (NWF) located on Andersen Air Force Base (AAFB).

October 12, 2012. The Service and DON discussed the proposed changes to the project and whether the changes constituted an amendment or a reinitiation of the 2010 DON BO. The Service stated that the 2010 DON BO would need to be reintiated due to substantive changes in the scope of the action.

January 30, 2013. The DON, the Service's Pacific Regional Office (RO), and the Regional Solicitor's Office via a conference call discussed the subjects of extirpated species consultation and the need to reinitiate versus amend the 2010 DON BO for the DON's " interim actions" that would occur between 2013 and 2015.

April 3, 2013. The Service received DON's request to reinitiate the 2010 DON BO and received the *Biological Assessment for the Reinitiation of Consultation for the Proposed Military Relocation to Guam; Fiscal Years 2010–2015*. The DON determined that the only federally listed species affected by the DON activities between fiscal years 2010 and 2015 was

the Mariana fruit bat. The DON determined that the project "may affect, but is not likely to adversely affect" the Mariana fruit bat.

April 9, 2013. The DON and the Service met to discuss DON's request to reinitiate the 2010 DON BO. The DON delivered a presentation on the proposed adjustments to the project, which included the relocation of approximately 5,000 USMC personnel and 1,300 dependents and the LFTRC alternative located at NWF, AAFB on Guam. The DON requested the reinitiated consultation only address the project activities that would be conducted between 2010-2015. The discussion focused on how to best address the "interim actions" that would occur between 2013 and 2015; the inclusion of the extirpated species, the Guam Micronesian kingfisher, Guam rail, and the Mariana crow, in the consultation; the status and implementation of conservation measures; and brown treesnake interdiction measures.

May 3, 2013. The Service acknowledged the receipt of the DON's request to reinitiate the 2010 DON BO. The Service determined that there was insufficient information to initiate consultation. The Service questioned the need to determine if reinitiation of consultation or an amendment would be the best mechanism to address DON's changes in the proposed action. The Service requested a table with a list of project activities and their associated or linked conservation measures that would mitigate impacts to the listed species. The Service also requested that the brown treesnake control and interdiction measures in the 2010 DON BO remain in the consultation.

May 7, 2013. The Service provided a draft table that tracked the conservations measures that should have or have been implemented as required by the 2010 DON BO.

May 30, 2013. The DON responded to the Service's letter of May 3, 2013, and provided the requested table (hereinafter "crosswalk table"). The crosswalk table listed project activities and linked conservation measures that avoid, minimize, and compensate for the impacts associated with the interim actions. DON also provided a color coding of all the conservation measures included in the 2010 DON BO to delineate which conservation measures have been implemented and those measures which have not been triggered or will not be implemented based on the proposed adjustments to the action.

June 13, 2013. The DON requested a meeting to discuss the crosswalk table and for the Service to provide the rationale to support including the Guam Micronesian kingfisher, Mariana crow, and Guam rail in the consultation.

July 8, 2013. The Service and DON met to discuss the following: 1) The Service discussed staffing workload and recommended a programmatic approach to the Marianas related DoD consultations being submitted to the Service office in the next 18 months; 2) The Service requested that the Guam Micronesian kingfisher, Mariana crow and Guam rail be included in the consultation. The DON requested the legal rationale requiring section 7 consultation on extirpated species. The Service stated they had a draft white paper in development that would address DON's request; 3) Standardized language for brown treesnake interdiction and rapid response efforts; 4) The Service acknowledged that they requested a reinitiation of the 2010 DON BO, which resulted in DON's April submittal of a reinitiation request; however the Service

thought an amendment may be more appropriate considering the interim actions are within the scope of the consultation; and 5) Both parties agreed further clarification and discussion on the crosswalk table were needed.

August 19, 2013. The Service provided rationale to the DON regarding the requirement under the ESA to consult on project impacts to the Guam Micronesian kingfisher, Mariana crow, and Guam rail.

August 22-23, 2013. The Service submitted comments on the crosswalk table to DON. Email correspondence was exchanged between the Service and DON on the crosswalk table.

August 28, 2013. The DON provided their reasons why they disagreed with the Service's August 19, 2013, rationale.

September 10, 2013. The DON requested a species list for this consultation, the DON Relocation of the USMC from Okinawa to Guam and Associated Activities on Guam (proposed project). The DON also provided the Service with the preliminary drafts of chapters 1 and 2 of the Draft SEIS.

September 11, 2013. During a conference call between DON and the Service, the participants agreed that the extirpated species issue required elevation to the Service's RO and Regional Office of the Solicitor.

September 30, 2013. The Service provided the DON with a species list of federally listed species and information on critical habitat for the proposed project.

October 1, 2013. The Service notified the DON that the Service completed their review of the August 28, 2013, correspondence from the DON. The Service determined that both agencies were at an impasse regarding the issue on consulting on project affects to the Guam Micronesian kingfisher, Mariana crow, and Guam rail. The Service informed the DON that this issue would be elevated to the Service's RO.

December 3, 2013. The DON and the Service discussed the development of the biological assessment for the proposed project and the initial approach on the conservation measures.

December 2013. The DON's Assistant General Counsel for Energy, Installations, and Environment reconfirmed the Service's RO position in discussions with the Department of the Interior's Deputy Solicitor for Fish, Wildlife, and Parks. The date of "December 2013" and meeting description are referenced in a January 30, 2014, letter from the DON to the Service.

January 30, 2014. The DON requested to terminate their request for reinitiation of the 2010 JPGO BO for their interim actions as described in their April 3, 2013, biological assessment.

February 24, 2014. The Service replied that they would consider the January 30, 2014, request from the DON; however before a decision could be made, the Service requested assurances that

key conservation measures outlined in the Service's letter would be implemented per the requirements of the 2010 DON BO.

March 21, 2014. The DON acknowledged receipt of the Service's February 24, 2014, response and requested a meeting to discuss issues outlined per the January 20, 2014, and February 24, 2014, correspondences.

April 15, 2014. The Service and DON met and discussed the following: The DON will reinitiate the 2010 DON consultation by submitting one consolidated biological assessment for the entire relocation to include 2010-2015 interim actions identified in the DON's request to consult, dated April 3, 2013, and the changes to the project (the reduction in USMC relocating to Guam and the proposed LFTRC and NWF). The DON will assess impacts and proposed conservation measures for all project activities and actions associated with the project.

May 6, 2014. A teleconference occurred between DON and the Service as a follow up to the April 15, 2014, meeting. Items discussed included the Service's review of completed and ongoing mitigation to assess interim legal compliance and the Service's and DON's points of contacts for the consultation.

May 15, 2014. The Service and DON discussed the twenty-three species located on Guam and the U.S. Commonwealth of the Northern Mariana Islands (CNMI) that were under consideration for listing as either threatened or endangered under the ESA. The Service also mentioned they are considering designating critical habitat for these species (if listed) and revising critical habitat for currently listed species on Guam and the CNMI.

May 23, 2014. The Service and DON met to discuss the development of the biological assessment, including preliminary thoughts on mitigation for habitat loss.

June 26, 2014. The DON discussed including mitigation in the consultation for the demolition and related function of the ungulate management fence at NWF, AAFB. The ungulate management fence is a conservation measure and requirement of the Intelligence, Surveillance, Reconnaissance, and Strike Capability (ISR) Biological Opinion that was issued to the Air Force.

July 22, 2014. The Service and DON discussed the status of this consultation and related briefings to regional and headquarters Service and DON counterparts; the status of the predictive modeling for the U.S. Department of Agriculture, Wildlife Service's (USDA) brown treesnake interdiction costs; and future coordination between the Service and DON on the proposed project's biological assessment.

September 16, 2014. The DON provided a presentation of the general contents of the biological assessment that would be submitted to the Service on October 1, 2014. During the meeting, the DON explained the main differences between the project as described in the 2010 Final EIS and the Draft SEIS. Other topics that were discussed were the species that would be included in the consultation and potential project impacts to their habitat, project construction chronology, training activities at the NMS, conservation measures, and proposed project activities on critical

habitat on Guam.

September 24 and 26, and October 15, 2014. The Service and DON discussed and corresponded via email regarding available sea turtle literature and information.

October 1, 2014. The DON transmitted a letter, dated September 30, 2014, requesting formal consultation on the potential adverse effects of the proposed DON military relocation to Guam to the Guam Micronesian kingfisher, Mariana fruit bat, Mariana crow, and Guam rail. The DON also requested informal consultation on the Mariana gray swiftlet, green sea turtle, hawksbill sea turtle, and the *Serianthes nelsonii*. The DON's letter included an enclosed biological assessment for the proposed action: the *Biological Assessment for the Re-Initiation of Consultation regarding the Proposed Military Relocation to Guam*, dated October 1, 2014 (hereafter, referred to as the BA).

October 2, 2014. The DON requested a map of the proposed listed species locations on Guam from the Service.

October 22, 2014. In response to the DON's request, the Service provided a map of the proposed threatened and endangered species' locations on Guam.

October 31, 2014. The Service acknowledged the receipt of the September 30, 2014, DON letter and BA for the proposed DON military relocation to Guam. The Service determined that the information in the 2014 DON BA was insufficient to reinitiate consultation and requested additional information from the DON on the proposed action necessary to initiate and complete this consultation. The Service outlined the requested information in a letter.

November 11, 2014. The DON transmitted a letter, dated November 7, 2014, and enclosure in response to the Service's October 31, 2014, request for additional information needed to reinitiate the formal consultation.

December 4, 15, and 19, 2014. The Service and DON corresponded via emails to further clarify the project description, and met to discuss mitigation for the loss of habitat on Guam as a result of the proposed project. During the December 19 meeting, the Service provided the DON with the *Framework for Mitigating the Impacts of Listed Species Habitat Loss on Guam*, dated December 19, 2014 (hereafter, referred to as the Mitigation Framework), and delivered a presentation on the Mitigation Framework.

December 19, 2014. The Service provided the DON with the updated Geographic Information System (GIS) layers for the recovery habitat for the Guam Micronesian kingfisher and Mariana crow.

December 19, 2014. The Service acknowledged receipt of the November 7, 2014, DON letter and enclosure and the December 19, 2014, DON email and table with the additional information necessary to initiate consultation. In these correspondences, the DON stated that the information on the peak noise levels for the proposed LFTRC would be provided to the Service on January 8, 2015. The Service also recognized the ongoing dialogue between the agencies on the project

impacts to the *Serianthes nelsonii* at NWF; however the Service did not concur with DON's determination that the proposed action "may affect, but is not likely to adversely affect" the *S. nelsonii*. The Service recommended that the DON request formal consultation on the project effects to *S. nelsonii*. The Service agreed to initiate the consultation on January 8, 2015 in good faith that above issues would be resolved by this date.

January 8, 2015. The Service and DON, met at the Marine Corps Base Hawaii on Oahu. The DON and USMC presented information on noise levels associated with the machine gun range they proposed to build and operate at the LFTRC at NWF, AAFB on Guam. The Service agreed that the requested information on noise levels was received during this meeting. The DON agreed to change their determination from a "not likely to adversely affect" to "may affect, likely to adversely affect" for project impacts to *S. nelsonii*. The DON and Service also agreed to communicate more effectively regarding issues related to the project consultation.

January 16, 2015. The Service and DON met to discuss the status of the consultation and additional clarifications to the project description and conservation measures. The DON provided information on changes to the project description, including updated acreage of recovery habitat that would be impacted by the project and the timing of range construction activities based on the data provided by the Service on December 19, 2014. The Service and DON also discussed the impacts to the critical habitat on Guam. The Service stated that based on the review of the information on the noise levels, they did not concur with DON's determination that the proposed action would "not likely to adversely affect" critical habitat for the Guam Micronesian kingfisher, Mariana crow, and Mariana fruit bat.

January 28, 2015. The Service requested written information on the changes to the project description, as discussed on January 16, 2015, from the DON. On January 31, 2015, the DON provided information on the project description changes via email and further clarified this information in a meeting on February 6, 2015.

January 28 to February 11, 2015. Emails were exchanged among U.S. Geological Survey (USGS), Fort Collins; the Service; and the DON on the noise levels and potential impacts to the close population facility located at NWF, AAFB. On January 30, 2015, a meeting was held to discuss noise levels and provide information on the future access and coordination that would be needed to access the facility. As a follow up to the January 30, meeting, the DON provided a response via email to questions about access and operations to the closed population facility on February 3.

February 3, 2015. The Service and DON conducted a site visit to the proposed Finegayan mitigation site on Guam.

February 3, 2015. The Service, via an email, stated that DON's proposed clearing of critical habitat for the relocation of the Guam National Wildlife Refuge (GNWR) headquarters was not acceptable. The Service stated that they were willing to identify alternative(s) proposed relocation sites. In addition, the Service confirmed completing the final Biological Opinion to the DON by May 18, 2015.

February 6, 2015. The Service and DON discussed: the logistics of the inspections of the surface danger zone (SDZ) in beach areas within the GNWR prior to the operation of the LFTRC; an update (and increase) in the number of acres of habitat that would be lost per listed species; conservation measures for *S. nelsonii*; USMC training at the NMS; and the Mitigation Framework.

February 12, 2015. The DON provided a response to the Service's request for additional mitigation to compensate for the loss of recovery habitat, as presented in the December 19, 2014, meeting and the Mitigation Framework. The DON provided a process for habitat conservation in one comprehensive document (INRMP) that is a planning and execution tool for the Navy, Air Force, Marine Corps and Army and is approved by the Joint Region Marianas Commanding Officer. Identifying mitigation ratios in the INRMP provides an incentive early in the planning process to avoid impacting mitigation sites and the associated increased cost to the program. DON included chapters 5 and 6 of the Marine Corps Air Station (MCAS) Miramar Integrated Natural Resource Management Plan (INRMP) to use as an example of how the DON proposes to address project and mitigation planning for this consultation and future DON consultations on Guam.. The DON stated that the Joint Region Marianas (JRM) will incorporate conservation measures of the BO into the INRMP.
February 13, 2015. The Service received updated information on the total number of acres of habitat for the Guam Micronesian kingfisher, Mariana crow, Mariana fruit bat, Guam rail, and *S. nelsonii* that would be lost as a result of the proposed project from the DON.

February 13, 2015. The Service sent an email to the DON that included recommended conservation measures for *S. nelsonii*. On February 18 and 19 and on March 4, 6, and 10, the DON and Service discussed by phone and corresponded via email about the conservation measures for *S. nelsonii*.

February 18, 2015. The Service requested clarification on the brown treesnake interdiction and control measures. The Service and DON discussed and corresponded about these measures on February 20, March 18 and 19, 2015.

February 20, 2015. The Service provided a preliminary draft of the Consultation History and Project Description sections of the BO for DON's review.

February 24, 2015. The Service and DON reconfirmed the due date of May 18, 2015, for the final DON BO. It was discussed that the due date of the Draft BO for the Navy's review would be April 27, 2015. The Service and DON also discussed the importance of a conservation measure which included maintaining a minimum of 30 outplanted individuals of *S. nelsonii*, parented from the Guam (*S. nelsonii*) adult tree, to adulthood. The DON stated that the Joint Region Marianas (JRM) has the responsibility to manage the conservation measures in the BO through JRM's INRMP.

February 28, 2015. The DON sent updated maps depicting the peak noise levels as a result of the operation of the LFTRC to the Service.

March 1, 2015. The Service provided a draft description of the project activities (based on the

BA) that are carried over from the 2010 DON BO into the proposed project for the DON's review.

March 3, 2015. The DON provided initial comments on the February 20, 2015, preliminary draft of the Consultation History and Project Description sections of this BO.

March 2-4, 2015. The Service and DON exchanged emails regarding the duration of the proposed project. The DON described the duration of the proposed project as indefinite.

March 5, 2015. The Service and DON met to discuss the Guam Micronesian kingfisher recovery needs on Guam and the Service's analysis of the amount of available habitat for the kingfisher on Guam. The DON also went through the calculations on the peak noise levels at the LFTRC and the SDZ. The DON stated that the peak noise levels presented in a model during the January 8, 2015, meeting no longer presented a valid estimate on peak noise levels and would provide the Service with new information using the noise calculations presented during the January 8, 2015, meeting on the peak noise levels within the LFTRC and SDZ. The Service also stated that a noise monitoring study should be developed and implemented during the operations of the LFTRC to validate the noise calculations on the peak noise levels. The DON presented a mitigation concept that included protecting large amounts of habitat for the recovery of the Guam Micronesian kingfisher on DoD land, and it was discussed that the DON and the Service should work together to develop language to present as a conservation measure for the proposed project.

March 5, 2015. The Service provided a map of the recovery habitat that is needed to support the recovery of threatened and endangered species in northern Guam. The purpose of this map was to provide guidance and information to DON regarding recovery habitat (within DoD lands) that should be protected and set aside in conservation status, as mitigation, for the proposed project. On the same date, the DON submitted an ambient noise study for the LFTRC (DON 2015a).

March 7, 2015. The DON provided comments on the preliminary draft sections of the Consultation History and Project Description, including the 2010 DON carry-over activities, to the Service. The DON also provided additional information on the peak noise levels at the LFTRC. The Service requested DON provide the rationale of why the new information on peak noise levels should replace the previously submitted (on January 8, 2015) peak noise levels.

March 9, 2015. The Service and DON discussed the intent of the brown treesnake interdiction and control measures and *S. nelsonii* conservation measures, and other clarification to the draft project description including the introductory paragraph to the conservation measures. On the same date, the Service requested via email that DON provide the rationale of why the new information on peak noise levels should replace the previously submitted (on January 8, 2015) peak noise levels.

March 10, 2015. The DON submitted a request for initiation of a Conference Opinion on proposed federally listed species. The DON determined that the proposed project *would not likely adversely affect* proposed federally listed species. On March 24, 2015, the Service

informed the DON via a conference call that the Service did not concur with their determination on the project effects to proposed federally listed species within the action area.

March 12, 2015. The DON provided additional information on the description of the LFTRC and number of construction workers that would contribute to the population increase over the life of the project.

March 13, 2015. The DON provided a statement via email that the January 8, 2015, model on peak noise levels should be replaced with the new information submitted on March 5 and 7, 2015, to the Service. The DON explained that the most current information on the peak noise levels at the LFTRC is coupled with the attenuation as appropriate for the directional aspects of position relative to the muzzle of the weapon, effects of humidity, vegetation, and a berm and an excerpt of the ambient noise study for the LFTRC (DON 2015a).

March 17 and 18, 2015. The Service requested information on the additional barriers that reduced the noise levels and effects on the listed species, as proposed by the DON on March 5 and 7. On March 19, 2015, the DON informed the Service that the additional barriers were intended to be Conservation Recommendations and would not be included in the Project Description. This change modified the DON's previous noise assessment provided on March 5, 2015.

March 17, 2015. The Service delivered a presentation to DON on the assessment of habitat in northern Guam for the recovery and survival of the Guam Micronesian kingfisher.

March 23, 2015. The Service and DON discussed conservation measures that would mitigate adverse effects to listed species as result of the proposed project. During this meeting, the DON stated the issue of concern was the Service's request that the DON should permanently set aside land for the recovery of the extirpated (listed) species (kingfisher, crow, rail) as mitigation for the proposed project. Given the broad implication of such an endeavor, the DON did not want to include their support of conserving land for future recovery of extirpated (listed) species on Guam as part of the proposed project. Both the DON and Service discussed establishing inter-agency conservation teams to work on commitments for land conservation. The DON requested that the Service include DON-drafted Conservation Recommendations, which would be submitted on March 25, 2015 to the Service, in the Biological Opinion.

March 24, 2015. The DON and Service discussed ongoing recovery efforts and requirements for the Guam Micronesian kingfisher.

March 25, 2015. The DON submitted proposed Conservation Recommendations to the Service.

March 27, 2015. The DON submitted via email revised conservation measures on project lighting requirements for the Mariana fruit bat and nesting sea turtles to the Service.

March 30, 2015. The DON via email clarified that the beach access road located outside the SDZ and northwest of the previously proposed new Service facilities would not be a stand-alone action and should be considered part of the proposed project. The DON stated that the

development of the beach access road would result in the clearing of 1.72 acre (ac) of designated critical habitat for listed species on Guam. On April 1, 2015, the Service reiterated to the DON that the clearing of critical habitat on the fee simple land at the GNWR was unacceptable as stated in the Service's February 3, 2015, email to the DON. The Service offered to work with the DON to identify alternative(s) to the proposed relocation that does not affect land with wildlife habitat value.

March 31, 2015. The DON submitted additional comments on the February 20, 2015, preliminary draft of the Consultation History and Project Description sections. The DON stated that the comments were mainly editorial and suggested the Service address the comments when the DON received the complete Draft Biological Opinion for their review.

March 31, 2015. The Service and DON discussed that the DON-drafted Conservation Recommendations will not be a part of the biological analysis and the beach access road would not be part of the project description. The DON inquired if an action alert for jeopardy was being issued for the consultation. The Service replied that they were not able to answer this question because the analysis has not been completed. The Service stated that they would have a Draft BO completed for the Service's internal review on April 17, 2015. In addition, both parties acknowledged that alternatives for the ISR Strike Fence would need to be further discussed.

April 13, 2015. The Service sent an email to the DON requesting clarification on their position on the reintroduction of native and listed species on DoD land on Guam. In this email, the Service stated that per a meeting on March 9, 2015, the Service and DON discussed reintroduction language (the same reintroduction language that was in the 2010 DON BO). During this meeting, the DON agreed that the reintroduction language could be included in the introduction paragraph to the Conservation Measures section of this Biological Opinion. However, on March 25, 2015, the DON sent the Service a list of proposed Conservation Recommendations. The first Conservation Recommendation included the reintroduction paragraph. The Service advised the DON that when the Service writes Conservation Recommendations for an action agency, these recommendations include items that the action agency is not currently doing or not currently committed to doing. Therefore, by including the reintroduction paragraph into the Conservation Recommendations, as requested by DON, the Service interprets this as DON reversing a previous commitment to allow the reintroduction of listed species on DoD land on Guam. The Service requested the DON provide clarification on this issue.

April 14, 2015. The Service and DON discussed that conservation recommendations in a biological opinion are not binding, and it is at the discretion of the action agency on their implementation. The Service and DON also discussed the reintroduction of native species language per the April 13, 2015, Service email sent to the DON. The Service requested that the language remain in this BO. The DON suggested that the Service include the reintroduction language in the introduction letter and in the baseline of this BO, as it is an action the DON will support in the future when threats are reduced. DON asked the Service for an update on the status of this BO. The Service stated that the Draft Biological Opinion would be available for DON's review on April 27, 2015, and that the analysis is in review at the RO.

April 16 and 17, 2015. The Service and DON exchanged emails regarding the ungulate fence conservation measure for *S. nelsonii*.

April 24, 2015. Office of the Secretary of Defense and Deputy Assistant Secretary of the Navy (Environment) met with Department of the Interior, Deputy Assistant Secretary for Fish, Wildlife, and Parts, the Deputy Director and Assistant Director for the Service, and Regional Director for the Service's Pacific Region to discuss staffing fixes and streamlining consultations. The Service and DoD agrees to develop a Memorandum of Agreement (MOA) to preserve a minimum amount of kingfisher habitat on DoD land in northern Guam.

June 4, 2015. The Service received updated information from the DON regarding the total number of acres of habitat for *Serianthes nelsonii*, Mariana crow, Guam rail, Mariana fruit bat, and the Guam Micronesian kingfisher that would be removed as a result of the proposed project.

June 11, 2015. The Service and DON entered into an MOA to ensure that sufficient amount of suitable survival and recovery habitat for the Guam Micronesian kingfisher is conserved and managed within DoD lands in northern Guam (see Appendix B).

June 26, 2015. The Service provided the DON with the Draft Biological Opinion for their review.

July 6, 2015. The Service received comments on the Draft Biological Opinion from the DON.

July 13, 2015. The Service received additional comments to the Draft BO entitled “Priority Issues” and “Top 5 Issues”.

July 29, 2015. The Service met with DON and provided responses to DON comments received on July 6 and July 13. The agencies discussed both the DON comments and Service responses to comments.

July 31, 2013. Biological Opinion signed and submitted to DON

B. DESCRIPTION OF THE PROPOSED ACTION

The DON proposes to relocate USMC personnel from Okinawa, Japan to Guam; construct and operate a main cantonment area, including family housing; and construct and operate a live-fire training range complex (LFTRC); and conduct training activities on Guam. Project activities will occur on land administered by the Department of Defense (DoD) and the Government of Guam (for road and bridge work). The proposed action also includes activities that were initially proposed in the 2010 DON BO, and that will now be covered in this Biological Opinion. To be consistent with the BA (DON 2014a) and the Draft SEIS (2014b), these actions will be called “carry over” actions. The project description is based on information in the BA (DON 2014a), the Draft SEIS (DON 2014b), addendum to the BA (DON 2015b), and the DON’s review of the Draft Biological Opinion (see Consultation History).

The proposed action includes the following components:

- Relocation of approximately 5,000 USMC personnel and 1,300 dependents from Japan to Guam
- Construction of the main cantonment within 1,213 acres at Finegayan, AAFB
- Construction of housing within 510 acres at AAFB
- Utilities and site improvement activities within DON-administered lands
- Road and bridge development and/or improvement within DON-administered lands and Government of Guam lands
- Construction and operation of the LFTRC at NWF, AAFB
- Establishment of a SDZ within NWF and the GNWR
- Development and operation of a hand grenade range at Andersen South
- Air craft training activities within the NMS and adjacent areas
- Conservation measures for federally listed species

Relocation of U.S. Marines and Population Growth on Guam

In furtherance of an agreement with the Government of Japan, the DON plans to relocate 5,000 USMC personnel and 1,300 dependents from Okinawa to Guam. Based on the most recent population estimate for Guam, which is approximately 161,000 residents (CIA 2015), the relocation is estimated to temporarily increase Guam's population by approximately 10,000 (DON 2014b, p. ES-4) or 6.2 percent by 2021. This number will decrease to about 7,400 additional residents after construction is completed in 2028 (DON 2014b, p. ES-4) or a 4.6 percent overall increase.

Probable Sources of Labor Supply

An estimated maximum number of 1,227 workers from Guam would work on construction projects related to the proposed project. A maximum of 3,227 workers from off-island would work on construction projects related to the proposed project. It is anticipated that the majority of off-island construction workers would be H-2B workers from the Philippines and other Pacific Islands. During the later years of construction (2025-2026), it is anticipated that more workers from Guam than from off-island would work on construction projects related to the proposed project.

Construction

The DON proposes over 130 separate construction projects on Guam (DON 2014a, Appendix A) to occur within a time period of thirteen years. The construction projects include clearing, grubbing, earthwork (such as digging, trenching, drilling, boring and/or cut and fill), processing and stockpiling of green waste, erosion and sediment control, roadways, sidewalks, curbs and gutters, traffic signs, temporary construction fence, perimeter / security fence, ungulate fence, landscaping and other site improvements. The construction projects also require removal of vegetation, stripping limestone rock, and removal and stockpiling of reusable topsoil. Typical equipment used would include heavy haul trucks, excavators, cranes, concrete trucks, cranes, backhoes, graders, and pick-up trucks. Construction activity would be temporary and localized

within existing noise contours that range from 60 to 85 dB average day-night sound level (ADNL) (DON 2014a, p. 64; see Operation of LFTRC section below for definition of ADNL). The use of heavy equipment can reach noise levels of 96 dB (USFWS 2006a, p. 15). No blasting or use of dynamite will occur as part of the proposed project. The construction activities are summarized below and details are provided in the BA (DON 2014a, pp. 9-18).

Main Cantonment

The proposed main cantonment development includes base operations and support facilities constructed within 1,213 ac at Finegayan, AAFB (DON 2014a; p. 2, 14-17, DON 2015b). An approximately 27,900-ft (8,500-m) long security fence will be constructed around the main cantonment perimeter. The main cantonment and support facilities are divided into the categories listed below, followed by examples of buildings/facilities for each category.

- Command core - Marine expeditionary brigade headquarters and command buildings
- Unit operations – 3rd Marine expeditionary brigade command element, 4th Marines, ground combat element infantry battalion 1 and 2, artillery battery, combat logistics battalion, 9th engineer support battalion and explosive ordnance disposal
- Base operations – base administration, fire station, public works, vehicle fueling, base auto shop, kennel, corrosion prevention and control, security
- Bachelor enlisted quarters and bachelor officer quarters
- Community support – dining facility, fitness center, recreation areas, education center, auditorium/theater, branch exchange, bank/credit union, food court/amusement center, medical/dental clinic, post office
- Training – battle training center, individual combat skills course

Family Housing

The proposed family housing will be located at currently existing family housing (510 acres of developed land) on AAFB. Family housing includes residences for accompanied permanent USMC personnel and their dependents and support and recreational facilities. Unaccompanied USMC personnel would stay at the main cantonment during their shorter-term (approximately 6 months) assignment to Guam. The proposed housing density at AAFB is 5.5 units per acre. The family housing area would be accessed by the existing family housing gate (the Santa Rosa Gate) at the northern end of Route 15, or from the AAFB Main Gate off Route 9. The existing family housing would be demolished and 912 family housing units would be constructed as replacements for the existing AAFB housing in addition to the 535 family housing units required for USMC families. All of the 1,447 family housing units would be integrated into one large housing pool where all eligible personnel and families would live.

Expansion of existing community support facilities, such as the child development center, youth center, and temporary lodging facility may be required. Other potential new facility construction may include a new temporary lodging facility, a new community center, and a new family support center.

Potable Water
Water for the family housing area would be provided by the current system, which would be modified to reroute the system along the new road alignments for the proposed family housing. There will be a connection from the AAFB well field water storage tank to the AAFB water system to provide water to the proposed family housing area. The new potable water distribution pipes would be installed underground at least 3-ft (0.9-m) deep. The width of the trench to install the pipes would be about 1.5 to 4 ft (0.46 to 1.2 m).

Wastewater Collection
The family housing wastewater collection system would include a network of gravity mains, manholes, two new wastewater pump stations, force mains and refurbishment of existing wastewater pump stations. The family housing wastewater collection system would use the existing connection to the Guam Water Authority's (GWA) wastewater collection system. Existing wastewater pump stations would be demolished as part of the proposed project. Wastewater would be conveyed to the Northern District Wastewater Treatment Plant for treatment and disposal.

Power
The existing AAFB main substation would have adequate capacity to serve the family housing, including the redeveloped housing units, new common facilities, and expanded common facilities. The distribution system would be rebuilt, enhanced, and reconfigured to accommodate the housing layout.

Solid Waste
Family housing areas would continue to have their solid waste handled as currently done for the existing AAFB housing area (Layon landfill).

<u>Utilities and Site Improvements</u>

The proposed action includes the development of on-site utilities, access roads, and related off-site infrastructure to support the main cantonment, family housing and LFTRC.

Grading and Earthwork
The utility and site improvement work includes major earth moving (mass grading) and limited fine grading along the roadway corridors and drainage systems. The cut and fill quantities associated with this mass grading would require approximately 5,300,000 cubic meters of structural fill material. The cut and fill quantities also assume a 2-ft (0.6-m) deep typical road pavement section including compacted base and pavement surfacing. The cut and fill quantities are based on the assumption that native material excavated on site is suitable for reuse as fill material. If soil testing and/or geotechnical recommendations indicate otherwise changes in grading or importation of material may be required. Contractors are required to obtain aggregate/soil from contractors/vendors who have local permits. Imported sand and other quarried products from abroad are subject to inspection by the Guam Department of Agriculture and require an importation permit. All sand and aggregate material imported must be accompanied by official records indicating chemical composition, pest-free certification, treatment certificate, and certificate of origin.

Although the Draft SEIS estimated that the amount of cut exceeds the amount of fill required, the DON contract does not prohibit quarry material from off-island. For example, any grading or other earthwork required during facility construction at any of the alternative sites would be implemented to balance cut and fill on-site to the extent possible. If off-site fill material were needed, it would be obtained from a permitted source. In addition, if a contractor needs fill material the excess cut from other DoD projects would be available for no additional cost as opposed to paying for fill material from a quarry (DON 2015b).

Best Management Practice for utilities includes the Comprehensive Waste Management Plan, August 2010 (DON 2010a or any applicable update), and the Integrated Solid Waste Management Plan for DoD Bases, Guam, February 20, 2013 (DON 2013a). Additional contractor requirements are as follows: process green waste on-site for reuse (goal of 100 percent) during construction; meet 50 percent diversion rate goal for construction/demolition debris through reuse (including such actions as concrete crushing and reuse as base material and grinding and reuse of asphaltic concrete from roads); and meet a goal of 50 percent diversion rate from disposal for project non-construction/demolition solid waste (not directly generated from materials used for erecting structures).

Based on the FAR 52.236-7, PERMITS AND RESPONSIBILITIES (DON 1991), the contractor shall, without additional expense to the government, be responsible for obtaining any necessary licenses and permits, and for complying with any Federal, State, and municipal laws, codes, and regulations applicable to the performance of the work. The contractor shall also be responsible for all damages to persons or property that occurs as a result of the contractor's fault or negligence. The contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire work, except for any completed unit of work which may have been accepted under the contract.

Reuse and Recycling Facility

Green waste processing and construction and demolition debris generated during construction will be handled by contractors at designated laydown areas. Contractors will be required to process the generated green waste as part of their assigned contract requiring 100 percent diversion of the green waste into mulch (trees and stumps) and compost (leaves and grass), and 60 percent minimum diversion of construction and demolition debris waste. The DON subject matter experts will review the contractor's green waste processing and composting facility operations plan to ensure that it meets industry and regulatory standards. The contractor will be responsible for obtaining the solid waste facility permit issued by Guam Environmental Protection Agency (GEPA) prior to commencing activities.

The construction and demolition debris and green wastes that cannot be recycled or reused, as well as wastes that are prohibited at Layon Landfill would be disposed at the Naval Base Guam Landfill, subject to ongoing discussions between the U.S. Environmental Protection Agency (USEPA), GEPA, and DON, and permitted private hardfill facilities (DON 2015b).

Electrical Substation

A main substation equipped with two 15-megavolt ampere, 34.5 kV-13.8 kV transformers will be constructed in the main cantonment area, south of the main gate. Provisions will be made in the substation for primary line connections to the planned 34.5-kV underground line from the Harmon Substation and to the planned 34.5-kV line from AAFB.

Water Distribution
A new transmission main, to be installed by the well field project, will convey water from the well field storage tank at AAFB to the boundary of the main cantonment area near the commercial/tactical vehicle gate. The DON proposes to construct a water pipeline from Route 3A near the commercial/tactical vehicle gate to the new two million gallon ground level water storage tank on Finegayan. The existing mains between some of the existing water wells on Finegayan will be demolished and realigned to the proposed roadways. The existing distribution mains servicing the abandoned Building 200 also will be removed. In the short term, the existing Finegayan water wells will provide the USMC water distribution system with water. The long-term plan will provide the USMC water distribution system with water from both the existing Finegayan wells and the well fields system.

Sanitary Sewer
The existing DoD wastewater collection system within the main cantonment area at the Finegayan site consists of a trunk sewer serving Building 200 and connected to the GWA wastewater collection system through a GWA interceptor sewer along Route 3. Wastewater is conveyed to the Northern District Wastewater Treatment Plant. Capacity evaluations of the existing collection system indicate the GWA interceptor sewer has adequate capacity for the project. The grading for the main cantonment area generally slopes downhill from north to south. A connection to the existing GWA interceptor sewer main along Route 3 is included.

Live-fire training range complex

The proposed LFTRC development area at AAFB NWF will require construction of the individual ranges, range support building, range towers, range access roads, and a perimeter fence (all within federally-controlled land at NWF), extending an ungulate exclosure fence (see Conservation Measures section) and the establishment of a SDZ within the NWF and the GNWR. The LFTRC would require construction of new electrical, telecommunication, wastewater and water lines and/or facilities configured to operate with the existing utility infrastructure of AAFB NWF (DON 2014a, pp. 18-22).

The proposed LFTRC would include five ranges and repairs to Route 3A. The individual ranges are described in more detail below (DON 2014b, p. 2-7).

Known Distance (*KD*) *Rifle Range*: The proposed KD Rifle Range would have 50 firing points for 5.56-millimeter (mm) weapons. The range would be 534 ft (163 m or 178 yards) wide and 1500 ft (457 m or 500 yards) from the farthest firing line to the target line. The target line would be flush with the ground, and there would be level ground from the 200 yard (183 m) firing line to the target line. The range would include a 25-foot (8-m) tall impact berm behind the target line. The range footprint would encompass approximately 18.5 ac (7.5 hectare [ha]).

KD Pistol Range: The KD Pistol Range would provide 25 firing points for training with 9-mm and 0.45-caliber (cal) weapons. The range would be 123 ft (37.5 m or 41 yards) wide by 150 ft (46 m or 50 yards) long with level ground from the firing line to the target line. The range would include a 12-ft (4-m) tall impact berm behind the target line and 12-ft (4-m) lateral berms. The range footprint would encompass approximately 0.4 ac (0.2 ha).

Non-standard Small Arms Range: The Non-standard Small Arms Range would provide 25 firing points, and be used for training with 5.56-mm weapons. The range would be 204 ft (62.5 m or 68 yards) wide by 328 ft (100 m or 109.4 yards) long with level ground from the 91 m firing line to the target line. There would be a 16-ft (5 m) tall impact berm behind the target line, and 16-ft (5-m) lateral berms. The range footprint would encompass approximately 1.5 ac (0.6 ha).

Modified Record of Fire Range (*MRF*): The proposed MRF Range would have 16 firing points for use by 5.56-mm weapons. This live-fire range area would be 525 ft (160 m or 175 yards) wide by 657 ft (200 m or 219 yards) in length with a 25-ft (8-m) tall impact berm at the far end of the range. The range footprint would encompass approximately 7.9 ac (3.2 ha).

MPMG Range: The proposed Multi-purpose Machine Gun (MPMG) Range would have eight stationary firing lanes to support training with 5.56-mm, 7.62-mm, and 0.50-cal weapons, as well as 40-mm inert training rounds (i.e., non-explosive). The range would be 525 ft (160 m or 175 yards) wide at the firing line, expanding to 1,050 ft (320 m or 350 yards) wide at the far end of the range. The range would be 3,281 ft (1,000 m or 1093.6 yards) long and would include a 25 ft (8 m) tall impact berm at the far end of the range. The range footprint would encompass approximately 59 ac (24 ha).

Except for the MPMG Range, the range footprints would be entirely cleared of vegetation and the range would be designed with berms to contain expended rounds of ammunition within the range footprint. The MPMG range would include more uneven terrain and with some vegetation. The purpose of the MPMG range is to simulate a more natural environment. Vegetation on the range would be designed using the Guam Landscaping Guidelines (DON 2011) and use appropriate or non-invasive species in order to reduce potential impacts associated with non-native vegetation.

The proposed LFTRC also would include three range observation towers, a target storage and maintenance shed, a ready issue ammunition magazine, covered bleachers, portable toilets, perimeter fencing, safety signage, parking, and lighting. Lighting will be designed to meet minimum safety, sustainable, antiterrorism, and force protection requirements. “Night-adapted lights” will be installed in the briefing and bleacher areas at NWF. Night-adapted lighting uses bulbs in red or other spectrums that allow a person’s eyes to remain adapted to low light or night conditions while still providing enough light for work and safety. Illumination of the coastline or beach will be kept to an absolute minimum including the shielding of lights and directing lighting away from the forest or other wildlife habitat (see Conservation Measures section below).

The location and siting of firebreaks will be addressed in the fire management plan (see Conservation Measures section). The fire management plan, which is a component of the Range

Management Plan, will address issues as it relates to the potential for a fire to start on the range and how to control any fires.

Construction of LFTRC

Development of the LFTRC is anticipated to occur in two phases that would construct the smaller ranges and repair/improve Route 3A under one phase and construct the MPMG range under the second phase. Approximately 256 acres would be cleared as a result of the construction of the LFTRC (DON 2014a, p. 19). Proposed construction timelines are subject to availability of funding but are proposed as: 1) The dates for the KD ranges are March 2016 for the construction award, August 2019 for the completed construction, and start of range operations in February 2020, and 2) The dates for the MPMG ranges are January 2021 for the construction award, January 2024 for the completed construction, and range operation starting in December 2024.

Grading requirements for construction of the ranges and associated infrastructure would include 2,047,295 yd^3 (1,565,270 m^3) of cut and 1,932,392 yd^3 (1,477,420 m^3) of fill, resulting in a net of 114,903 yd^3 (87,850 m^3) of cut (DON 2015b). However, any grading and other earthwork required during facility construction at any of the ranges would be implemented to balance cut and fill on-site to the extent possible. If off-site fill material were needed, it would be obtained from a permitted source.

Operation of LFTRC

Range utilization would depend on the number of personnel required to complete annual individual training events, the duration of each event, and the training capacity of each range. However, the proposed live-fire operations at the LFTRC would occur between 7:00 a.m. and 7:00 p.m. for up to 39 weeks per year, and night operations (estimated to occur 2 nights per week over 39 weeks per year) would occur between 7:00 p.m. and 10:00 p.m. or 6:00 a.m. and 7:00 a.m. The estimated annual ammunition usage of the LFTRC by USMC and non-USMC personnel is 6,719,190 rounds (DON 2014b, p. 2-9) (Table 1).

Table 1. The estimated annual ammunition usage of the LFTRC (DON 2014b, p. 2-9).

Range	*Weapon*	*Ammunition Type*	*Estimated Ammunition Usage*		
			Day [1]	*Night* [1]	*Total*
Marine Corps					
KD Rifle Range	M16/M4	5.56-mm	1,533,300	322,800	1,856,100
	M249 SAW	5.56-mm	59,200	39,664	98,864
KD Pistol Range	M9	9-mm	324,956	19,328	344,464
Non-standard Small Arms Range	M16/M4	5.56-mm	569,356	403,500	972,856
	M249 SAW	5.56-mm	152,736	34,900	187,636
MRF Range	M16/M4	5.56-mm	304,920	62,820	367,740
	M249 SAW	5.56-mm	59,200	17,760	76,960
MPMG Range	M249 SAW	5.56-mm	377,104	0	377,104
	M40/M110	7.62-mm	13,824	4,104	17,928
	M240	7.62-mm	576,716	141,336	718,052
	M107	0.50-cal	3,520	0	3,520
	M2	0.50-cal	190,756	6,180	196,936
	MK19	40-mm inert	84,480	8,448	92,928
	M-203/ M-32 Grenade Launcher	40-mm inert	24,940	2,580	27,520
Marine Corps Total Estimated Use =			4,275,008	1,063,420	5,338,608
Joint Use (non-Marine Corps) Total Estimated Joint Use =			1,104,466	276,116	1,380,582
GRAND TOTAL (MARINE CORPS AND JOINT USE) =			**5,379,474**	**1,339,536**	**6,719,190**

Legend: SAW = Squad Automatic Weapon.
Notes: [1]"Day" operations would occur between 7:00 a.m. and 7:00 p.m. "Night" operations (estimated to occur two nights per week) would potentially occur between 7:00 p.m. and 10:00 p.m. or 6:00 a.m. and 6:59 a.m. Night firing training requirements need to be met during hours of darkness, dusk until dawn, and this timeframe differs from "acoustic" night (10 p.m. to 7 a.m.) used in noise modeling. Of the 1,063,000 rounds expected during darkness, only 326,000 rounds or 7% of the total number of rounds would occur during "acoustic" night, and no training is planned to occur between the hours of 10:00 p.m. and 6:00 a.m.

The noise levels at LFTRC are estimated at weighted day-night average sound levels (ADNL) within the immediate and adjacent areas and would range from 55 ADNL to greater than 85 ADNL, depending on the zone (area) (DON 2014a, p. 68). The ADNL is a metric that cannot be measured directly. Rather, it is calculated as the average sound level in decibels with a 10 dB penalty added to the night-time levels (10 p.m. to 7 a.m.). This penalty accounts for the fact that noises at night sound louder because there are usually fewer noises occurring at night so generally night-time noises are more noticeable. The day-night sound level (DNL) noise metric may be further defined, as appropriate, with a specific, designated time period (e.g., annual average day DNL, average busy month DNL). Noise levels due to .50 caliber or less small arms weapons use the average-weighted scale and are expressed as dB average-weighted DNL (ADNL).

The noise disturbance from the training will be impulse noise with very intense sounds of short duration (e.g., the discharge of a weapon). Firing noise from single shots merged in bursts, machine gun burst, and concurrent firing of multiple weapons would result in short periods of intense firing followed by periods of silence. Live-fire operations may occur for hours at a time, for 5 days a week, or not occur for multiple weeks in a row. The DON provided the Service with peak noise levels for the MPMG range using a formula to calculate peak noise levels at a specified distance from the source. Because the peak noise calculation did not account for sound

attenuation from the directional nature of the noise generated by the muzzle blast, terrain, ambient noise, vegetation, temperature, humidity, and other factors, the Service developed a model to estimate peak noise from the LFTRC (USFWS 2015a).

Surface Danger Zone

The DON proposes to establish a SDZ within the NWF and the GNWR (Figure 1). The SDZ would delineate areas that fired ammunition fragments or ricochet may land, forming the outermost limit of the LFTRC. The DoD standard for risk acceptance on ranges is a 99.9999% level of containment, which means the probability of munitions (for inert ordnance) or a hazardous fragment (for live ordnance) escaping the SDZ is one in a million. The SDZ projects north and outward over the GNWR-administered fee simple land and submerged lands. The DON would demarcate the SDZ beyond the shoreline through navigation map updates to alert maritime traffic of the potential hazard. For the land based perimeter of the SDZ, perimeter access roads (KD and MPMG), perimeter fencing and/or signage would indicate its boundaries for personnel and public safety. Approximately 3,701 acres (1,498 ha) acres of lands and submerged lands are required to support the SDZ. This includes approximately 142 acres (57 ha) of the Ritidian Point Unit (fee simple land) of the GNWR and 3,059 acres (1,238 ha) of the submerged lands of the Philippine Sea. No critical habitat within the GNWR would be cleared as a result of the proposed project.

Prior to operation of the LFTRC, the SDZ would be surveyed visually from observation towers to ensure the area is cleared of people. Since the GNWR has existing hours of operation (0800-1600) and the gate to the GNWR is locked outside of the hours of operation, the potential for incursion into the SDZ will be limited by the GNWR gate. However, when operation of the LFTRC is planned, the USMC would deploy USMC personnel to put up SDZ signage on trails and the beach at either end. If there are indications that people are in the area, a patrol would be deployed to ensure safety.

Although most of the SDZ area can be seen with binoculars from the observation towers at Ritidian Point at NWF, ground patrols within the GNWR are to ensure that the area under the surface danger zone is cleared of people prior to the operations of the LFTRC. Patrols would be conducted on the nesting beach prior to the operations of the LFTRC, which will operate daily up to 39 weeks per year. The purpose of the access is to ensure the water portion of the SDZ is clear of people. The Range Safety Specialist (RSS) would conduct a ground survey of three locations (Figure 1); however may only access one or two of these locations to clear the water portion of the SDZ. The RSS will access the location by using an all-terrain vehicle (ATV) (2 or 4 passenger Gator-type vehicle). The RSS will get out of the ATV and move to an area where the water portion of the SDZ can be seen (not on the beach). The RSS will use a pair of binoculars to clear the water portion of the SDZ. The RSS will walk back to the ATV and drive out the same trail taken to get to the access locations. Once the SDZ has been cleared, the RSS would notify Range Control and depart the area. The ground survey would last approximately 20 minutes.

As part of the RSS training package, personnel would be directed to not interact with sea turtles and report all sightings to the Service and coordinate with the GNWR on nesting surveys at the Refuge (see Conservation Measures).

Hand Grenade Range

In addition to the small arms training ranges collocated within the LFTRC, the proposed project also includes a development area for a separate HG Range at Andersen South. The proposed HG Range would include an approximately 0.9 ac-area developed as a hand grenade training complex for the M67 fragmentation grenade and will be connected to existing utility infrastructure where available. The following features would be developed within the hazard zone: a holding shelter for four persons, four throwing positions with grenade sumps, a range observation tower with ballistic glass, and a grenade "dudded" impact area. A grenade house would be collocated with the grenade throwing pits. There also will be a concrete munitions storage (i.e., magazine) surrounded on three sides by earthen berms for the temporary storage of hand grenades during training events.

In addition to the live-fire area, there would be a 1.0-ac non-live-fire training area developed adjacent to the range and outside of the SDZ. The training area would consist of a demonstration area with bleachers, an open practice throwing field with various targets and throwing positions, portable toilets, and a parking area. Inert practice grenades would be used at this training area to provide familiarization training prior to proceeding onto the live-fire area of the range.

Information and Communications

The proposed Information Technology/Communications (IT/Comm) development area would require inter-base connections between the proposed USMC main cantonment area, and other existing bases, the proposed LFTRC, and DON's 2010 Record of Decision-covered training facilities at Andersen South (DON 2010b). These hardwired connections would consist of conduits buried approximately 3-ft (0.9-m) deep. Off-site conduits would be encased in concrete and would have lockable manholes for security. Because redundant off-island communication paths are needed, an additional connection to the Tata Communications Cable Termination Facility (in Piti) from AAFB may be required. Off-site conduits would follow existing roads and rights-of-way between the facilities.

AAFB Well Field and Associated Water System

Increased water supply for the main cantonment area would come from the proposed AAFB well field, refurbished wells, and DON's existing water system. Based on conservative estimates, it is anticipated that to locate one well of sufficient yield to support production approximately three test wells would be required. During testing, only those wells with good water quality and capacity will be identified as production well sites. Test wells deemed unsuitable will be filled and capped and left in place, restored or converted to monitoring wells for management of the Northern Guam Lens Aquifer.

The development area would accommodate the construction of the approximately 22 test wells, 11 production wells, and associated equipment. The actual footprint of the final production wells and the access roads to each is not known at this time, but it would occur within the well field limits as shown (Figure 2).

During the design phase, the design contractor will conduct site investigations and drill test wells, determine locations of the wells, and design the entire water production system (wells, feeders, and storage tank). During the construction phase, the construction contractor will convert the test wells into production wells based on the locations identified in the design document and construct the water production system per the design specifications. Prior to start of work, efforts will be made by the design contractor to minimize disturbance to the limestone forest by inspecting the area with a DON biologist and identifying "already disturbed areas". In addition, the following actions would be implemented.

- Where disturbed areas cannot be identified, for each well location, a 14-ft (4.3-m) path will be created for the drill rig, trucks/vehicles and other equipment to get to the test well locations.

- An approximately a 100 ft x 100 ft (or 0.23 ac) work area will be required to set up the equipment at each test well location.

- For each test well, an 8 in. to 12 in. borehole will be drilled to a depth of approximately 500 ft to 600 ft below ground surface. A submersible pump will be placed at the bottom of the well, and a pump test and water sampling conducted. Based on the results of the pump test and water sampling, the well will either be abandoned or identified as a potential production well. For test wells identified as a potential production well, GIS survey coordinates will be taken and a stake placed at the test well site.

- A production well consists of well casing (approximately 10 to 12 in. diameter), screen, gravel pack, submersible well pump, pump motor housing, and surface/borehole seal. At each well station the following will be provided: well housing, discharge piping, and flow meter. Each well head will have electrical lines, water transmission pipes, and feeders to each well. The estimated disturbance area during construction is 100 ft x 100 ft (.23 ac).

- Locations of the water transmission and feeder lines will normally follow already disturbed areas made during test well drilling (path made by the drill rig/vehicles/equipment). A 20 ft to 30 ft wide strip will be required for construction of the pipelines, and manholes, valves, bends, anchor blocks, etc. as well as backfill material. The main transmission lines ranging from 8 in. to 16 in. will connect the well field storage tank facility to feeder lines. The individual well feeder lines, approximately 6 in. will connect the wells to the main transmission lines.

- In the well field storage tank facility area, there will be a booster pump, water treatment, storage tank, electrical room and central emergency backup generator and fuel storage tank. In addition to the 14-ft (4.3-m) path for cranes/vehicles/equipment, an

approximately 550 ft x 650 ft area (8.2 ac) will be disturbed during construction of the water storage tank and associated facilities.

- Unless cuttings or excavation materials are deemed contaminated or unacceptable as fill material, cuttings will be placed back into a borehole or trench. Unacceptable fill material or excess cuttings/excavation material will be removed from the site.

- When 68 ac (75 percent of the disturbance area) is reached, the construction contractor will stop work and re-evaluate to determine if 90 ac will be exceeded.

The new potable water production wells would feed a new well field collection tank, pump and water treatment facility (chlorination and fluoridation), all proposed within AAFB. The main cantonment area would be provided with a new ground level water storage tank supplied by the new well field storage tank.

Project Activities Carried Over from the DON Action addressed in the Service's 2010 BO

Andersen Air Force Base Operations

Currently, as of March 2015, the air combat element beddown facilities, air embarkation facilities, and associated buildings, a new north gate and access road with associated facilities are being constructed at AAFB.

There are two airfields on AAFB, the AAFB airfield with its north ramp and the south ramp runways. The facilities constructed at AAFB north and south ramps will be used by 12 permanently stationed MV-22 helicopters and will accommodate the loading of additional transient aircraft listed in Table 2. These aircraft will be used to conduct training and operational flights (sorties) including the following components: field carrier landing practice, familiarization-instrument, Marine air ground task force, tactical air operations center, and routine operations will occur in association with the air mobility campus and the air combat element. A training event consists of one aircraft performing a take-off, a training evolution, and a landing. These training operations will occur on airfields in current use by similar aircraft (Table 3) such as those addressed in the MITT Biological Opinion (USFWS 2015b, 66 pp.).

Table 2. Proposed aircraft loading (DON 2010b, vol 2, p. 2-91).

Element	*Number*	*Type*
Permanent stationed: Rotary wing	12	PCS (12) MV-22 (Assault Transport)
Fixed wing	12	F/A-18
Transients: Rotary wing	12	MV-22 Transport (Osprey)
	3	UH-1 Multipurpose Utility (Huey)
	6	AH-1 Attack (Super Cobra)
	4	CH53E
Fixed wing	2	KC-130
	24	F/A-18
	4-6	F-4 (visiting Allied Forces)

Table 3. Anticipated total flight operations at Andersen Air Force Base resulting from previous projects with the addition of the proposed action (Czech and Kester 2008).

Aircraft Type	**Anticipated Total Aircraft Operations per Year Andersen Air Force Base**			
	Previously Addressed	**DON Project**	**Total**	**% Increase**
Helicopter	19,029	19,489	38,518	102%
Jet/Propeller	25,697	6,424	32,121	25%

The new air combat element facilities will be used for aircraft operations, maintenance of MV-22 tilt rotor aircraft, and training and support functions. The air combat element facilities also will be used for USMC air control group training. The USMC air control group training involves coordination of air command, control, and defense units and the tactical air operations center. Training entails the operation of air traffic control radar and radio frequency emitters and facilities consisting of shelters, a portable tower, and electrical power sources. Tactical air operations center training involves the establishment and dismantling of these facilities within a 96-hour period. Training includes use of various emitters and sensors which need to be de-conflicted with other electronic equipment operating in the area. To minimize the constraints it puts on airspace availability, radar equipment, which generates strong electromagnetic radiation fields, will be operated for no more than one hour at a time. The air combat element beddown facilities will operate 24 hours per day and 7 days per week. Staffing levels will be contingent on surge and operational requirements of the air combat element facilities. Traffic will include government-owned vehicles, personal-owned vehicles, and shuttle buses from the proposed main cantonment area.

Approximately 1,000 annual field carrier landing practice and 79 annual familiarization-instrument flight events are proposed for Andersen Main Base. Field carrier landing practice operations entail one or more aircraft flying at a low altitude in almost circular patterns and involves landing on a simulated aircraft carrier during the day and, using night-vision goggles, at

night. Familiarization-instrument training, including autorotation and simulated engine-out approaches will occur on the improved airfields with the support of aircraft rescue and firefighting facilities.

Rotary-wing aircraft operations will occur at the AAFB airfields and in various proposed training areas on Guam. Fixed-wing aircraft operations will occur only in the immediate airfield environment of AAFB. Aircraft will then leave this area to conduct activities within established training areas of the MITT or other locations as described under MITT (USFWS 2015b, 66 pp.). Air traffic at the air combat element beddown and the north ramp will include helicopter, vertical lift aircraft, fixed-wing, and unmanned aircraft arrivals and departures.

In addition, a new air embarkation site is currently being built, as of March 2015, to serve as the passenger terminal for AAFB and temporary cargo storage. Air embarkation and disembarkation refers to the loading and unloading of passengers or cargo to and from aircraft. The passenger facilities are comparable to those of a small airport: luggage handling, waiting area, and ticket and documentation area. Cargo is staged for loading to aircraft or disbursement to warehouses or individual commands. Currently the Air Force has air embarkation facilities at the south ramp of the airfield. Once the new facility is built, the existing facility will be closed. The site will operate 24 hours per day and 7 days per week.

The project will result in noise levels in excess of 60 dB over the Guam landscape. Northern Guam will be periodically exposed to noise levels in excess of 93 dB PK15. Peak sound levels are the calculated peak noise level, without frequency weighting, expected to be exceeded by 15 percent of all events that might occur.

Andersen South

The proposed project will result in the construction of a military operations in urban terrain training area, a portion of which will be a modular unit and another will be reconstructed from the existing unit; a logistics and administration area; a convoy course; an advanced motor vehicles operators course; an aviation training landing zone; an aviation and maneuver area landing zone; Pioneer Road; other range roads; a perimeter fence; main, secondary, and range road gates; and the realignment of Route 15 at Andersen South.

Andersen South Operations

Convoy operations, maneuver training for military operations in urban terrain, and general maneuver and air-ground operations will vary, but may occur up to 5 days per week, 45 weeks per year, day and night. The maximum estimate is approximately 250 to 300 USMC personnel will participate in maneuver training at Andersen South each week, for a total annual throughput of 11,250 to 13,500 personnel. Convoy operations will typically consist of 7 to 10 vehicles (e.g., high mobility multipurpose wheeled vehicles) traveling in tandem along an established course. Military operations in urban terrain includes transporting units to Andersen South by helicopter or vehicle, maneuvering toward the military operations in urban terrain complex on foot or in vehicle, and engaging in integrated training at the military operations in urban terrain complex. Military operations in urban terrain at the reconstructed training area (also referred to as the

urban embassy component) will consist of 24 or more, multi-story concrete structures to simulate at least four city blocks.

The modular military operations in urban terrain (also referred to as the rural military operations in urban terrain) will consist of movable components that can be stacked and grouped into a number of configurations to present tactical situations to be overcome by training units. This modular military operations in urban terrain will consist of shipping containers that will be assembled on site to simulate a more rural village or set of suburban buildings located outside the core urban area. Forklifts or cranes will be used to reconfigure the modules of the military operations in urban terrain to add variety and diversity to training. The proposed military operations in urban terrain complex will include live-fire ranges, including a bleacher and shooting house that will be used for forced-entry training, and a hand grenade range and house. These will be suitable for units or organizations of up to 800 USMC personnel at a time, and will be used daily by 40 to 750 personnel. The military operations in urban terrain will operate day and night; night operations will comprise an estimated 15 percent of all operations. The military operations in urban terrain will be used by organizations based on Guam, transients, and visiting regional allied forces. Units using the military operations in urban terrain may bivouac in the vicinity, or arrive and depart daily.

Typically, dry runs and individual skills training will occur prior to the military operations in urban terrain exercise, which will involve fire teams (smallest unit of infantry, typically four or fewer individuals), and squad drills (a group of 8 to 12 individuals). Types of weapons that will be authorized for use at the military operations in urban terrain will include M16, M4, M249, and M240. Blanks, simulators, smoke grenades, diversionary devices (improvised explosive devices and booby traps that release smoke when activated), special effects small arms marking system (similar to paintball), and multiple integrated laser engagement system (small laser receivers scattered over the uniform of an individual soldier, which detect when the soldier has been shined by another soldier's firearm laser) are used instead of ammunition and explosives that would be used in a real combat situation.

Tactical motor vehicle operator training is a continuous requirement for USMC units. The proposed advanced motor vehicle operations course will consist of a route along which a series of obstacles will be placed for driver trainees to negotiate. This will include obstacles simulating terrain features such as narrow bridges, serpentine courses, brake modulation blocks, river crossing, side slope, pot holes, curb and ditch crossing, humps (similar to moguls on a ski slope), and narrow urban driving. The obstacles are connected with unpaved roads. The capacity of the advanced motor vehicle operations course facility will range from 25 to 60 personnel and will be used for individual, section, squad, or platoon training. An estimated 20 drivers per week will train at the advanced motor vehicle operations course, primarily with high mobility multipurpose wheeled vehicles. At two drivers per vehicle, an estimated 10 high mobility multipurpose wheeled vehicles will use the course during training events.

Convoy training consists of simulated threats and tactical scenarios to train in various defensive techniques. This area of Andersen South is currently used by the Air Force for expeditionary airfield and military operations in urban terrain training which has similarities to the proposed maneuver area training. The convoy training course is 2.5 mi (4 km) and will use existing and

new roadways (see Andersen South construction above) within areas identified for the maneuver training space. All existing roads will be open to motor vehicle use associated with maneuver area training; this will primarily be wheeled vehicles, but occasionally a tracked vehicle may be used in maneuver area training at Andersen South. The area will continue to support Air Force training, while also accommodating Marine Corps training requirements. Access to the site will be by vehicle or air lift. Air lifts will typically involve two to four CH-53 helicopters dropping off and picking up personnel twice a week.

Andersen South will support landing zones for aviation training and include helicopter support team training for ground units. Personnel train in rappelling from the helicopter and procedures that will be used in inserting and extracting troops via helicopter at combat locations. The air operation events associated with this air-ground training will typically consist of a pass for orientation, followed by a downwind approach, hovering at 30 ft (9 m) above ground level for approximately one minute at a designated landing zone and a departure. Since the maneuver area aviation training operations will be a component of training to meet the aviation training requirements, they are also described below under aviation training. Helicopter-insertion extraction activities include fast rope, rappelling, helocasting, and parachute operations. Helicopter insertion-extraction training operations will involve one pass for landing zone orientation, followed by an approach of the landing zone, hovering at approximately 30 ft (9 m) above ground level for approximately one minute, and then departing the landing zone. During each training event, approximately three helicopter insertion-extraction operations will be conducted at one or more closely located landing zones. Approximately 114 helicopter insertion- extraction events will occur at Andersen South per year. Confined area landing, external loads, and maneuver lift (see descriptions above) training will also occur on Andersen South at a frequency of 125, 63, and 720 events per year, respectively.

Shooting house operations, which are proposed to be located in Andersen South, are conducted in an enclosed structure and provide training in close-quarter skills, like room clearing and hallway navigation. No explosives are used; however, live-fire training operations with the 5.56 mm rifle will be authorized at the facility.

Naval Base Guam

Naval Base Guam (NBG) is located along the southern side of Apra Harbor on the western coast of Guam. The civilian Port of Guam flanks the northern side of the Harbor. The 2010 JPGO carry-over activities constructed and implemented within the NBG are described below. As of March 2015, the working dog kennel and the Apra Harbor wharf and utility upgrades and associated dredging and dredge disposal management activities are under construction.

<u>Naval Base Guam Construction Projects</u>

In-water ship berthing and embarkation areas, staging areas, an amphibious craft laydown area, a military working dog kennel relocation, a medical and dental clinic, washdown facilities, brown treesnake barriers, and quarantine areas will be developed at the NBG. In addition, a U.S. Coast Guard berthing and crew support building will be relocated to an area that is not currently forested. The military working dog kennel will be relocated from its existing site to a new site

on NBG. The proposed project location is in an existing laydown area for base maintenance with existing access roads and utility tie-ins. Associated with the aircraft carrier berthing at NBG are the shore-side facilities (recreation, gathering, laundry, waiting for transportation, and food and beverage sales), staging areas, new buildings, and parking. The Apra Branch Medical and Dental Clinic will be built on a previously disturbed area that is currently vacant. The Morale, Welfare, and Recreation area will be developed to provide food and beverage booths, seating for 500 people, 40 phone bank seats, 100 stalls for visitor and rental car parking, portable restrooms, laundry facilities, temporary lighting, and trash dumpsters.

All facilities will have security lights mounted on buildings or steel poles. Lighting along the wharves will consist of 1,000-watt high pressure sodium floodlights mounted on new or existing poles. Lighting will be shielded and aimed such that the majority of the illumination will be directed towards the wharf deck, extending over water approximately 100 ft (30.5 m). All actions related to development and improvement of waterfront facilities will occur in currently paved or landscaped areas. All utility distribution lines and ductwork will be located underground, generally within existing utility corridors.

The DON will develop permanent and temporary washdown, quarantine, and inspection areas at arrival areas on Guam at Apra Harbor (ship and amphibious vehicle loading and unloading) and AAFB (DON 2010c, p. 70) as follows.

1. A washdown, quarantine, and inspection facility will be built at Apra Harbor within 600 ft (183 m) of Victor Wharf to reduce the risk of exposure to invasive species after leaving the clean, biosecure area. During construction, invasive species and debris will be removed from the site. Prior to operation, the biosecure area will be inspected and will only begin operations when the area is invasive species-free. These facilities will provide vehicle cargo quarantine, inspection, and storage areas. These areas will be constructed with a brown treesnake barrier and active trapping for brown treesnakes will occur. These facilities will provide a pre-wash down area, vacuum equipment, wash racks (raised platforms with ramps at either end that facilitate cleaning and inspection of undercarriages), an inspection building, and fenced area that will meet the requirements for the use of inspection dogs and a cargo loading and inspection area. Specifically, these facilities will be built in a designated paved area with a wash down area and sufficient space for segregating “clean” from “dirty” equipment, cargo, and vehicles. The areas will be surrounded by brown treesnake barriers following specifications received from the Service: The barriers will be 4.5 ft (1.4 m) tall; made from pre-cast concrete with an outward projecting lip to deter snakes; the barriers will have only two gates providing one-way flow of traffic through the site; each gate made from sliding chain-link with fabric barriers or comparable materials to prevent snake ingress and egress.

2. When in Apra Harbor, the vehicles and equipment unloaded or loaded onto a ship will be inspected and receive a wash down on arrival and departure to prevent introduction of any pest or invasive species that may present a potential threat to agriculture, public health, or the natural resources of Guam or other Pacific Islands. All wash downs will be conducted and supervised by trained personnel in accordance with Armed Forces Technical Guide 31 (2008). Personnel from USDA may participate in inspections and

brown treesnake inspections will be conducted with involvement of USDA Animal and Plant Health Inspection Service (APHIS) personnel. Vehicles will be inspected (internally and externally) prior to passing into the biosecure area. The water used to wash vehicles will be captured and circulated through filters to prevent pests from spreading. All waste on board ships will continue to be steam sterilized prior to disposal in regulated landfills in accordance with base operating procedures.

3. Supplies for the Coast Guard Cutters are delivered to the wharves from existing DON supply warehouses where all supplies and material have undergone required USDA inspections upon arrival and before being transferred out of the warehouse and onto a U.S. Coast Guard ship. The U.S. Coast Guard ships will not be offloading supplies onto Guam from other locations (DON 2010c, p. 79).

4. Truck traffic at the wharf will be required to re-supply ships (DON 2010c, p. 85). Trucks may be from DON Supply or direct from commercial vendors. Equipment to move cargo will be brought to the wharf as needed. When an aircraft carrier is not berthed, the Port Operations building will be used for storage. All equipment and cargo will go through inspection procedures prior to being brought into "clean" areas or being loaded on to ships, regardless of vendor.

5. A washdown, quarantine, and inspection facility will also be built at the amphibious vehicle laydown area in Apra Harbor to reduce the risk of exposure to invasive species after leaving the clean, biosecure area. This facility will be adjacent to the shore so that amphibious craft can drive into the washdown, quarantine, and inspection facility. This facility will be built to the specifications described above for Victor Wharf with modifications to accommodate amphibious vehicles, specifically: the laydown area will have dedicated ramps for landing craft air cushion and amphibious assault vehicles in the quarantine area.

6. Typically, the Amphibious Task Force will arrive fully supplied to meet all training requirements or will be replenished as needed prior to training in the CNMI. If cargo is loaded or unloaded, inspection is required as described above for Victor Wharf. Cargo will be loaded and unloaded in the laydown area which will be of sufficient size to segregate "clean" from "dirty" cargos. If there is a training mission on Guam, the trucks will drive off the ships' stern ramps (and be inspected as described above). Other cargo may be offloaded by mobile crane. After inspection, cargo may be temporarily stored in a "clean" material handling equipment at the waterfront.

7. There are several projects in Apra Harbor. For all facilities, the DON will attempt to include USDA APHIS at the earliest possible time to plan for brown treesnake inspections. Planning for cargo storage will include considerations of the length of time for storage, risk of brown treesnake or other invasive species, and origin and destination of cargo. These considerations need to be vetted through the Biological Monitor (who will coordinate with other partners. Permanent barriers and moveable brown treesnake barriers will be used as the situation dictates.

8. The DON will develop permanent and temporary quarantine and inspection areas at a new Air Embarkation and Disembarkation area at Andersen Main Base to load and unload passengers and cargo from aircraft (DON 2010c, p. 62-63). USDA APHIS will be included in the design of this facility as early as possible to assist with planning. This facility will be surrounded by a brown treesnake barrier built to the specifications described above and will have inspection and quarantine areas to separate "clean" from "dirty" areas such that all aircraft, baggage, equipment, and cargo are 100 percent inspected upon arrival and 100 percent inspected upon departure. The aircraft carrier berthing will bring up to 59 aircraft to Guam that may beddown at AAFB. All transient aircraft will follow all existing invasive species inspection protocols, including brown treesnake protocols (DON 2010c, p. 83).

Naval Base Guam Operations

All amphibious training operations and conservation measures are assessed under the MITT Biological Opinion (USFWS 2015b, 66 pp.). Though new facilities will be constructed due to the proposed project, no additional amphibious training will occur in undisturbed areas, either new or increased frequency or tempo is proposed under the proposed project. Therefore, amphibious training will not be analyzed within this Biological Opinion.

New aviation training, called external load, will occur at Orote Airfield on NBG. The training requires access to pre-positioned cargo for practice, and ground access is needed for ground support team personnel. External loads cannot be carried across public roads or populated areas. External load training operations will involve one pass for landing zone orientation, followed by an approach of the landing zone, hovering approximately 30 ft (9 m) above ground level for approximately one minute while the ground support team attaches a load (e.g., concrete block, items in a cargo net, or a vehicle), departure of the landing zone vicinity with the load in tow, flying with the load in an arc, then returning to the landing zone with the load, and hovering for approximately 30 seconds while the ground support team retrieves the equipment, and then departing the landing zone vicinity. During each event, these operations will typically involve five repeated attachments and detachments of external loads at the same landing zone where the ground support team is positioned. Ground support teams will include up to 40 personnel at one time and will support landing zone operations. Approximately 10 to 12 wheeled vehicles (e.g., high mobility multipurpose wheeled vehicles) will be used by these teams. External load training will involve pick up and return from the same location on Guam.

Naval Munitions Site Operations

Company-level patrolling, jungle training, land navigation, and air-ground operations will occur on 5 to 7 consecutive days, 12 weeks per year, day and night, for a total annual throughput at the Naval Munitions Site of 1,440 Marines. Sixteen events are authorized under the MITT Biological Opinion (USFWS 2015b, 66 pp.), the number of days and weeks described above represent an increase of training events per year due to the proposed project (revised total of 28 events per year). This site is rural and rugged and is designated as the Southern Land Navigation Area, supporting foot land navigation training primarily for special forces personnel (USFWS

2015b, 66 pp.). Access to the NMS for training will occur via helicopter transport operations at proposed landing zones. Approximately eight CH-53 (heavy-lift transport helicopters) lifts will be required for a company-level training event. Personnel, hand-carried supplies, and equipment will typically be airlifted to the site on a Monday and lifted out on Friday of the same week. No other roads will be established and no vehicles will be used within the training site. The access road will have an associated parking area that will be periodically mowed to allow for parking and to reduce fuel loading and potential for fires. Foot trails will be established within the southern portion of the NMS due to repeated use during maneuver training.

Terrain flight, ground threat reaction, defensive maneuvering, confined area landing, and external load training will occur at the NMS. Terrain flights require a route with varying terrain for night flight with night-vision goggles, at 50 to 200 ft (15 to 61 m) above ground level. Training for terrain flights will occur only within the southern portion of the NMS, south of the southern extent of Fena Reservoir. Aircraft will leave AAFB and transit to southern Guam using standard military flight procedures (i.e., greater than 1,000 ft [305 m] above ground level). Aircraft may fly over land or over water on their way to the NMS. A typical training event may involve an aircraft leaving AAFB, moving to the east over the ocean, traveling along the coast at an altitude greater than 1,000 ft (305 m) until approximately the Talofofo River, and then flying up the river to the NMS still at an altitude equal to or greater than 1,000 ft (305 m). Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at Highway 4 and then flights may conduct low-level terrain flights. Once the aircraft crosses into the NMS below Fena Reservoir (training restriction line), pilots will then be authorized to conduct low-level (50 to 200 ft (15 to 61 m) above ground level) terrain flights within the southern NMS. Low-level flights will not occur over the munitions bunkers, the main NMS, the area to the east of the munitions bunkers, over Fena Reservoir, or over the Almagosa Springs.

Ground threat reaction training requires a tactical flight maneuver area or route (similar to terrain flight routes) where ground-based electromagnetic radiation threat simulators may be placed. Defensive maneuvers are also conducted along a route over land or water. Differing helicopter types (AH-1, CH-53E, UH-1) and the MV-22 tilt rotor aircraft, will be used to conduct terrain flights, ground threat reaction, and defensive maneuvers training; however, terrain flights training operations are low altitude tactics and the ground threat reaction and defensive maneuvers training is conducted more in a tactical navigation area than along a route. Ground threat reaction is also low-altitude training like terrain flights, while defensive maneuver training is higher in altitude (equal to or greater than 1,000 ft [305 m] above ground level). Approximately 100 terrain flights, 94 ground threat reaction, 94 defensive maneuvers, and 1,104 maneuver lift flights per year will occur in the NMS.

Confined area landing training operations will also occur at the NMS. Confined area landing training consists of one pass of the landing zone for orientation, a downwind approach, followed by the landing, and takeoff. To meet qualification requirements, confined area landing training events typically will have five associated operations. Typically, a number of different, closely located landing zones, will be used during the training event. There will be approximately 125 confined area landing training operations per year at the NMS. Approximately 63 external load

training operations per year will also occur at the NMS and are described under "Naval Base Guam Operations".

Roadways

The proposed road projects on Guam will enable and improve roadway connectivity, capacity, and pavement strength for military construction and deployment in support of the proposed project. Some of these road projects will be funded by DoD pursuant to the Defense Access Roads program. The projects that are not funded by DoD will be the responsibility of the Government of Guam Department of Public Works or the Federal Highways Administration. Logistical routes for construction-related transport will connect the Port of Guam with NBG, AAFB, the proposed main cantonment, the NMS, and existing concrete batch plants, rock quarries, and precast concrete panel fabrication sites associated with the military buildup on Guam.

In addition to improvements to the construction routes, increased traffic associated with the presence of the military personnel and their dependents will require roadway modifications. As a result of the recent transportation and traffic studies on the island of Guam, 50 individual road projects have been proposed but would occur within urban areas. The more extensive roadwork projects will either occur within previously developed areas of Guam such as residential and commercial areas, or they will not entail impacts to woody vegetation or other natural resources potentially utilized by listed species (for instance, pavement strengthening will not require any additional disturbance to areas outside of the existing roadbed) (Table 4). However, the Agana Bridge 1 Replacement Project occurs along Route 1 and has the potential to impact wetland habitat.

Table 4. DON Actions Associated with the Military Relocation to Guam that are Carried Over from the 2010 DON BO (modified from Table 1-1, DON 2014a, p. 3)

Location	Action
AAFB	Location for the Marine Corps Air Combat Element and construction of associated facilities at AAFB North Ramp
AAFB	Construction of air embarkation facilities at AAFB South Ramp
AAFB	Construction of the North Gate and access road at AAFB, including a new Entry Control Point facility
Andersen South	Development of a training range complex to include maneuver training and landing zones
Apra Harbor	Waterfront functions at Apra Harbor to support embarkation, including wharf and utility upgrades, and associated berth dredging and dredge disposal management
Apra Harbor	Relocation of Military Working Dog Kennel
Apra Harbor	Relocation of U.S. Coast Guard
Apra Harbor	New Medical Clinic
Apra Harbor	Apra Harbor Embark Operations
Naval Munitions Site	Training activities, including aviation training and nonfiring operations training
Naval Munitions Site	Access to the NAVMAG area using the existing hiking trail as the access road (No Construction Required)

Naval Munitions Site	Use of Parsons Road area for the location of additional ammunition storage at NAVMAG
Roadway Project (by FHWA and Guam Department of Public Works[GDPW])	Route 1 and Route 8 intersection and improvement (Hagåtña) ("Guam Road Network" [GRN]1) – (Part of Hagåtña Bridge Replacement Project Scope)
Roadway Project(s)	Route 1 and Route 3 intersection and roadway improvements (Dededo) (GRN2)
Roadway Project	Replacement of Hagåtña (Agaña) Bridge #1 with reinforced concrete (GRN3)
Roadway Project	Route 11 roadway improvements from the port to Route 1, including pavement strengthening (GRN4)
Roadway Project	Widening of the Route 1 and Route 11 intersection, adding a second left turn lane and pavement strengthening (GRN5)

Term of the Proposed Action

The proposed project includes carry-over activities per the 2010 DON BO and new proposed activities as described above. The proposed construction activities would continue and occur over a 13-year period from 2015 to 2028. In addition, construction of the LFTRC is expected to be completed in January 2024. After the construction is completed, there will be about 6 months of equipment outfitting and testing before the range will be operational. There is no planned end date for the operation of the proposed action; therefore the duration of the project is indefinite.

CONSERVATION MEASURES TO AVOID OR MINIMIZE PROJECT IMPACTS

The project's conservation measures are designed to avoid or minimize project effects to listed species and their habitats or to contribute to the recovery of a listed species. The conservation measures are intended to represent a comprehensive summary of those measures that were proposed in the BA (DON 2014a), addendum to the BA (DON 2015b), and through discussions and email correspondence between the DON and the Service. Conservation measures are considered part of the proposed action and are vital to determining the scope of the proposed action. Implementation of conservation measures is required under the terms of the proposed action. The Service's effects analyses and determinations assume proposed project conservation measures will be implemented in full. Any changes to, modifications of, or failure to implement these conservation measures may result in a need to reinitiate this consultation. Modifications to aspects of the conservation measures described, that provide protection equal to or greater than the protection afforded by the measure, as it is proposed in this Project Description, may be substituted for those provided in this Biological Opinion with the Service's written concurrence. The conservation measures will be implemented prior to or concurrent with construction unless otherwise stated. After completing the conservation measures, the long-term management of the natural resources will be incorporated into the JRM INRMP (DON 2014a, p. 35). Based on discussions and meetings between the DON and Service, the Service understands that the implementation of the conservation measures would be the responsibility of the DON; however conservation measures over the long-term would be managed by the JRM. The JRM's mission is to provide executive level installation management support to all DoD components and tenants

through assigned regional installations on Guam and the Northern Mariana Islands in support of training in the Marianas.

General Conservation Measures to Contribute to the Recovery of Listed Species

1. Forest Enhancement

   The DON will implement a forest enhancement project on approximately 1,000 acres in Finegayan (Figure 3). The forest enhancement project will include:
   - Installation of ungulate exclusion fences around approximately 1,000 acres
   - Active removal of ungulates (i.e. trapping, snaring, shooting) with the goal of eradication within the fenced areas
   - Invasive plant removal
   - Propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats (e.g., *A. mariannensis*, *G. mariannae*, *F. prolixa*, *M. citrifolia*, *C. micronesica*, *W. elliptica*, *S. nelsonii*, *H. longipetiolata*, *T. rotensis*)

   When a DON-related project is initiated that results in clearing of recovery habitat, a commensurate amount of forest enhancement will begin. The exact amount of recovery habitat that will be cleared will depend on final design specifications. The DON's forest enhancement project will enhance at least the same number of acres of recovery habitat as that cleared by the proposed action. The DON expects that approximately 1,000 acres of forest will need to be enhanced as part of the Project Description (Table 6). The timeline of initiation of forest enhancement projects will be based on the construction timeline for the proposed action. The first construction funds that are released for a project that will clear recovery habitat will also trigger the initiation of the forest enhancement funding. The sequence of forest enhancement will be: (1) ungulate exclusion fence, (2) ungulate removal, (3) invasive plant control, and (4) native plant establishment.

2. Guam *Serianthes* Adult Tree

   a. DON will propagate, plant, and maintain a minimum of 30 individuals of *Serianthes nelsonii*, parented from the Guam *Serianthes* adult tree, within the forest enhancement areas. Outplanting methods and maintenance success criteria will be developed in coordination with the DON and the Service. Over the long term, the outplanted individuals will be managed by JRM through the JRM INRMP to ensure survivorship into adulthood.

   b. DON will ensure that seeds from the Guam adult Serianthes tree will be collected by entities specified on recovery permits, provide storage for these seeds, and provide funds for *Serianthes* seed viability testing. Seed storage and viability testing shall occur at a certified facility (*e.g.*, National Center for Genetic Resources Preservation or Lyon Arboretum). The DON will ensure the seeds are appropriately prepared or treated for shipping per the instructions of the certified facility.

c. The DON will protect the adult Guam *Serianthes* tree from ungulates through one of the following options.

   i. DON will construct and maintain a fence, with a minimum buffer of 100 feet, around the forested area surrounding the Guam adult *Serianthes* tree to protect the tree and its seedlings from ungulates. The DON will remove all ungulates from the fenced area either prior to the completion of the fence construction or within six months of the fence construction.

   OR

   ii. DON will construct and maintain a fence around the LFTRC to encompass the area within the existing Ritidian ungulate fence (per the ISR Strike Biological Opinion and NWF Beddown project) and the Guam adult *Serianthes* tree. The DON will remove all ungulates from the fenced area either prior to the completion of the fence construction or within six months of the fence construction.

   iii. This fence shall be completed within two years of award of the construction for the portion of the live fire training range complex that removes the Ritidian ungulate fence.

d. DON would allow access to the *Serianthes* adult tree at NWF for seed collection and seedling rescue provided (1) the need to collect seed and/or rescue seedling has been coordinated in advance with the Service, AAFB, and JRM, and (2) adequate timing and coordination is permitted for DON to process the access request. Access requests would be coordinated through Range Control, which is the entity responsible for scheduling all training events on military ranges.

3. Sea Turtle Public Outreach and Coordination

The DON, in cooperation with the Guam Department of Aquatic and Wildlife Resources (DAWR), has undertaken an educational program to inform military and civilian personnel about sea turtle nesting and the potential impacts to the species from nest disturbance, direct harassment of sea turtles, beach disturbance, and other threats. The DON has developed and distributed sea turtle conservation posters, tri-fold brochures and activity booklets for elementary school children. These educational materials have been distributed to local dive shops on Guam, and will continue to be used and refined throughout the construction period of the proposed relocation. As part of the RSS training package, personnel would be directed to not interact with sea turtles and report all sightings to the Service and coordinate with the GNWR on nesting surveys at the Refuge.

Brown Treesnake Control and Suppression

The DON has initiated support for large-scale, long-term efforts to refine methods for brown treesnake (BTS) control that will reduce the snake population on a landscape level more cost-effectively and increase the efficacy of capturing snakes in low-density situations. In early FY12, the DON coordinated with the Service, USDA, and U.S. Geological Survey (USGS) on priority BTS projects. The development of a bait formulation for BTS suppression was determined to be the highest priority project need. The USDA National Wildlife Research Center (NWRC) was funded for a multi-year project by the DON at the start of fiscal year 2013 to implement the bait formulation project.

The DON will implement selected projects identified as priorities in the BTS Technical Working Group Strategic Plan that are compatible with the military mission on Guam for up to 10 years from the start of main cantonment construction, subject to Congressional funding guidelines and restrictions. DON and the Service acknowledge financial support is subject to the availability of funds, and no provision herein shall be interpreted to require obligation of payment of funds in violation of the Anti-Deficiency Act, 31 U.S.C Section 1341.

The DON's intent with these projects is to identify and use successful technology to severely suppress or eradicate brown treesnakes. DON will install a BTS barrier to exclude brown treesnakes from approximately 160 acres (65 ha) after the current experimental suppression activities within the Habitat Management Unit (HMU) has been determined to be successful. If the DON is successful at eradicating brown treesnakes within the 160 acres, the DON will install a second brown treesnake barrier to exclude brown treesnakes from approximately 300 acres (121 ha).

In response to decreased BTS densities, the rodent and feral cat population is expected to increase. In order to address this anticipated increase the DON will implement rodent and feral cat control. Rodent control would benefit recovery habitat as rodents consume seeds of native plants. Feral cat control would benefit the recovery of endangered birds as cats predate on native birds.

Conservation Measures to Minimize the Effects of Construction

1. Contractor Education Program. The DON contractor education program ensures that construction contractor personnel are informed of the biological resources in the project area, including invasive species, special-status species, avoidance measures, and reporting requirements. The measure is intended to prevent inadvertent effects to terrestrial biological resources due to lack of awareness of resource presence, sensitivities, and protective measures. The measure will be implemented during pre-construction and construction.

2. Contractor Plans and Specifications: All construction will occur within the limits of construction shown in the plans and specifications. This measure is intended to prevent additional habitat loss. The measure will be implemented during pre-construction and construction.

3. Pre-Construction Surveys for the Mariana Fruit Bat. For projects within or in the vicinity of suitable fruit bat habitat, surveys following the Service-approved JRM protocol (USFWS 2009a) will be conducted one week prior to the onset of work. If a fruit bat is present within 492 ft (150 m) of the project site, the work will be postponed until the bat has left the area. The measure is intended to prevent avoid and minimize potential effects to fruit bats, and will be implemented during pre-construction and construction.

4. Guam Landscaping Guidelines. Appropriate or non-invasive species will be planted in all new landscapes. This measure is intended to reduce potential effects associated with non-native vegetation, promote habitat for native species, reduce water consumption, and reduce the need for fertilizers. The measure will be implemented during construction.

5. LFTRC Range Berm Controls. LFTRC range berms will contain native or non-invasive herbaceous vegetation, and other engineering controls. This measure will help to manage stormwater runoff and control erosion, and the berm will minimize the number of bullets that may fall outside the range footprint. The measure will be implemented during construction.

6. Lighting Installation. Lighting will be designed to meet minimum safety, sustainability, antiterrorism, and force protection requirements. Hooded-lights will be used to the maximum extent practicable at all new roads and facilities within known sea turtle land habitat and fruit bat roost areas. Either hooded or "night-adapted" lights will be installed at the LFTRC. Illumination of forest, coastline, or beach will be consistent with range safety and security requirements and kept to an absolute minimum including the shielding of lights and directing lighting away from the forest or other wildlife habitat. This measure will be implemented during pre-construction, construction, and during operations.

7. Monitoring. The DON will be responsible for oversight of avoidance, minimization, and conservation measures implementation by the contractors for projects associated with the proposed action. The DON shall ensure that construction remains within the limits of construction and that sensitive resources are avoided, unless otherwise specified in this Project Description. This measure will be implemented during pre-construction, construction, and operations.

Conservation Measures to Minimize the Effects of Invasive Species

Regional Biosecurity Plan. To address invasive species pathways and encourage a more holistic approach to managing invasive species, the DON funded the development of a Regional Biosecurity Plan (RBP) for Micronesia and Hawaii (formerly referred to as the Micronesia Biosecurity Plan). Individual activities for various species will continue, but the DON and others agree it is more efficient to manage pathways and prescribe corrective measures for a suite of species which will be monitored at discrete control points over time. The RBP will provide stakeholders in Micronesia and Hawaii with a platform for coordination and integration of inter-agency invasive species management efforts such as control, interdiction, eradication, and

research. The final RBP was completed in March 2015 (DON 2015c). Several of the recommendations are incorporated into the Project Description as BMPs:

1. Onsite vegetation waste management procedures. Green waste will be handled by the contractors at designated laydown areas within the limits of construction. Contractors will be required to divert all the green waste. The larger-sized green waste consisting of trees and stumps will be processed into mulch and the smaller sized green waste will be processed into compost. A proposed green waste processing facility at NBG Landfill may also be used to process green waste generated during construction. The DoD will seek permit authorization from the GEPA for the proposed green waste processing facility. (Refer above to Construction – Utilities and Site Improvements for additional detail.)

2. DON's Final Guam Landscaping Guidelines. The DON has developed a manual providing landscaping design guidelines specific to appropriate plant selection and establishment for all the DON construction activities on Guam (DON 2011). This manual implements required DON policies including, but not limited to:
    a. use of native regional plants for landscaping;
    b. design, use, and promoting construction practices that minimize adverse effects on natural habitat;
    c. pollution prevention by reducing fertilizer and pesticide use, integrated pest management practices, recycling green waste (composting), and minimizing runoff;
    d. implementing efficient water practices; and
    e. preventing the introduction of invasive species.

    The above measure is intended to reduce potential effects associated with non-native vegetation, promote habitat for native species, reduce water consumption, and reduce the need for fertilizers.

3. Biosecurity outreach and education - The DON has initiated and will continue to implement a targeted, comprehensive outreach and education program for DoD and civilian populations for biosecurity focused on prevention. As a starting point, the DON contracted for the development of biosecurity outreach and education materials. The contractor has designed and produced an activity booklet, a two-sided, tri-fold, educational brochure with an associated poster that differentiates native from introduced species, defines invasive species, describes the known impacts of invasive species on native species and ecosystems, and what can be done to prevent and control invasive species. This effort also included the development of radio public service announcements (PSA) in three languages, and a television PSAs both of which aired for one month in September of 2013 during peak broadcasting times.

    The DON's biosecurity outreach and education program has already begun concurrent with the actions that were initiated under the 2010 EIS ROD (DON 2010b). The DON will develop additional informational videos, expand the radio PSAs broadcasts, and other print media as well as active public outreach concurrent with the arrival of the first major influx of USMC personnel in 2020 and continue for an additional 5 years.

4. HACCP planning. Hazard Analysis Critical Control Point (HACCP) planning is a pathway management tool that provides a comprehensive method to identify risks and focus procedures to prevent spread of species through pathways. Construction work could unintentionally spread non-target (potentially invasive) species. These non-targets could hitchhike on construction equipment or be included in shipments of materials and supplies from locations outside of Guam. The pathways used by invasive species to move into new locations are not always obvious. Many problematic species, diseases, and parasites have been transferred to new locations as undetected (and unplanned) hitchhikers. HACCP planning is a management tool that provides a structured method to identify risks and focus procedures. Understanding pathways and developing plans to reduce non-target species and prevent biological contamination is necessary to avoid unintended spread of species.

   In August of 2011, the DON sponsored several HACCP training courses for DON employees and construction contractors. A HACCP Planning Overview for Managers was held on August 8, 2011, and 2 two-day HACCP Planning courses were held August 9 through 12, 2011. Over 60 people attended the three courses. Additional trainings are held at the various project sites when there is worker turnover.

   a. All construction contracts will contain a requirement to develop a HACCP Plan which will identify risks and potential pathways for non-native species and will outline procedures for controlling and removing risks identified. Construction contractors are required to provide documentation that supports prevention, worker awareness training, and control of non-native invasive and pest species in the project area and efforts to prevent the movement of non-native invasive species to areas outside the project area, whether in a purposeful or inadvertent manner. The contractor is responsible for ensuring that employees receive applicable environmental and occupational health and safety training and keep up to date on regulatory requirements for specific training for the type of work to be conducted onsite.

   b. Construction contracts also will contain a requirement for inspections and proper re-use or disposal of vegetation to avoid contributing to the further spread of the coconut rhinoceros beetle. The construction contractors are to identify and implement control measures to prevent the inadvertent movement of non-native, invasive species to Guam and to and from the project site to other locations. The contractor is required to establish appropriate facilities that comply with all environmental laws and regulations, provide training for proper vehicle hygiene, and promptly take corrective and preventative actions for noncompliance. This includes vehicle washdown and inspection for soil and other materials and appropriate control measures are implemented to prevent the inadvertent movement of non-native invasive species from the project site to other locations.

   c. All HACCP planning and implementation related to the proposed action will be the responsibility of the awarded project contractor(s) to ensure that proper

control measures are used throughout the construction activities to prevent the inadvertent movement of invasive species from one location to the project site, and/or from the project site to other locations. It will be the responsibility of DON to review and concur with the development phase of the HACCP planning process to ensure proper compliance by these contractors.

d. HACCP plans will be approved and inspected by the DON.

5. Monitoring to evaluate effectiveness of HACCP

The DON shall provide training, review, and technical guidance on HACCP plan development, implementation, and revision during the construction phase of the buildup on Guam. The HACCP planning covers Guam-related rapid response actions. The DON contracted a baseline ecosystem monitoring study for projects on AAFB in 2011. Transects were focused on areas where newly introduced species were most likely to occur. The intent of the project was to establish a baseline of both native and non native plants present prior to the beginning of planned construction activities. The baseline will serve as a reference for subsequent monitoring efforts conducted concurrently with construction in order to aid in evaluating the success of implemented HAACCP plans. The baseline will also provide a basis of comparison relative abundance of invasive species during construction as well as whether any species detected during long-term monitoring are newly introduced or were present prior to the beginning of construction. The AAFB project was completed in December 2012.

To document the effectiveness of the HACCP implementation at construction sites, the DON has developed and implemented a long-term monitoring program for terrestrial vegetation. For any clearing of vegetation that is adjacent to or contiguous with recovery habitat, the perimeter and 98.4 ft (30 m) into the habitat will be surveyed to identify vegetation community species composition. This survey will be repeated six months and at one year after vegetation removal to ensure effectiveness of HACCP implementation (clean equipment, supplies, and materials) during construction activities. If new nonnative, invasive species are detected, the DON will notify the Service and the DON will develop and implement an eradication plan or control effort to prevent infestation.

The DON will develop an early detection and rapid response component for when an incipient invasive species is discovered in the proposed action area.

6. Brown treesnake interdiction

a. JRM has established a comprehensive brown treesnake interdiction program to ensure that military activities, including the transport of civilian and military personnel and equipment to and from Guam, do not contribute to the spread of brown treesnake to other islands or regions. Brown treesnake interdiction requirements are specified in DoD instructions (i.e., 36 Wing Instruction 32-7004, Brown Tree Snake Control Plan and COMNAVMAR Instruction 5090.10A,

Brown Tree Snake Control and Interdiction Plan). The proposed action will continue to comply with these established procedures.

b. The DON will fund any increase of current federally funded brown treesnake interdiction measures (in Guam, CNMI, and Hawaii) where the increase is related to direct, indirect and induced growth caused by the USMC relocation to Guam. The fiscal year (FY) 2010 level of funding for the Federal interagency BTS interdiction effort on Guam, CNMI, and Hawaii and 2010 transportation levels associated with outbound cargo from Guam for the U.S. or U.S. territories will be used as the baseline. Any increase in funding will continue and become part of the DON's Brown Treesnake interdiction funding under authority of the Brown Tree Snake Control and Eradication Act (7 USC § 8501 note) (USFWS 2010a). The Service agrees that it is not DON's responsibility to fund increased interdiction measures *that are identified* more than one year after the end of the fiscal year both USMC relocation construction has ended and the permanent non-transient USMC military units have relocated to Guam. For the purposes of this Project Description, interdiction is defined as: "to hinder, prohibit, or prevent the brown treesnake from becoming established in new locations by conducting inspection and suppression processes."

   Since the original BO on DON was issued in 2010, the DON has worked with USDA and the Service to determine brown treesnake interdiction cost increases. To date, there has been no measurable increase in interdiction costs according to USDA.

c. Coordination with the USGS regarding the Brown Treesnake Research Closed Population Facility at NWF (located adjacent to the LFTRC and SDZ) – The DON will ensure through briefings or information packages that the personnel using the LFTRC know the importance of the facility and maintaining the integrity of the fence. An SOP will be developed as part of the Range Management Plan for the LFTRC to ensure the above and that USGS will be immediately notified in the event that the fence is accidentally damaged so the fence can be quickly repaired.

Conservation Measures to Minimize the Effects of Fire

The LFTRC and the Hand Grenade Range would be managed in accordance with Marine Corps Order (MCO) 3550.10, Policies and Procedures for Range Training Area Management, which addresses safe, efficient, effective, and environmentally sustainable use of the range area and includes fire management.

Fire management is a key component of range management. The DON goal is to reduce the effects of fires by limiting their frequency, size, and severity while still allowing the USMC to maintain a high level of combat readiness. In order to avoid or minimize impacts to listed

species or recovery habitat, the range management plan will include the following elements of fire management:

1. A Fire Danger Rating System tailored to the specific military uses at the LFTRC and the local weather and fuel conditions will be established. Weather readings will be taken every hour by remote automated weather stations (RAWS) on the installation. This information is immediately available to Range Control, who will use the output from the remote automated weather stations to determine the level of fire danger. This, in turn, determines any restrictions placed on military training for that hour. Restrictions are relayed to troops in the field via radio transmission. By restricting highly fire prone activities during periods of high fire danger, the likelihood of a fire start is reduced. Additionally, fires that are ignited are more likely to occur during periods of low or moderate fire danger, making them easier to control and extinguish.

2. Fuels management. All available fuel management techniques will be considered for fire break, fuel break, or fuel management area. Standard on-the-ground application is limited to mechanical cutting, herbicide application, and prescribed fire. If herbicide is to be applied, care will be taken to ensure there is no overspray into adjacent forested areas.

3. Locations and standards of fire breaks and fuel breaks. Fire breaks are similar to four-wheel-drive roads and are cleared of all vegetation to mineral soil. Fuel breaks are swaths of cut, burned, grazed or otherwise modified vegetation so that a fire's behavior is reduced. The fuel break widths are determined by fuels, topography, and prevailing winds. Fuel management corridors will be established and maintained providing areas through which fire will not carry. These corridors will provide several distinct areas where fire may be contained in order to prevent a catastrophic fire event. Each corridor will be approximately 100 to 300 m wide, although terrain, safety concerns, or protected resources may constrain the width in some areas. Fire breaks and fuel breaks shall be established immediately adjacent to the forest edge, along the outer perimeter of each range, so that there is no herbaceous vegetation along the edge of the forest.

   Fuel specifications within the corridor require that canopy cover not exceed 20 percent. Cover of fuel within the fuel management corridors will be measured at a scale of 10 meters. Within the fuel management corridors, no 10- by 10-meter area will have greater than 20 percent cover of fuel. Cover ‘starts/stops’ at the edge of a plant clump's canopy. The clump includes the dead herbaceous fuel on the ground. The frequency of a fuel break's upkeep is dependent on the speed of regrowth and/or colonization. If the vegetation within the range footprint is less than three feet tall, then no active management would be needed to maintain fuels at the < 3-ft height in the 40-60-m inner edge of the fuel break area.

4. Standard Operating Procedures (SOP). SOPs outline responsibilities for fire prevention, Fire Danger Rating System usage, staffing levels, equipment caches, fuel modifications, proper fire suppression actions, and post-fire reports. The SOPs also include fire prevention briefings to be given to range users prior to commencement of training,

notification lists in case of fire, operational decision charts for fires, and maps of resources, fuels, fire breaks, and Fuel Management Areas.

5. Range Control approval and guidance. Prior to firing all pyrotechnics (including tracers), Range Control approval and guidance must be obtained. Fire Department and Range Control personnel will have the authority to stop live-fire training for non-compliance with any training regulation and/or SOPs.

6. Fire Suppression. Water trucks (pickup truck with a tank in the back) will be on-site as a first responder vehicle. Water trucks may be supported by a fire truck or helicopter, as warranted.

7. The Service will be provided a 30-day review period, from the date of receipt of the draft draft Range Management Plan (including the fire management plan), to provide comments and recommendations for the DON's consideration. The Rire Management Plan will be finalized for the LFTRC prior to operation of the first range at the LFTRC.

Conservation Measures to Minimize the Effects of Training

1. Aviation Training in NMS (see Naval Munitions Site Operations above in the Project Description). All aviation training will be conducted so that flights will approach the southern portion of the NMS over the Talofofo River watershed and Fena Reservoir at heights of 1,000 ft (305 m) or greater above ground level. Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at Highway 4 and then flights may conduct low level terrain flights. Low-level training flights will be restricted to the southernmost portion of the NMS where Mariana swiftlets are not commonly present. This measure is intended to avoid and minimize effects to swiftlets, and will be implemented during operations.

2. Ground Training in NMS (see Naval Munitions Site Operations above in the Project Description). The DON will maintain 328-ft (100-m) no training buffers around the known Mariana swiftlet nesting caves (*e.g.*, Mahlac Cave, Fachi Cave, Maemong Cave) in NMS. This measure is intended to avoid and minimize effects to Mariana swiftlets, and will be implemented during operations.

C. OTHER ACTIONS CONSIDERED FOR THE ANALYSIS

Although not part of the project description, a Memorandum of Agreement (MOA) between the DON and the Service regarding conservation of the Guam Micronesian kingfisher recovery habitat in northern Guam was signed by both parties on June 11, 2015. The purpose of the MOA is to ensure that a sufficient amount of suitable survival and recovery habitat (thereinafter "habitat") is conserved and managed in accordance with Federal agency obligations under section 7(a) of the ESA in northern Guam to support the reintroduction of the Guam Micronesian kingfisher (kingfisher). Another purpose of the MOA is to ensure that the DON meet the

purpose and need for the proposed action to relocation the USMC to Guam (DON and Service 2015c, p. 1; also see Appendix B).

The Service has determined that approximately 8,178 total acres are required on lands currently under the custody and control of DoD in northern Guam to provide sufficient habitat for the reintroduction and eventual recovery of the kingfisher. To facilitate kingfisher recovery goals, the DON agrees to designate approximately 5,234 acres under the custody and control of the DoD in northern Guam as identified in the MOA (DON and Service 2015c). These 5,234 acres have been identified by the Service as habitat for the kingfisher needed to offset impacts of the Guam Military Relocation (the proposed action). The DON and Service recognize that the designation of the 5,234 acres may also provide a conservation benefit to other federally-listed species with similar habitat requirements (*e.g.*, Mariana crow, Mariana fruit bat) (DON and Service 2015c, p. 3).

For the 5,234 acres of land identified, the Service required enhanced management activity to ensure this habitat supports the reintroduction of the kingfisher. Accordingly, starting in fiscal year 2016, the DON commits to provide an additional $2 million per year of funding for management activities above execution year INRMP funding levels (adjusted for inflation) for the next ten years, subject to Congressional authorization and appropriation. Upon expiration of this ten-year period, parties will reassess progress of recovery efforts and future funding may be available from DON (see section V4 of MOA, DON and Service 2015c).

D. ANALYTICAL FRAMEWORK FOR THE JEOPARDY/ADVERSE MODIFICATION ANALYSES

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis of this Biological Opinion relies on four components: (1) *Status of the Species*, which evaluates the range-wide condition of the Guam Micronesian kingfisher (kingfisher), Mariana crow (crow), Guam rail (rail), Mariana fruit bat (bat), and *Serianthes nelsonii*, the factors responsible for that condition, and the survival and recovery needs of each species; (2) the *Environmental Baseline*, which evaluate the current condition of the kingfisher, crow, rail, bat, and *S. nelsonii* in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of each affected species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the kingfisher, crow, rail, bat, and *S. nelsonii*; and (4) *Cumulative Effects*; which evaluates the effects of future, non-Federal activities in the action area on the kingfisher, crow, rail, bat, and *S. nelsonii*.

In accordance with the policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the kingfisher, crow, rail, bat, and *S. nelsonii* current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the kingfisher, crow, rail, bat, and *S. nelsonii* in the wild.

The jeopardy analysis in this Biological Opinion places an emphasis on consideration of the range-wide survival and recovery needs of the kingfisher, crow, rail, bat, and *S. nelsonii* and the role of the action area in the survival and recovery of the kingfisher, crow, rail, bat, and *S. nelsonii* as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

This Biological Opinion does not rely on the regulatory definition of "destruction of adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this Biological Opinion relies on four components: (1) the *Status of Critical Habitat*, which evaluates the range-wide condition of designated critical habitat for the kingfisher, crow, and bat in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat at the range-wide scale; (2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of affected critical habitat units in the action area; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For the purpose of the adverse modification determination, the effects of the proposed Federal action on kingfisher, crow, and bat critical habitats are evaluated in the context of the range-wide condition of the critical habitat at the range-wide scale, taking into account any cumulative effects, to determine if critical habitat at the range-wide scale would remain functional (or would retain the current ability for PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the kingfisher, crow, and the bat.

The analysis in this Biological Opinion places an emphasis on using the intended range-wide recovery function of kingfisher, crow, and bat critical habitats and the role of the action area relative to those intended functions as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

E. ACTION AREA

The term "action area" is defined in the implementing regulations for section 7 at 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action."

The action area for this consultation is the island of Guam (Figure 4). The specific areas likely to be affected, directly or indirectly, by the proposed action are discussed in detail in the BA. In

addition to what is detailed in the BA, the following effects from the action may be Guam-wide: 1) effects from introduction of invasive species by the proposed action could spread throughout the whole island of Guam and 2) the population increase resulting from the proposed action will cause additional human disturbance throughout the island, including at recreation sites, hunting areas, traffic along roads, etc.

F. STATUS AND ENVIRONMENTAL BASELINE OF THE SPECIES

STATUS OF THE SPECIES

Status of the Guam Micronesian Kingfisher

Legal Status

The Guam Micronesian kingfisher (*Todiramphus cinnamominus cinnamominus*; "sihek" in Chamorro; hereafter, referred to as the kingfisher) was listed under the ESA as endangered in 1984 (USFWS 1984, 9 pp.). A revised recovery plan for the kingfisher was completed in 2008 (USFWS 2008a, 117 pp.). On October 28, 2004, the Service designated critical habitat for the kingfisher on approximately 376 ac (152 ha) in the fee simple portion of the GNWR (USFWS 2004, 117 pp.).

Species Description and Current Known Range

The kingfisher is endemic to the island of Guam in the Mariana Islands. Other subspecies, *Todiramphus* [=*Halcyon*] *c. pelewensis* and *T. c. reichenbachii*, exist on Palau (Republic of Palau) and Pohnpei (Federated States of Micronesia), respectively. The Guam subspecies is a small, sexually dimorphic forest kingfisher (Baker 1951, pp. 227–228). The adult male has a cinnamon-brown head, neck, upper back, and underparts. A black line extends around the back of the neck and the eye ring is black. The adult female resembles the male except that the upper breast is paler, as are the chin and throat, with the rest of the underparts and underwing coverts white (Jenkins 1983, p. 21). Immature birds have the crown washed in greenish-blue, and a whitish chin and throat. Underparts are buffy-white in the immature male, but may be paler in the female (Jenkins 1983, p. 21).

The kingfisher is extirpated in the wild on Guam but persists in captivity at the Guam DAWR facility and 24 U.S. mainland zoos and institutions. In response to the decline of Guam's native birds in the 1980s, the Association of Zoos and Aquariums (AZA) initiated the Guam Bird Rescue Project. Between 1984 and 1986, 29 kingfishers were translocated from Guam to zoos in the U.S. mainland to start a captive breeding program. The breeding program has been managed under the auspices of the AZA's *Micronesian Kingfisher Species Survival Plan* (Bahner et al. 1998, 54 pp.).

Life History

In the wild, kingfishers nest in cavities and feed primarily in mature, second growth limestone forest, and, to a lesser degree, in scrub limestone forest (Jenkins 1983, pp. 22–23). Kingfishers

are also known to use coastal strand vegetation containing coconut palm as well as riparian habitat. However, Jenkins (1983, p. 22) reported the kingfisher was probably most common along the edges of mature limestone forest. Few data exist about specific nest sites of the kingfisher in the wild, but in one study in northern Guam (Marshall 1989), 16 nest sites were correlated with closed canopy cover and dense understory vegetation. The report by Marshall (1989) indicated that kingfisher nest cavities were excavated from the soft, decaying wood of standing dead trees averaging 43cm (17 in) in diameter (Marshall 1989, p. 475). Kingfisher nests have been reported in a number of tree species including *Ficus* spp. (banyan), *Cocos nucifera* (coconut), *Artocarpus* spp. (breadfruit), *Pisonia grandis* (umumu), and *Tristiropsis obtusangula* (faniok) (Baker 1951, p. 228; Jenkins 1983, p. 24; Marshall 1989, p. 475).

Kingfisher breeding activity in the wild is thought to be concentrated from December to July (Baker 1951, p. 228; Jenkins 1983, p. 24). Pairs may excavate their own nests in soft trees, arboreal termitaria (the nests of termites [*Nasutitermes* spp.]), arboreal fern root masses, or they may utilize available natural cavities such as broken tree limbs (Jenkins 1983, p. 24; Marshall 1989, p. 474). Jenkins (1983, p. 23) observed that some excavated cavities were never used as nesting sites, which suggests that the process of excavating nest sites may be important in pair-bond formation and maintenance.

Both male and female kingfishers incubate eggs, and brood and feed nestlings (Jenkins 1983, p. 24). Clutch sizes from wild populations (n=3) were either one or two eggs (Baker 1951, p. 228; Jenkins 1983, p. 24) and clutch sizes of one to three eggs have been reported in the captive population (Bahner et al. 1998, p. 21). Incubation, nestling, and fledgling periods for populations of kingfishers in the wild are unknown. However, incubation and nestling periods of captive birds averaged 22 and 33 days, respectively (Bahner et al. 1998, p. 21).

Although there is still more to learn about the breeding behavior of Guam Micronesian kingfishers, it is known that the nest excavation and courtship stages are crucial to successful reproduction. Kingfishers excavate multiple cavities in trees before selecting a suitable nest site. Courtship includes cavity excavation, male feeding the female, and vocal duetting (simultaneous calling between members of a pair). These activities are common and are thought to function in both pair-bond maintenance and territorial maintenance (USFWS 2008a, p. 24; Bahner et al. 1998, p. 18). The breeding season for this species on Guam is reported to range from December to June, however, within the managed population (in captivity) we have seen reproduction in all months of the year with January through July being the prime breeding period. During the breeding season, it is important to minimize disturbance within the territorial range of breeding pairs. Based on experience with the managed population, Guam kingfishers are especially sensitive to stress which would likely be increased by noise and disturbance, and compounded during the breeding season (B. Bahner, Philadelphia Zoo, pers. comm. 2015). Additionally, anything that disrupts the availability of prey items in their territory would be detrimental would negatively affect kingfishers. There is no known recommended buffer around active kingfisher nests; however in captivity nesting kingfishers have sometimes been monitored by cameras to avoid disturbing breeding birds (Bahner et al. 1998).

In the wild, the kingfisher is known to feed on invertebrates and small vertebrates, including insects, segmented worms, hermit crabs, skinks, geckoes, and possibly other small vertebrates

(Marshall 1949, p. 210; Baker 1951, pp. 228–229; Jenkins 1983, p. 23). The species typically forages by perching motionless on exposed branches or telephone lines and swooping down to capture prey off the ground with their bill (Jenkins 1983, p. 24). They also will capture prey off nearby foliage and have been observed gleaning insects from bark (Maben 1982, p. 78).

Records of kingfisher distribution and intraspecific territorial behavior suggest this species maintains exclusive year-round territories in the wild (Jenkins 1983). Research and observations of the related Pohnpei kingfisher show this species has a "helper" social system where birds from previous nests may stay in the parental territory for several years. Pohnpei kingfishers defend their approximately 8.1 hectare (20 ac) territories from conspecifics (Kesler and Haig 2007a, pp. 386-387). Kesler and Haig (2007b, pp. 769–770) determined that kingfisher home ranges on Pohnpei consist of mixed forest and open areas and at least part of this area includes mature forest. It should be noted that Guam Micronesian kingfisher territories may differ from Pohnpei Micronesian kingfisher territories due to differences in forest structure (Mueller-Dombois and Fosberg 1998, pp. 269–275, 288–291). However, information on the related Pohnpei kingfisher as a surrogate species to the Guam Micronesian kingfisher represents the best available scientific information on kingfisher territory size and home ranges in the Pacific islands to date.

The life expectancy of the kingfisher in the wild is unknown. However, demographic data from captive kingfishers suggest that life history traits such as lifespan and reproductive span differ between the sexes. In captivity, males have a longer lifespan (23 years) than do females (15 years). Both males and females can reproduce at 1 year of age. In captivity, males have been observed to breed as old as 19 years, while females have not been observed to breed beyond the age of 12 (AZA 2014, p. 4).

Current Status

The kingfisher is currently extirpated from the wild. It was considered "fairly common" and occurred throughout forested areas on Guam in 1945 (Baker 1951, p. 229). Populations in southern and central Guam disappeared by the 1960s (Jenkins 1983, p. 25) and 3,023 individuals were recorded in 1981 in northern Guam (Engbring and Ramsey 1984, p. 34). The northern Guam population subsequently declined rapidly, and by 1985, fewer than 30 individuals were recorded on Guam (Marshall 1989, p. 474) and the taxon was considered extirpated from the wild by 1988 (Wiles et al. 2003, p. 1,354). Predation by the brown treesnake is considered the main cause of the decline of the kingfisher population on Guam (Savidge 1987, USFWS 2008a, p. iv). Between 1984 and 1986, 29 kingfishers were captured and sent to zoological institutions in the U.S. mainland (Hutchins et al. 1996, p. 4). Currently, the captive population consists of 155 adult kingfishers (86 males and 69 females) in captive rearing facilities (GMKF Recovery Team 2015, p.3). In 2015, the Service provided funding to the Boorkfield Zoo in Illinois to install 30 new cages, which would increase the population by more than 25 percent.

The goal of the captive kingfisher propagation program is to grow the population while trying to maintain genetic diversity above 90 percent heterozygosity. The current captive population was founded by 16 of the 29 individuals brought into captivity. The current gene diversity is 87.74 percent; with the potential to reach 92.45 percent (AZA 2014, p. 4).

Threats (see also the General Environmental Baseline section of this Opinion)

The Service intends to reintroduce the kingfisher into the wild on Guam. For that effort to be successful, the following threats need to be addressed. The following discussion is adapted from Service (2014, p. 2):

- Loss or Degradation of Habitat
    - Incremental habitat loss due to fire, especially in southern Guam (Department of Agriculture 2010), and urban and agricultural development is increasingly threatening the long-term conservation of the kingfisher because of the continued loss of habitat on Guam.
    - Ongoing and proposed plans by DoD to expand training and operations on Guam are threatening much of the remaining kingfisher habitat.
    - The persistence of large, feral ungulate populations is likely to further degrade remaining forest habitats, thus lowering their value for kingfisher recovery.
- Predation
    - Predation risk from brown treesnakes currently prevents effective reintroduction of the kingfisher to Guam.
- Stochastic Events
    - Typhoons will continue to degrade forest and the affected forest areas may require several years to regenerate.
    - Although birds in the Mariana Islands have evolved with typhoons, typhoons in concert with low population numbers, habitat loss, and behavioral and genetic consequences of captive breeding could negatively affect the recovery of the Guam Micronesian kingfisher.
    - Climate models indicate that hurricanes in the northwestern Pacific are expected to increase in intensity, frequency, and duration by 2200 and continue to increase further into the future (Emanuel et al. 2008, p. 360). These storm increases will likely have a significant effect on habitat and survival of listed species on Guam.

Survival and Recovery Needs

For purposes of this Opinion, the “survival condition” of the kingfisher in the wild represents the level of reproduction, numbers, and distribution necessary to support a persistent population on Guam that is fully protected by the ESA. For purposes of this Opinion, the “recovery condition” of the kingfisher is the survival condition where the threats to the species have been addressed such that the protections of the ESA are no longer necessary to ensure perpetuation of the survival condition of the kingfisher in the wild.

The recovery plan (USFWS 2008a) for the kingfisher calls for a total viable population of 2,000 adult kingfishers on Guam within two subpopulations of 1,000 adults each. One subpopulation would be located in northern Guam, and one subpopulation would be located in southern Guam to reduce the risk of a second extirpation event due to random, stochastic events. For the purpose of population viability modeling to identify viable subpopulations that would meet a minimum population growth rate to achieve recovery, we assumed that the 1,000 adults are 500 breeding pairs (see Environmental Baseline section for kingfisher). The area requirements for a breeding pair (approximately 20.0 acres; Kesler and Haig, 2007a) is less than the combined area for an individual non-breeding adult male (average of 17.5 acres; Kesler and Haig 2007a) and an individual non-breeding adult female (average of 14.1 acres; Kesler and Haig 2007a). Thus the total area for recovery will be minimized by assuming all 1,000 adults are in breeding pairs. Additional area may be needed if a significant number of adult kingfishers forgo breeding in any year.

Each subpopulation must have brown treesnakes and other predators controlled to a level where establishment of a sustainable kingfisher population is feasible and habitat to support this population level must be protected and managed. In the interim, the kingfisher also may need to be established in the wild on other islands outside their native range to reduce the detrimental consequences of long-term captivity and to spread the risk from stochastic events. Although any population(s) established on other islands outside of the kingfisher's historical range would be considered temporary and would not contribute toward the recovery goal of two subpopulations of 1,000 adults each on Guam, the ability to translocate wild birds versus captive birds to Guam would increase success of their recovery and survival on Guam. However, ultimately the recovery of the kingfisher is dependent on having adequate protected habitat free of threats on Guam to provide for the two subpopulations.

New management actions that have occurred in the last five years include:

- Construction of the 136-ac (55-ha) Habitat Management Unit (HMU) brown treesnake and ungulate exclosure fence at Anderson Air Force base. Ungulate removal within the HMU is near completion by DoD per a section 7 consultation requirement (USFWS 2006b).
- In 2014, the USDA-APHIS Wildlife Services, in coordination with the National Wildlife Research Center, the DoD-Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs, conducted a test of aerial application of a brown treesnake toxicant (acetaminophen) over forested areas in AAFB (Dorr et al. 2014, unpublished data). The results of this study within the approximately 136-acre (55-hectare) HMU on AAFB may result in the reduction of snake numbers to a low enough level to allow kingfishers to survive and reproduce within this snake-proofed area on Guam. The knowledge gained from this study will help with potential future improvements to the method and efficiency of the delivery of the acetaminophen to snakes on Guam.
- Construction of a 312-ac (112-ha) ungulate exclosure fence at Northwest Field on AAFB by DoD per Biological Opinion requirements (USFWS 2006b and USFWS 2006c).

- Construction of a multi-species exclosure fence within the fee simple portion of the GNWR at Ritidian Point, Guam.
- Construction of 4,400 ft of coated chain link fence along Route 2A on the perimeter of NBG by DoD per Biological Opinion requirements (USFWS 2010a). The fence provides an ungulate exclosure for the 3,114 ac (1,260 ha) of the main base of NBG. The fencing project is intended to effectively close off Orote peninsula from any new ungulate incursions and only entry control gates will be left unfenced. Ungulate removal within NBG is ongoing.

Recommendations for Future Actions (adapted from USFWS 2008a; USFWS 2014a, p. 3):

- Maintain or increase genetic diversity in the captive kingfisher population by implementing management strategies to exploit the potential gene diversity in the captive populations at the DAWR and AZA facilities.

- Predator Monitoring and Control
  - Continue efforts to develop and refine brown treesnake control techniques and support small-scale and large-scale control and/or eradication efforts on Guam.

- Reintroduction / Translocation
  - Develop a reintroduction plan for the kingfisher on Guam and set aside and protect recovery areas to facilitate its de-listing as soon as possible following the reintroduction of the kingfisher on Guam.

- Protection and restoration of kingfisher recovery habitat, including permanent protection as conservation areas and fencing to exclude brown treesnakes and ungulates.

Status of the Mariana Crow

Legal Status

The Mariana crow ("aga" in Chamorro) was listed as endangered throughout its range in 1984 and critical habitat was designated on Guam and Rota (USFWS 1984, pp. 33881-33885; 2004, pp. 62944-62990). No significant new information regarding the biological status has come to light since listing to warrant a change in the federal listing status of the Mariana crow. On October 28, 2004, the Service designated critical habitat for the Mariana crow on approximately 376 ac (152 ha) in the fee simple portion of the GNWR (USFWS 2004, 117 pp.).

Species Description and Known Range

The Mariana crow is the only member of the genus *Corvus* occurring in Micronesia (Jenkins 1983, p. 25). This species is known historically only from the islands of Rota and Guam, but is now extirpated from Guam. Preliminary genetic studies indicate that the Rota population is most likely a genetic subset of the Guam population (Tarr and Fleischer 1999, p. 946).

Life History and Population Dynamics

Mariana crows are omnivorous, and their diet includes a wide variety of plants and animals, including insect larvae, centipedes, grasshoppers, mole crickets, praying mantis, earwigs, hermit crabs, skinks, geckos, and bird eggs (Jenkins 1983, p. 26, 31; Tomback 1986, p. 399; Ha and Ha 2010a, pp. 8-10; Faegre *in press*). Faegre (*in press*) observed 619 food captures from approximately 36 wild crows and found that 14 percent of food captures were of plant-based foods, and 86 percent were from animal prey; 65 percent of animal prey were of insects or their larvae.

Mariana crows use forested habitats including limestone, strand, ravine, agricultural forests, and secondary forests (Jenkins 1983, p. 25, 32). However, evidence suggests they are most abundant in native limestone forests (Morton et al. 1999, p. 13, 41; Ha et al. 2011a, p. 25; Ha et al. 2011b, p. 240) and nests are found exclusively in native trees (Morton et al. 1999, p. 13, 33; Ha et al. 2011a, 2012, and 2013, pp. 32, 25, and 24-31, respectively). Nesting occurs in closed canopy forests in trees that are on average 17 cm in diameter at breast height, 8.7 m high, and 290 m from roads (Morton et al. 1999, p. 32).

Breeding likely occurs all year on Rota, while peak nesting activity generally occurs between August and February (Morton et al. 1999, p. 12; Ha et al. 2013, p. 31). A minimum of 65 days is necessary to build the nest, incubate the eggs, and rear the brood through fledging (Morton et al.1996, p. 21). Both parents generally participate in all aspects of breeding, although the female incubates most of the time (Morton et al. 1996, p. 21). The incubation period is 21 to 23 days, and the nestling period is 36 to 39 days (Morton et al. 1996, p. 21). After fledging, Mariana crows will typically remain in family groups until the following breeding season, a period that averaged 241 days (SE = 33, median 197 days) for 15 banded family groups (Morton et al. 1996, p. 21). However, the period of parental attendance after fledging varies widely, from 99 to 537 days (USFWS 2005a, p. 19). Mariana crows will often reinitiate the nest cycle within two weeks after abandoning an empty nest, and within four weeks after losing a clutch or brood (USFWS 2005a, p. 18).

Mariana crows generally produce only a single brood per year; however, nest failure and other factors lead to multiple nest attempts each breeding season. From 1996 to 1999, 32 crow pairs on Rota constructed a mean of 2.2 nests per year (SE = 0.14, n = 78), with one pair building as many as seven nests in one season; however, not all nests resulted in egg deposition (Morton et al. 1999, p. 14, 36). Zarones et al. (2014, pp. 6-7) examined 204 active nests on Rota from the 1996 to 2009 breeding seasons and documented, on average, a clutch size of 2.57 (SD = 0.8, n = 82), 1.39 nestlings per nest that hatched (SD = 0.5, n = 106), 1.25 fledglings per nest that fledged (SD = 0.4, n = 68), and an overall nest success rate of 25.7 percent. The proportion of monitored pairs that produced at least one fledgling per breeding season ranged from 0.21 to 0.73, with an overall rate of 0.49 over the entire study period. During the 2013 breeding season, 16 of the 46 pairs (35 percent) successfully fledged young (Kroner 2014, p. 3). The estimated pair breeding success rate for 2013 was down from 60 percent in 2008 (Zarones et al. 2014, p. 7) and 57 percent in 2012 (Ha et al. 2013, pp. 59-60).

Little is known regarding lifespan, age of sexual maturity, and length of reproductive life in Mariana crows. The oldest known wild crow was at least 18 years old when last observed on Rota in 2014 (A. Kroner and S. Faegre, University of Washington, pers. comm. 2014). This same adult male was at least 17 years old when he was last seen feeding a fledgling in 2013. Another male was 14 years old when he last produced a chick in 2009, and a 15-year-old female was observed with a fledgling in 2014 (S. Faegre, University of Washington, pers. comm. 2014). Although it was originally thought that Mariana crows begin breeding around 3.5 years old (Morton et al. 1999, p. 2), a radio-tagged male Mariana crow built his first nest at 16 months of age and was observed feeding a fledging at 21 months of age. Two other banded crows, a female and a male, successfully fledged young in 2011 and 2013, just after they turned two years old (A. Kroner and S. Faegre, University of Washington, pers. comm. 2014). A banded female was observed at a recently failed nest when she was approximately 1.5 years old (A. Kroner and S. Faegre, University of Washington, pers. comm. 2014).

Survival to one year of age for male and female Mariana crows banded on Rota between 1990 and 2010 was 49.9 and 75.2 percent, respectively (Ha et al. 2010b, p. 25). Annual survivorship for adult males and females was 83.5 and 82.7 percent, respectively (Ha et al. 2010b, pp. 25-26). Recent analyses suggest that first-year survival has increased to 0.65 and adult survival has remained steady at about 0.80 since 2010 (R. Ha, University of Washington, pers. comm. 2014).

Mariana crows are known to be highly susceptible to disturbance from human activities (Morton 1996, p. 60, 62, 72; Ha, R. 2015, pers. com.; Ha et al. 2011, p. 5). Based on observations of disturbance of crow nests on Guam, Morton (1996, p. 72) recommended a 300-meter radius for a buffer zone around active crow nests; Morton's recommendations were based on observations of crows reacting to facility/grounds maintenance, brown treesnake trapping, research activities, loud music, and human voices. One Mariana crow nest on Guam was abandoned due to disturbance from maintenance activity and from radio noise coming from a sound system 150 meters away (Morton 1996, p. 62). Ha et al. (2011, p. 236) found that nest sites were always greater than 300 meters from any buildings, and that actual nest sites were almost twice as far from roads and buildings as random sites.

Distribution, Status, and Threats

Guam

Although the Mariana crow was once present throughout Guam (Baker 1951, p. 246), the population has been declining since at least the 1960's (Engbring and Ramsey 1984, p. 30; Engbring et al. 1986, p. 92) and is now extirpated. The last known crow of Guam origin was observed in 2001, and the last known wild Mariana crow that was captive-reared from Rota and released on Guam was observed in 2012 (J. Quitugua, DAWR, pers. comm. 2014). Predation by brown treesnakes is the overriding factor in the extirpation of Mariana crows from Guam (USFWS 2005a).

Suitable habitat for Mariana crows is still present on Guam. As described below in the Environmental Baseline for the Mariana Crow, we estimate that 24,919 acres (10,084 ha) of Mariana crow habitat is left on Guam. More information on crow habitat is provided in the Environmental Baseline for the Mariana Crow section below.

Rota
In 1976, Mariana crows were considered relatively common and widely distributed on Rota (Pratt et al. 1979, p. 234). Reanalysis of the first island-wide survey for the species on Rota in 1982 using current density estimate methods resulted in a population estimate of 1,491 birds (815-3115 birds, 95 percent confidence interval) (Engbring et al. 1986, pp. 92-95; F. Amidon, USFWS, pers. comm. 2014). The most recent island-wide pair survey on Rota was conducted during the 2013 breeding season and documented 46 breeding pairs; an approximate 94 percent decrease in the population since 1982 (Kroner 2014, p. 3). The primary threats to the Mariana crow on Rota are suspected to be predation by cats, human persecution, and habitat destruction (USFWS 2014b, p. 3), but evidence is limited and substantially more research is needed.

Mariana crow telemetry studies were conducted from 2009-2013 and will begin again in the 2014-2015 nesting season. Before telemetry studies began on Rota there was no evidence available to suggest feral cats (*Felis silvestris*) were predating crows. The lack of evidence was likely due to high scavenging and decomposition rates, and the extreme unlikelihood of finding a fresh carcass in time to retrieve any useful information regarding cause of death. Since telemetry efforts began, nine recently-deceased, radio-tagged Mariana crows have been found with evidence suggesting cat predation, and one untagged adult was taken in for care and later died after receiving what a veterinarian confirmed as an infected cat bite (Ha et al. 2013, pp. 5-6).

Recovery Criteria for the Mariana Crow

The following criteria are taken from the Draft Revised Recovery Plan for the Mariana Crow (USFWS 2005a).

1. The Mariana crow may be considered for downlisting from endangered to threatened status when all of the following criteria are met:
    a. Mariana crow occur in two populations, one on Rota consisting of a minimum of 75 territorial pairs, and 1 in northern Guam consisting of a minimum of 75 territorial pairs;
    b. Both populations are stable or increasing based on quantitative surveys or demographic monitoring that demonstrates an average intrinsic growth rate (λ) not less than 1.0 over a period of at least 10 consecutive years;
    c. Sufficient Mariana crow habitat, based on quantitative estimates of territory and home range size, is protected and managed to achieve criteria 1 and 2 above;
    d. Brown treesnakes and other introduced predators found to be a threat to Mariana crow are controlled at a sufficient level to achieve criteria 1 and 2 above;
    e. Brown treesnake interdiction efforts are in place to prevent the establishment of brown treesnakes on Rota; and
    f. Efforts to resolve Mariana crow and landowner conflicts have been implemented.

2. The Mariana crow may be removed from the Federal list of threatened and endangered species when all of the following criteria are met:
    a. Mariana crow occur in three populations, one on Rota consisting of a minimum of 75 territorial pairs, one on northern Guam consisting of a minimum of 75

territorial pairs, and one in southern Guam consisting of a minimum of 75 territorial pairs;

b. All three populations are stable or increasing based on quantitative surveys or demographic monitoring that demonstrates an average intrinsic growth rate (λ) not less than 1.0 over a period of at least 10 consecutive years;
c. Sufficient Mariana crow habitat, based on quantitative estimates of territory and home range size, is protected and managed to achieve criteria 1 and 2 above;
d. Brown treesnakes and other introduced predators are controlled at a sufficient level to achieve criteria 1 and 2 above;
e. Brown treesnake interdiction efforts are in place to prevent the establishment of brown treesnakes on Rota;
f. Efforts to resolve Mariana crow and landowner conflicts have been implemented; and
g. A monitoring plan has been developed and is ready for implementation, to cover a minimum of five years post-delisting, to ensure the ongoing recovery of the species and the continuing effectiveness of management actions.

Since the draft revised recovery plan was published in 2005, additional work on population viability of the Mariana crow has occurred. This recent assessment of population viability indicated that 75 territorial breeding pairs may not be viable over the long-term due to potential inbreeding depression (O'Grady et al. 2006) and projected increases in tropical storm intensity, duration, and frequency (Emanuel et al. 2008) and that 100 territorial breeding pairs may be a more appropriate recovery target (Amidon 2012, unpubl. data).Therefore, the Service now considers 100 territorial breeding pairs as our recovery target for each of the three regions identified above.

<u>Survival and Recovery Needs on Rota</u>

Management and recovery actions that have occurred in the last five years (USFWS 2014b, pp. 3-4) include:

- Banding: The University of Washington's Rota Avian Behavioral Ecology Program (RABEP) has banded 80 Mariana crows since 2005 (Ha et al. 2013 pp. 5-6; Kroner 2014, p. 3). Re-sight data has been used to develop age-specific survivorship models.
- Nest monitoring: RABEP have conducted nest monitoring for the Mariana crow on Rota since 2005. Efforts provide data that is used for analyses of nesting success and demographics.
- Mariana crow mortality monitoring: From 2009 to 2013, transmitters were attached by RABEP to 32 Mariana crows that were tracked and monitored for the life of the battery (n=14), until death of the bird (n=12), loss of the signal (n=1), or until the harness was removed (n=5) (Ha et al. 2013, pp. 5-6).
- Habitat and natural process management and restoration: The Mariana Crow Conservation Area (MCCA) was established on Rota through an MOA between the Commonwealth of the Northern Mariana Islands (CNMI) and PIFWO (USFWS 2011, pp. 1-4).
- Human interaction monitoring and management: The Mariana Crow Incentive Plan (2012-2014) compensated participants on Rota with a monetary award in exchange for

protecting occupied crow habitat and allowing access for population monitoring and feral cat control on their land (USFWS 2012a, pp. 1-8). The goal of the plan was to change human perceptions of the Mariana crow and protect valuable habitat.

- Predator monitoring and control: The University of Washington Rota Island Feral Cat Removal Project began cat removal efforts on Rota in February 2012 (Ha et al. 2013, p. 49). As of June 2014, the project removed 589 cats from areas in and around crow territories (Leo 2014, p. 3). The Institute for Wildlife Studies took over cat control efforts on Rota in October 2014.
- Captive care: Captive care of sick or injured crows is conducted on an as-needed basis by RABEP captive care specialists.
- Release of rehabilitated crows: Crows are released into the wild after they have been rehabilitated and reared to at least 2 years of age. Two crows were successfully released after being taken in as fledglings and reared to adulthood in captivity (Hannon 2014, pp. 1-3).
- Strategic planning / threats management planning: The Service in cooperation with the Mariana Crow Recovery Team conducted an exercise in structured decision making (SDM) to determine which actions should be taken now and over the next several years to maximize the probability of preventing extinction and set the foundation for at least one stable to increasing population in the wild (see below). The two primary objectives driving the SDM were to prevent the extinction of the Mariana crow and to ensure a viable stable or increasing population in the wild.

Recovery actions still needed to prevent the extinction of the Mariana crow on Rota:

- Implement priority actions identified in the Mariana crow SDM exercise:
    - Predator control on Rota
    - Phased approach to captive propagation, beginning with rear and release program
- Identify and manage sources of adult and juvenile mortality
- Improve public perception of the crow to reduce potential human persecution
- Protect important habitat on Rota and Guam
- Research and reduce the threat of the brown treesnake on Rota and Guam

<u>Survival and Recovery Needs on Guam</u>

Management and recovery actions that have occurred in the last five years include:

- Construction of a 312-ac (112-ha) ungulate exclosure fence at Northwest Field on AAFB by DoD per Biological Opinion requirements (USFWS 2006b). However, the DON has proposed to build the proposed LFTRC within this mitigation site, which is also located on Overlay Refuge.
- Construction of the 136-ac (55-ha) Habitat Management Unit (HMU) brown treesnake and ungulate exclosure fence at AAFB. Ungulate removal within the HMU is near completion by DoD per a section 7 consultation requirement (USFWS 2006c).
- Construction of a multi-species exclosure fence within the fee simple portion of the GNWR at Ritidian Point.
- Construction of 4,400 ft of coated chain link fence along Route 2A on the perimeter of NBG by DoD per Biological Opinion requirements (USFWS 2010a). The fence provides

an ungulate exclosure for the 3,114 ac (1,260 ha) of the main base of NBG. The fencing project is intended to effectively close off Orote peninsula from any new ungulate incursions and only entry control gates will be left unfenced. Ungulate removal within NBG is ongoing.

- In 2014, the USDA-APHIS Wildlife Services, in coordination with the National Wildlife Research Center, the DoD-Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs, conducted a test of aerial application of a brown treesnake toxicant (acetaminophen) over forested areas in AAFB (Dorr et al. 2014, unpublished data). The results of this study within the approximately 136-acre (55-hectare) HMU on AAFB may result in the reduction of snake numbers to a low enough level to allow kingfishers to survive and reproduce within this snake-proofed area on Guam. The knowledge gained from this study will help with potential future improvements to the method and efficiency of the delivery of the acetaminophen to snakes on Guam.

Recovery actions still needed to allow the reintroduction of the Mariana crow to Guam

- Development and implementation of large-scale, long-term methods for brown treesnake control that will reduce the brown treesnake population on a landscape level.
- Protection and restoration of Mariana crow habitat in northern and southern Guam including in-perpetuity protection as conservation areas and fencing to exclude brown treesnakes and ungulates.
- Continued management of the fenced exclosures at Northwest Field, the HMU, and NBG as described above.

Status of the Guam Rail

Legal Status

The Guam rail (*Gallirallus owstoni*; ko'ko' in Chamorro; hereafter, rail) was listed as endangered on Guam in 1984 (USFWS 1984, pp. 2485-2488). An experimental, nonessential population of rails occurs on Rota. The rails on Rota are treated as threatened species, rather than as endangered species, for the purposes of sections 4(d) and 9 of the ESA (USFWS 1989, pp. 43966-43970). Critical habitat for the rail has not been designated on Guam.

Species Description and Current Known Range

The Guam rail is endemic to the island of Guam in the Mariana Islands. The species is derived from the closely related barred rail (*Gallirallus torquatus*) of the Philippines and Indonesia (Ripley 1977). No closely related species occur in Micronesia. The rail is medium-sized and capable of short burst of flight (1 to 2 m), but is seldom observed in flight (Jenkins 1979, p. 404). Rails are about 28 cm (11 in) in total length (Taylor 1998, p. 258). Guam rails have elongated and laterally compressed, particularly in the neck and breast regions, bodies allowing the birds to move rapidly through dense vegetation.

The rail is extirpated in the wild on Guam but persists in captivity at the Guam DAWR facility and twelve U.S. mainland zoos (AZA 2014, p. 1). Efforts to establish a nonessential experimental population on the island of Rota has been underway since 1989. The establishment

of a wild population on Rota will ensure that a source wild population is available for future repatriation of rails to Guam when brown treesnakes have been controlled or eradicated on Guam (USFWS 1989, p. 43967). On Cocos Island (a small islet approximately 1.6 km (1 mi) off the southern coast of Guam), breeding pairs of rails have become established in a predator-controlled habitat through efforts associated with a Safe Harbor Agreement and activities permitted under section 10(a)(1)(A) of the ESA (USFWS 2008b; USFWS 2008c, p. 1-2). This agreement, signed in 2008, has allowed for the establishment of Guam rails on private land owned and managed by Cocos Island Resort and public land owned by the Government of Guam and managed by the Guam Department of Parks and Recreation. The rails are monitored to learn more about survivorship, breeding behavior, habitat preference and nesting success.

Life History

The Guam rail formally occurred in most habitat types on Guam, including forest, savanna, secondary grassland, agricultural areas, mown grass bordering scrub communities, mixed woodland and scrub, and fern thickets (Jenkins 1979, p. 405-406; Taylor 1998, p. 259). Guam rails were predominantly observed using scrubby secondary growth area and the edges of mixed forest areas (Jenkins 1979, Engbring and Ramsey 1984). Jenkins (1979) reports that they were seldom observed in the interior of mature limestone forests or savanna areas and did not occur in wetlands. As Guam was probably mostly limestone forest before the arrival of humans (Forsberg 1960), the rail may have become more common after much of the mature forest had been converted to scrubby second-grown or mixed forest (Engbring and Ramsey 1984).

The diet of the Guam rail is comprised of snails, slugs, lizards, insects, and vegetable matter such as seeds and palm leaves; the rail feeds on food items from the surface of the ground, especially snails and slugs after rain showers (Jenkins 1979, pp. 405-406). They chase low-flying insects and feed on seeds and flowers from low grasses and shrubs, stretching up to reach items 40 cm above the ground. They often forage along edge habitat but seldom venture far from cover (Jenkins 1979, p. 404; Taylor 1998, p. 259). During the dry season the rails were reported to damage crops such as tomatoes, cucumbers and melons, but such damage probably resulted from their obtaining moisture rather than food. Rails also ingest coral chips and pieces of small shell for grit (Jenkins 1979, p. 405-406). They are able to forage at night, but are most active during the dawn and dusk (Jenkins 1979, p. 404-406; Taylor 1998, p. 259).

Guam rails are monogamous and breed throughout the year (Jenkins 1979, p. 406; USFWS 1990a, p. 9), with a possible peak breeding period during the rainy season (May-October) (Perez 1969 as cited in the USFWS 1990a, p. 9). They can lay two to four eggs per clutch and both parents share in the construction of the nest. Nests are located on dry ground in dense grass, are a shallow cup of interwoven loose and rooted grass, and are built by both sexes (Jenkins 1979, p. 406; Taylor 1998, p. 260). Incubation of eggs is 21 days (Beck 1985, unpubl. data cited in USFWS 1990a, p. 9) with both sexes sharing the nesting duties. The eggs hatch asynchronously, and the young are precocial, leaving their nests within 24 hours of hatching to forage with the aid of their parents (Jenkins 1979, p. 406).

In captivity, Guam rails can live up to 17 years, while females can reach 16 years old. Median life expectancy for captive males is 9.5 years; captive female median life expectancy is slightly lower at 5.7 years (AZA 2014, p. 5). The median life expectancy of Guam rails in the wild is unknown. Both males and females can begin reproducing at approximately 5 months old. Males have bred until the age of 11, and females as old as 9 years old have successfully reproduced. Breeding in captivity is complex, as males can be extremely aggressive and have at times injured or killed females. In captivity, clutch sizes range from one to six eggs, averaging 2.1 eggs, with an incubation period of 19 days.

Population Dynamics and Status

Guam rails were once distributed throughout Guam (USFWS 1990a, p.7). They first disappeared from southern Guam in the early 1970's (Jenkins 1979). In 1981, the population was reduced to approximately 2,300 individuals and only existed in northern Guam (Engbring and Ramsey 1984, p. 28). In 1983, estimates of the population size indicated that fewer than 100 individuals remained on Guam and 22 individuals were moved to captive propagation facilities (Haig and Ballou 1995, p. 446). The rail was extirpated on Guam by 1987 (Wiles et. al. 1995, p. 38).

There have been two releases of rails on Guam since this species has been listed as endangered. In 1998, 16 rails were released in "Area 50" at AAFB in northern Guam (Beauprez and Brock 1999). A temporary brown treesnake barrier was constructed around Area 50 and snake populations in the barrier were reduced through snake control. Breeding was documented, although the small population was extirpated by predators, mainly feral cats. In 2003, a second release of 44 rails occurred in a brown treesnake-reduced area of the Munitions Storage Area on AAFB (P. Wenninger, DAWR, pers. comm. 2008). Efforts to reduce cat predation on the rails were limited due to difficulty in obtaining approval to control cats in the area. By 2008, rails no longer were present in the Munitions Storage Area (P. Wenninger, DAWR, pers. comm. 2008; USFWS 2009b, p. 5).

On Rota, over 800 captive-bred Guam rails have been released between 1989 and 2008 in an effort to establish an experimental wild population (Witteman and Beck 1990, Beck 1991, Brock and Beck 1995, Beauprez and Brock 1996-1999a, P. Wenninger, DAWR, pers. comm. 2008). The introduction to the island of Rota, which is outside the historical range of the species, was justified because primary habitat on Guam had been altered through the establishment of the introduced, predatory brown treesnake (USFWS 1989, p. 43966). Improvements in managing the captive flock have increased the number of rails available for each release and the larger release cohorts have increased the likelihood of population establishment. Population estimates in 2002 indicated 100 rails were present on the northeast end of Rota near two release sites, Duge and Saguagaga. Based on surveys conducted in July 2013, there are approximately 125 rails on Rota (S. Medina, DAWR, pers. comm. 2013). However, released birds still suffer mortality primarily due to feral cat predation, which slows population establishment. Current release strategies include intensive cat trapping and a review and update of monitoring protocol for rails on Rota.

On Cocos Island, sixteen captive bred rails were released in November 2010. Prior to the release, rats (*Rattus* spp.) were eradicated on Cocos Island. Guam rails are successfully breeding

(16 nests and 12 chicks have been observed) on Cocos Island. Sightings of unbanded adults have been documented, which suggests that chicks are surviving into adulthood (S. Medina, DAWR, pers. comm. 2013).

As of December 30, 2014, the Guam rail captive population is distributed among 14 institutions, with the Guam DAWR facility holding 116 birds and the 13 Association of Zoos and Aquariums (AZA) facilities housing 46 birds. At that time, current gene diversity was 88 percent in the DAWR facility and 83 percent at the AZA facilities (AZA 2014, p. 4). When gene diversity falls below 90 percent in a founding population, it is expected that reproduction will be compromised by, among other factors, lower hatch rates, small clutch sizes, and greater neonatal mortality (Ross et al. 2006). However, there still remains the potential to increase the gene diversity in DAWR and AZA facilities over the long term (AZA 2014, p. 6). The DAWR and AZA work cooperatively and closely coordinate on the transfer of birds to facilities, as needed, in order to manage the genetic diversity within the captive Guam rail population (AZA 2014, p. 4). These facilities also support the releases of individuals into the wild on Rota.

Threats (adapted from USFWS 2014c, p. 2-5):

- Loss or degradation of habitat –
    - Agricultural and urban development is a factor in habitat loss and degradation on Guam.
    - Nonnative snake predation. The brown treesnake continues to limit efforts to reestablish rails on Guam.
    - Cat predation. Feral cats continue to limit efforts to reestablish rails on Guam and impact the rail experimental population on Rota.
    - Rodent predation. Because rats have been eradicated and are absent from Cocos Island, there is continued efforts to prevent the reintroduction of rats to this island. Rats can negatively impact rails by consuming eggs and preying on chicks.
    - Stochastic events – Although birds in the Mariana Islands have evolved with typhoons, typhoons in concert with low population numbers, habitat loss, and behavioral and genetic consequences of captive breeding could negatively affect the recovery of the Guam rail.

<u>Survival and Recovery Needs</u>

Before the Guam rail is considered for downlisting from endangered to threatened, the repatriation of 1,000 birds to northern Guam and 1,000 birds to southern Guam (total = 2,000 individuals; USFWS 1990a, p. 33) would need to occur and brown treesnakes would need to be controlled on Guam (USFWS 1990a, p. 33-34). No criteria were defined for delisting. Traill et al. (2009) proposed a minimum population target of 5,000 individuals as an appropriate target for species conservation.

New management actions that have occurred in the last five years include:

- Brown treesnake eradication and control using acetaminophen, as a toxicant to the snake, is being conducted within the approximately 136-acre (55-hectare) Habitat Management

Unit on AAFB. In 2014, the USDA-APHIS Wildlife Services, in coordination with the National Wildlife Research Center, the DoD-Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs, conducted a test of aerial application of a brown treesnake toxicant (acetaminophen) over forested areas in AAFB (Dorr et al. 2014, unpublished data). The results of this study indicate that development of a scalable automatic bait application system could be used in the near future for large landscape scale brown treesnake control and suppression (Dorr et al. 2014, unpublished data). The project may result in the reduction of snake numbers to a low enough level to allow for rails to survive and reproduce within this snake-proofed area on Guam.

- Management unit planning – On Guam, a management plan, funded by DoD, is currently being developed for the HMU on AAFB. The plan will consider the reintroduction of Guam rails to this site.
- Predator control – Cat control is conducted on Rota and will continue with increased efforts from additional funding by the Service in fiscal year 2015.

Recommendations for Future Actions (adapted from USFWS 2014c, p. 3):

- Maintain or increase genetic diversity in captive rail population – Implement management strategies to exploit the potential gene diversity in the captive populations at the DAWR and AZA facilities.
- Predator monitoring and control
    - Continue efforts to develop and refine brown treesnake control techniques and support small-scale and large-scale control and/or eradication efforts on Guam.
    - Continue and increase efforts to control and eradicate brown treesnakes on Guam and prevent introduction of brown treesnakes on other Mariana Islands.
    - Implement large-scale cat control and/or eradication.
- Reintroduction / translocation
    - Consider alternative sites for establishing other experimental populations.
    - Develop reintroduction plan for Guam rails on Guam and set aside and protect recovery areas for these rails on Guam.
- Revise recovery objectives and criteria – Revise recovery plan.
- Population monitoring and viability analysis – Continue population and demographic monitoring on Rota and Cocos Island.
- Protection and restoration of Guam rail recovery habitat including in-perpetuity protection as conservation areas and fencing to exclude brown treesnakes and ungulates.

Status of the Mariana Fruit Bat

Legal Status

The Mariana fruit bat (*Pteropus mariannus mariannus*; “fanihi” in Chamorro; hereafter, fruit bat) was listed as endangered on Guam in 1984, but was downlisted to threatened in 2005 when it was determined that all fruit bats on Guam and throughout the Commonwealth of the Northern Mariana Islands (CNMI) comprise a single subspecies (USFWS 2005b, p. 1191). In 2004 critical habitat for the fruit bat was designated at the Guam National Wildlife Refuge Ritidian Unit (USFWS 2004, p. 62944).

Species Description

The Mariana fruit bat is a medium-sized fruit bat in the family *Pteropodidae* that weighs 0.66 to 1.15 pounds. Males are slightly larger than females. The underside (abdomen) is black to brown with gray hair interspersed that creates a grizzled appearance. The shoulders (mantle) and sides of the neck are bright golden brown, but may be paler in some individuals. The head varies from brown to dark brown. The well-formed, rounded ears and large eyes give the face a canine appearance.

Current Known Range

The Mariana fruit bat is a subspecies endemic to the Mariana archipelago (Guam and the CNMI), where it was historically present on every island except Uracas (Wiles et al. 1989, p. 69). The fruit bat is currently thought to be extirpated from Tinian (USFWS 2009c, pp. 269-272; USFWS 2014d, pp. 2-3).

Life History

The diet of the fruit bat is comprised of fruits, nectar, pollen, and some leaves (Wiles and Fujita 1992, pp. 26-31; Wiles and Johnson 2004, p. 591), and it uses several forest types for foraging, roosting, and breeding, including native primary and secondary limestone forest, volcanic (or ravine) forest, old coconut plantations, and groves of *Casuarina equisetifolia* (Glass and Taisacan 1988, pp. 6–13; Worthington et al. 2001, pp. 137–138; Wiles and Johnson 2004, pp. 589–591). Most fruit bats roost during the day in maternity colonies at sites to which they show a high level of fidelity (unless disturbed). A small proportion of fruit bats, usually males, roost alone or in small groups called bachelor colonies. Fruit bats will abandon roost sites if disturbed and have been reported to move to new locations as far as 10 kilometers (km) (or 6 miles) away (USFWS 1990b, p. 9). Any fruit bat colony can be disturbed by humans close enough to be smelled; which can be up to 200 m (656 ft) away (J. Boland, pers. obs. 2009). In addition, fruit bats have flushed from maternal roosts in response to aircraft overflights on Guam with noise levels above 90 dB (SWCA 2012, p. 23, 37). When colonies are disturbed, fruit bats may be negatively affected in a variety of ways, including but not limited to, destruction of social structures, direct injury, disruption of energetic and hormonal balance, forced relocation to lower quality habitat, abandonment of non-volant young, and disruption of breeding activities (Wingfield et al. 1998, pp. 191-204; Heideman 2000, pp. 469-499; Klose et al. 2006, p. 341; CNMI 2010, p. 7).

Within colonies, fruit bats typically group themselves into harems (one male and 2-15 females) or bachelor groups (predominantly males; Wiles 1987a, pp. 93-94; J. Boland, unpubl. data). Unlike most Pteropus species, mating and the presence of nursing young have been observed in Mariana fruit bats throughout the year on Guam and Rota (Wiles 1987a, pp. 93-94; CNMI 2010, p. 12; CNMI 2011, p. 12; J. Boland, unpubl. data). Data is limited for age of sexual maturity,

reproductive rates, length of gestation, and lifespan of Mariana fruit bats. Female bats of the family Pteropodidae generally have a gestation period of 4.6- 6.3 months and one offspring per year (Pierson and Rainey 1992, pp. 1-17). Many Pteropus species typically do not give birth before 18 months of age (Pierson and Rainey 1992, pp. 1-17; McIlwee and Martin 2002, p. 76). Based on these reproductive traits, several authors have suggested that Pteropus bats have a low maximum population growth rate and thus a slow rate of recovery when a population is diminished (Pierson and Rainey 1992, p. 1-17; McIlwee and Martin 2002, p. 76).

Population Dynamics and Status

The total population of the Mariana fruit bat is estimated to be approximately 6,000 animals (USGS 2010, p. 36; CNMI 2011, p. 6). Surveys suggest populations are stable or declining throughout most of their range (Table 5). A notable exception to the declining trend is the island of Rota, where the population has increased since 2008 (CNMI 2008, p. 11; CNMI 2011, p. 6). The population increase on Rota is due to a recent decrease in illegal hunting at roost sites of fruit bat maternity colonies, and the decrease in illegal hunting can be attributed to an increase in enforcement of wildlife regulations that began in 2009 (CNMI 2010, pp. 7-9).

The fruit bat population on Rota is estimated at approximately 2600 (CNMI 2011; p. 6). Although comprehensive surveys have not been conducted on Saipan, there have been no confirmed observations of maternity colonies in recent years, and the island-wide population is expected to be less than 50 individuals (T. Willsey, CNMI DLNR, pers. comm. 2014). The population of fruit bats on Guam is estimated to be less than 30 bats (SWCA 2013, pp. 19-22; DON 2013b, pp. 11-15). The most recent and last colony to exist on Guam was at Pati Point, but recent surveys indicate that this colony no longer exists (Figure 5) (SWCA 2013, pp. 13). On July 3, 2014, a survey was conducted on Andersen Air Force Base which resulted in 10 observations of bats; analyses are still in progress to determine duplicate observations and detection probability given the amount of area surveyed on the Base (DON 2014c).

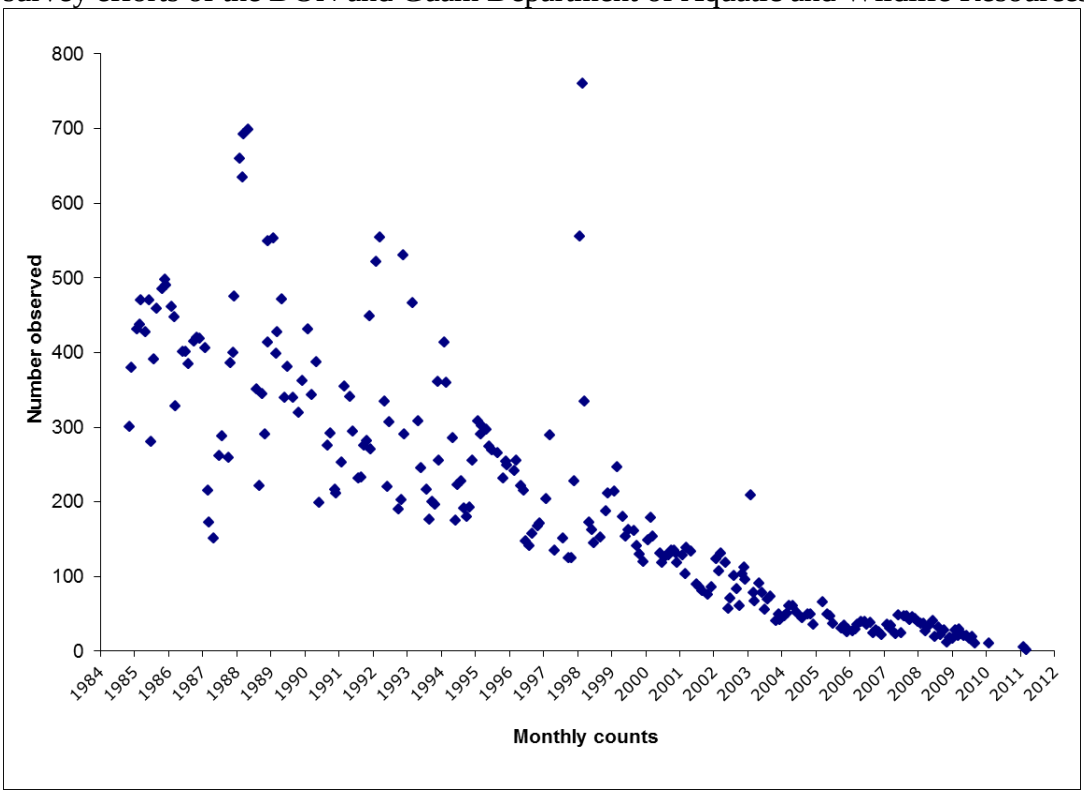
Table 5. Summary of population estimates for the Mariana fruit bat throughout the Mariana archipelago from 1983-2010 (USFWS 2014d, p. 2).

Island	**Area square mile (square kilometer)**	**Estimated minimum number of bats 1983-1984[1]**	**Estimated number of bats 2000[2]**	**Estimated number of bats 2008[3]**	**Maximum number of bats counted 2010[4]**
Maug	0.8 (2.0)	< 25	not surveyed	not surveyed	11
Asuncion	2.9 (7.4)	400	not surveyed	not surveyed	573
Agrihan	18.3 (47.4)	1,000	1,000	not surveyed	858
Pagan	18.4 (47.7)	2,500	1,500	not surveyed	1,017
Alamagan	4.3 (11.0)	0[5]	200	not surveyed	86
Guguan	1.5 (4.0)	400	350	not surveyed	226
Sarigan	1.9 (5.0)	125	200	not surveyed	157

Anatahan	12.5 (32.3)	3,000	1,000	not surveyed	150
Saipan	47.5 (122.9)	< 50	not surveyed	not surveyed	not surveyed
Tinian	39.3 (101.8)	< 25	not surveyed	0	not surveyed
Aguiguan	2.7 (7.0)	< 10	150-200	40-60	not surveyed
Rota	32.9 (85.2)	800-1,000	not surveyed	1019[6]	2,283[8]
Guam	212 (549.0)	425-500	119-179	<40[7]	not surveyed

[1] Wiles *et al*. 1989. Count methods: Evening dispersal counts at colonies and evening station counts of solitary fruit bats. All counts considered to be minimum estimates.
[2] Cruz *et al*. 2000a-f. Count methods: Evening dispersal counts at colonies, evening and morning station counts of solitary fruit bats. Data for Guam represents the range of 10 counts conducted in a separate effort in 2000 (A. Brooke pers. comm. 2007 *in* USFWS 2009d).
[3] Data for Tinian and Aguiguan from USFWS (2008). Data for Rota from CNMI (2008).
[4] Data for Northern Islands from USGS (2010). Data for Rota from CNMI (2010).
[5] Alamagan was inadequately surveyed in 1983 and may have held some fruit bats.
[6] Direct counts at all maternity colonies plus departure counts at extra-colonial sites in July 2008
[7] Brooke (2008) and SWCA (2013)
[8] Direct counts for all maternity colonies in May 2010 plus departure/arrival counts at extra-colonial sites in April 2010

Figure 5. Direct counts of fruit bats at the historical fruit bat maternity colony at Pati Point on Andersen Air Force Base from 1984-2011 (A. Brooke, pers. comm. 2014, data compiled from survey efforts of the DON and Guam Department of Aquatic and Wildlife Resources).



Threats (adapted from USFWS 2014d, pp. 4-5):

- Loss or degradation of habitat:
    - Human development is a factor in habitat loss on all inhabited southern islands and on northern islands with military activity.

  - Feral ungulates and Philippine sambar deer (*Rusa marianna*) degrade habitat on many of the Mariana Islands. The successful eradication of feral ungulates from Sarigan and Anatahan suggests that similar projects may succeed on other islands. However, once grazing and browsing pressure is removed, the potential invasion of native forest by alien plants may be a more difficult and long-term recovery issue.
- Human disturbance:
  - Illegal hunting is a threat to Mariana fruit bats throughout its range. Although law enforcement activity has increased since 2009 (CNMI 2008, 2009a-b, 2010), illegal hunting of fruit bats on Rota continues and will likely resume to historical levels unless consistent, effective law enforcement efforts in tandem with education and outreach programs continue. Fruit bats appear to be extirpated from Tinian and are declining on Saipan and Guam, and illegal hunting is thought to have greatly contributed to the decimation/decline of those populations (Wiles and Payne 1986; Wiles and Glass 1990; Sheeline 1991; Stinson et al. 1992; Wiles 1992; Esselstyn et al. 2006). As with Rota, recovery of the fruit bat on human-inhabited islands will not likely be possible without strong education programs combined with effective control of illegal hunting.
- Nonnative snake predation – The brown treesnake is thought to prey on non-volant young left at the roost during the night, thus preventing the recruitment of young bats into the breeding population. Effective control of brown treesnakes must be achieved before fruit bat population on Guam can recover. The interdiction, control, and ultimate eradication of brown treesnakes in the archipelago are the focus of major, ongoing projects, and the fruit bat is likely to benefit from these efforts in the long term. This prognosis would change drastically if the brown treesnake were to become established widely throughout the archipelago.
- Stochastic events – Typhoons and volcanic eruptions result in mortality, reduced population viability, and habitat loss. Natural disasters can be especially damaging to the viability of smaller fruit bat populations (e.g., on Guam, Saipan, Aguiguan, and Maug). The significant loss of habitat on Anatahan after the volcanic eruption in 2003 resulted in the loss of a substantial fruit bat population that has not yet recovered.

<u>Survival and Recovery Needs</u>

Before the Mariana fruit bat is considered for delisting, the Service proposes that stable or increasing populations should exist on three of the five southern islands (Saipan, Tinian, Aguiguan, Rota, and Guam), and six of the northern islands where Mariana fruit bats have persisted historically (Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug; USFWS 2009d, pp. 37-39). Of the six northern islands that require stable or increasing fruit bat numbers, two of these must include Pagan, Anatahan, or Agrihan. Since publication of the draft revised recovery plan in 2009, new information on the Mariana fruit bat has resulted in changes to how we look at recovery for the species. We now consider recovery in terms of stable or increasing subpopulations of sufficient size distributed across Guam and the Mariana Islands. To meet recovery objectives, stable or increasing fruit bat subpopulations should at a minimum be distributed on the islands that currently have extant populations (USFWS *in*

review). The final version of the Mariana fruit bat recovery plan is currently in review, and recovery criteria stated here may change upon completion of the final plan

Of the six northern islands, the only evidence for a possibly increasing population is on Asuncion (USGS 2010, p. 33). Of the five southern islands, only Rota has achieved an increasing population. Although a conservation area containing some important habitat for fruit bats was recently established on Rota (USFWS 2011, pp. 1), there is not currently enough protected fruit bat habitat on Rota, Guam, Tinian, or Saipan to support substantial population recovery on any of those islands. Even if sufficient habitat is set aside in conservation to support recovery of populations, controlling illegal hunting may continue to be a challenge that limits recovery of the species.

New management actions (adapted from USFWS 2014d, pp. 4-5):

- Monitoring and analysis of population viability – Technical assistance was obtained in 2008 to analyze fruit bat survey data from Rota and refine survey methods and the existing monitoring program (CNMI 2008, 2009a-b, 2010).
- Law enforcement and compliance – On the island of Rota, the Service and the CNMI Division of Fish and Wildlife (DFW) have increased law enforcement actions since 2009. With support from Service law enforcement and federal discretionary funds, CNMI Conservation Officers have participated in nine fruit bat-related arrests on Rota, all resulting in convictions. Enforcement actions have contributed to a decrease in illegal hunting, and approximate doubling of the fruit bat population on Rota.
- Development of monitoring protocol – Experts were consulted to review and refine survey methods for fruit bats to develop standardized, quantitative monitoring that permits data comparison at multiple timescales. Standard operating procedures were developed for CNMI DFW (CNMI 2009a) and a monitoring protocol was developed for Service for fruit bat surveys in the Northern Mariana Islands (Mildenstein and Boland 2010).
- Surveys / inventories – Surveys were conducted on Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug in 2010 (USGS 2010). A base-wide survey was conducted on AAFB in 2014 (DON 2014c)
- Habitat and natural process management and restoration – The Mariana Crow Conservation Area was established on Rota through an MOA between the CNMI and the Service (USFWS 2011). This area encompasses 444 hectares (1097 acres) and contains some high-quality foraging and roosting habitat for fruit bats.
- Outreach and education – Discussions were initiated with CNMI DFW and CNMI Public School System (PSS) to develop outreach and education materials and opportunities to curb illegal hunting. Several education and outreach programs were funded by the Service, Bat Conservation International, Disney, and Lubee Bat Conservancy, and these programs were implemented on Rota through a local non-profit. An education curriculum was developed with the CNMI PSS, but has not yet been implemented.

Recommendations for Future Actions (adapted from USFWS 2014d, pp. 5-6):

- Outreach and education – Decrease illegal hunting by developing and supporting outreach and education programs that emphasize the value of and need to protect fruit bats and other native plant and wildlife species in the Marianas.

- Law enforcement and compliance – Decrease illegal hunting by continuing to provide technical and financial assistance to CNMI DFW enforcement officers to facilitate apprehension and prosecution of poachers.
- Ungulate monitoring and control
    - Decrease habitat loss by eradicating feral ungulates on islands where they exist, and preventing their introduction on other islands where fruit bat recovery is desired.
    - Decrease habitat loss by controlling deer in areas of high-quality fruit bat habitat.
- Habitat and natural process management and restoration
    - Improve habitat through support of native forest restoration, especially on Guam, Saipan, and Tinian.
    - Set aside enough high-quality habitat including in-perpetuity protection of conservation areas to support the recovery of fruit bat populations on three of the five southern islands.
- Human interaction monitoring and management
    - Limit military training in areas occupied by fruit bats to activities that will not disturb fruit bats or their habitat.
    - Limit urban development in areas occupied by or potentially used for roosting and foraging by fruit bats.
- Population monitoring and viability analysis – Continue monitoring fruit bat numbers on Anatahan to understand the fluctuation of numbers in response to volcanic activity.
- Population monitoring and viability analysis – Hire and ensure consistent employment of a full-time, resident DFW or Service biologist who is charged with monitoring the fruit bat population on Rota according to established protocols (CNMI 2009a, Appendix 1).
- Predator / herbivore monitoring and control
    - Development and implementation of large-scale, long-term methods for brown treesnake control that will reduce the brown treesnake population on a landscape level on Guam.
    - Continue and increase efforts to prevent introduction of brown treesnake populations on other Mariana Islands.

Status of *Serianthes nelsonii*

Legal Status

Serianthes nelsonii, "hayun lågu" or "tronkon guafi" in Chamorro was listed as endangered in 1987 (USFWS 1994, p. 1). No critical habitat has been designated for this species.

Species Description and Current Known Range

Serianthes nelsonii is a large tree in the pea family (Fabaceae, subfamily Mimosoideae). Adult trees can reach heights over 30 m (98 ft) and diameters over 1.5 m (4 ft) (USFWS 1994, p. 11). Its bark is smooth and light brown in color. Fine rusty hairs cover the flowers, seed pods, and newer vegetation growth. Leaves are doubly pinnate with many pairs of leaflets. Flowers are brush-like with pink and white coloration, and fruits are hard, dry, brown pods (Stone 1970, p. 304). Seedlings closely resemble those of a small introduced tree, *Leucaena leucocephala*

(tangantangan), but can be discerned by the fine pubescence on new leaf buds (USFWS 1994, p. 6).

Serianthes nelsonii is endemic to the islands of Guam and Rota (USFWS 1987, p. 4907). Recorded specimens on Guam were mostly from northern limestone forests, but a few trees were recorded in southern clay soils (USFWS 1994, p. 8). Currently, the last remaining wild adult tree on Guam is located at NWF, AAFB in northern Guam. A new fence was constructed to exclude ungulates in 2012 by AAFB, the *Serianthes* tree and seedlings are monitored monthly by DoD. DoD has conducted research on limiting factors for seedlings, fallen seeds collected and stored for future use. In 2014, 31 *S. nelsonii* seedlings supplied to the Service by JRM were planted at the GNWR in northern Guam (Demeulenaere et al. 2015, p. 4). The 31 seedlings are maintained with 2 previously outplanted saplings on the GNWR. On AAFB, one outplanted sapling is located in the Tarague Basin.

The history of *S. nelsonii*'s abundance and distribution on Rota is poorly known (USFWS 1994, p. 7), but surveys in 1994 estimated 121 adult trees with very little regeneration (Wiles et al. 1996, p. 232). Current estimates for Rota are 40 to 50 wild adult trees with little to no regeneration (J. Manglona, CNMI DLNR, pers. comm. 2015).

Life History and Ecology

Serianthes nelsonii is recorded mainly from limestone soils, with a few historical occurrences in clay soils in Guam (USFWS 1994, p. 8). Most of the adult trees in Rota occur on or near steep limestone cliffsides, and the last wild adult tree in Guam is located in rugged limestone karst habitat at NWF. What little is known about pollination, seed dispersal, phenology, flowering, and fruiting for this species comes mainly from incidental reports (USFWS 1994, p. 11). Fruiting occurs throughout the year, as seed pods have been observed during all months of the year (USFWS 1994, pp. 11-13). Similarly, flowering has been recorded during all months of the year, with one report (Schreiner and Nafus 1991, as cited in USFWS 1994, p. 11) reporting the highest proportion of branches with flowers in May and June. This report also indicated leaf production throughout the year with declines during the dry season from January to June. Age of reproduction in the wild is also unknown, but flowers and pods have been observed on cultivated trees as young as 10 years old (USFWS 1994, p. 13).

Serianthes nelsonii, being a large, canopy tree species, provides habitat for a number of smaller species. This species supports a diverse community of arthropods including predator species such as spiders and mantids that may control other potentially problematic insect populations (Wiles et al. 1996, p. 233). *S. nelsonii* also hosts a variety of epiphytes including ferns, orchids, and other plants such as *Ficus* sp., and *Freycinetia reineckei* (Wiles et al. 1996, p. 233-234).

Population Dynamics and Status

The total wild population of *Serianthes nelsonii* is estimated to be 50 adult trees, with almost all of the population occurring in Rota, and a single wild adult tree in Guam. In addition, there are outplanted occurrences on each island, all younger than 20 years of age. Seedling propagation and outplanting on Rota have been ongoing with limited success over the past 20 years, mainly

in the Isang area in southern Rota, and between the main villages of Songsong and Sinapalo. Approximately 10 outplanted individuals in Rota have survived to a reproductive age (J. Manglona, CNMI DLNR, pers. comm. 2015). Twenty seedlings were outplanted in 1999 in the Tarague Basin, on AAFB in Guam (M. Marutani, University of Guam, pers. comm. 2015). To date, only one of these saplings has survived (AAFB 2015), but has not produced any seed pods (A. Gawel, USFWS, pers. obs. 2014). In 2009, approximately 30 seedlings were planted at the GNWR; all but 5 have survived (J. Cruce, USFWS, pers. comm. 2015). In 2014, 31 seedlings were donated to GNWR by JRM and outplanted and are being maintained by the Guam Plant Extinction Prevention Program (Demeulenaere 2015, p. 4) and GNWR staff.

Recent *Serianthes nelsonii* recovery efforts on Guam and Rota have been dependent on funding, the amount of available propagated seedlings in nurseries, and the seedling to adult survival rates in the wild. In early 2015, the total number of nursery seedlings and saplings in Guam and Rota was estimated at 300 individuals, with approximately 200 in Guam nurseries. However, this estimation may change rapidly if outplanting seedling survival is low. Recent studies from AAFB indicated that although many seeds fall from the Guam adult tree and many of the seeds germinate, there is very limited survival under the mother tree (AAFB 2015). Both islands' populations have constant regeneration of wild seedlings that are several days to several months old. However, these seedlings experience incredibly high turn-over, and in recent decades, none have been known to survive to adulthood in the wild (J. Manglona, CNMI DLNR, pers. comm. 2015; AAFB 2015, pp. 4-5). Although wild seedling survival is bleak, progress has been made on increasing the likelihood of survival of outplanted individuals with new methods of insect control and exclusion, given insect herbivory and damage are the major cause of outplanted seedling early mortality (E. Demeulenare, GPEPP, pers. comm. 2015).

Threats (adapted from USFWS 2012b, pp. 10-14):

- Loss and degradation of habitat – Development from construction and military training has decreased the total recovery habitat for this species. *Serianthes nelsonii* habitat continues to be degraded by ungulates (Wiles et al. 1996, p. 234; DON 2013c), i.e. feral pigs and Philippine deer (*Rusa mariannae*), and by encroachment of invasive plants. In addition, declines in pollinators, seed dispersers, and insectivores have contributed to habitat loss (Wiles et al. 1996 p. 230).
- Introduced predators and herbivores – Introduced deer and pigs feed on *Serianthes nelsonii* (Wiles et al. 1996, p.234; Morton et al. 2000, p. 230). A number of invertebrate predators and herbivores also have been reported on this species: mealybugs (*Dysmococcus brevipes*, *D. neobrevipes*, *Ferrisia virgate*, and *Planococcus* sp.), caterpillars of *Eurema blanda*, termites (USFWS 2012b), and katydids (A. Moore, University of Guam, pers. comm. 2014). In addition, insect predation occurs on seed pods in Rota, but the insect is unknown (USFWS 2012b).
- Stochastic events – Typhoons have resulted in damage and mortality to this species as well as damage to habitat (USFWS 2012b).

<u>Survival and Recovery Needs</u>

For *Serianthes nelsonii* to be considered for delisting, the Service proposes that at least four populations be established on each island – Guam and Rota – each with a 10-year average of 500

or more reproductive plants (USFWS 1994, p. 26). The populations should have age structures comprised of a large proportion of adult trees as well as seedlings and immature trees (USFWS 1994, p. 26). In addition, the Service recommends that the populations on Rota be separated by at least 1 km (0.621 mi), and that at least one of the populations in Guam should be in the southern part of the island (USFWS 1994, p. 26).

To achieve recovery needs, the Service outlines the following recovery actions (adapted from USFWS 1994, pp. 27-37):

- Additional surveys are needed on both islands since the last surveys for this tree were in 1994. To prevent ungulate degradation and herbivory, subpopulations should be fenced wherever possible. Methodology to control insect pests should be developed and implemented. Existing individuals need to be monitored for survivorship, new threats, and any possible evidence of regeneration. Public education and community involvement should also be encouraged and developed.
- Conduct research important to the management of *Serianthes nelsonii*. The ecology, life history, and habitat requirements of *S. nelsonii* are poorly understood and should be studied. Although a number of insect pests have been identified, many remain unidentified, and their ecology, specific effects, abundance, and especially control methods need to be investigated. The Service also recommends genetic studies, especially on the variation between Guam and Rota populations, as well as any effects from small population size and inbreeding.
- Augment current populations and reintroduce to historical range. Plans for augmentation and reintroduction should be developed for both Guam and Rota. Areas for outplanting should be identified and secured, and plants should be propagated and transplanted to the identified areas.
- Prevent clearing of forest next to *S. nelsonii*. Maintenance of an intact forest canopy next to *S. nelsonii* will reduce the potential of edge effects and for high winds during typhoons to break tree limbs and trunks.
- Implement standardized control procedures for insect pests after research on insect control determines appropriate methodology.

New management actions that have occurred in the last five years include:
Since *Serianthes nelsonii* was listed in 1987, outplanting of individuals have been attempted with limited success. However, several recovery projects aimed at understanding and improving outplanting efforts and management of individuals have begun since 2012:

- The last remaining adult tree in Guam is fenced to prevent access by ungulates. The Air Force has funded research to look at ecology, seedling survival, propagation methods, and health and life history of the adult tree (AAFB 2015).
- The Service has funded a project with the CNMI Division of Forestry in Rota to outplant and maintain *Serianthes nelsonii* in fenced plots on private property.
- The Service has funded a multi-year project for *Serianthes nelsonii* recovery on the GNWR to be managed by a full-time biologist. This person will work with the Guam Plant Extinction Prevention Program to maintain the *S. nelsonii* seedlings that were outplanted at the GNWR in 2014. The Service is collaborating with Guam Department

of Agriculture, DoD, the University of Guam, and the Guam Plant Extinction Prevention Program.

Recommendations for Future Actions (adapted from USFWS 2012b, pp. 17-18)

- Captive propagation for genetic storage and reintroduction:
    - Continue to collect seeds from all existing populations and propagate at multiple locations to increase success.
    - Perform genetic studies to determine if Guam and Rota populations are distinct.
- Captive propagation protocol development – Protect seed pods with a fine mesh covering to prevent predation by arthropods before seeds mature.
- Reintroduction / translocation implementation:
    - Propagate and maintain all outplanted individuals on the GNWR to a size where insect herbivory is less likely to cause mortality. This will likely be when plants produce multiple branches and the main stem achieves a girth sufficient enough to withstand damage from *Eurema blanda* butterflies laying eggs in the plant's tissue.
- Ungulate control – Continue to protect all populations against disturbances from feral ungulates.
- Invertebrate control research – Research and identify the effects of invertebrate predation on seeds and seedlings of *S. nelsonii*. If determined to be a limiting factor, develop and implement control measures to protect the species.
- Population biology research – Research the use of mechanical pollination to enhance outbreeding of the species.
- Surveys / inventories – Resurvey the historical range of the species to determine if previously unknown or newly reestablished populations exist.
- Threats research:
    - Research what factors are limiting the natural recruitment of individuals in Guam.
    - Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.
- Ecosystem-altering invasive plant species control – Control invasive introduced plant species within fenced exclosures.
- Site / area / habitat protection – Develop and implement effective measures to reduce the impacts of agricultural and urban development and hurricanes (typhoons).
- Fire protection – Develop and implement a fire management plan for all populations.
- Alliance and partnership development – Continue to work with GNWR, Guam Rare Plant Restoration Group, and other land managers to continue implementation of ecosystem-level restoration and management to benefit this species.

F. ENVIRONMENTAL BASELINE OF THE SPECIES

General Environmental Baseline

Below we provide a general overview of the status of, and threats to, limestone forest habitat within the action area, followed by species-specific environmental baseline sections. We focus

on habitat in this overview section as the three bird species are extirpated, there is one remaining adult *Serianthes nelsonii* tree, and only a very small population of Mariana fruit bats left on Guam. Therefore, protecting the remaining habitat on Guam is critical for the future recovery for all the listed species addressed in this Biological Opinion.

Limestone karst forests on Guam

Limestone karsts are sedimentary rock outcroppings consisting primarily of calcium carbonate and are recognized as important ecosystems, with high species diversity (Mueller-Dombois and Fosberg 1998, p. 217; Clements et al. 2006, pp. 733-734). The high species diversity on karsts arises from the numerous ecological niches created by complex terrains and variable climatic conditions (Clements et al. 2006, p. 734). On Guam, karst is found on an uplifted karst plateau in the northern half of the island and on uplifted weathered volcanic terrain in the southern half (Fosberg 1960, p. 54; Stone 1970, p. 12; Mueller-Dombois and Fosberg 1998, p. 241). The limestone soils of north and south Guam were historically forested (Stone 1970, p. 14; Mueller-Dombois and Fosberg 1998, p. 270; Guam Department of Agriculture 2010, p. 7), and limestone forest on Guam is composed primarily of mature growth of native trees and plants with a moderately dense canopy 10-30 m high (DAWR 2006, p. 19). We define primary limestone forest as forest with vegetation that was never cleared and is dominated by native species (Fosberg 1960, p. 56; DAWR 2006, p. 218).

Primary limestone forests are critical for Guam's native flora and fauna (Stone 1970, p. 22; USFWS 2005a, p. iv; DAWR 2006, p. 28; DON 2014b, p. 3-40). They retain key functional components of native forests such as large native trees and high canopy cover (Fosberg 1960, p. 56; Mueller-Dombois and Fosberg 1998, p. 217 and 270; DON 2014b, p. 3-40), and are necessary for the recovery of listed species on Guam (Jenkins 1983, p. 22; Michael 1987; Morton et al. 1999, p. 22). Intact primary limestone forests harbor greater tree species diversity than degraded habitat (Stone 1970, p. 22) and provides habitat for a broad diversity of wildlife; these forests are also highly productive and often store more carbon than degraded forests (Caves et al. 2013, p. 7). The primary limestone forest on AAFB is considered some of the best native limestone forest left on Guam to serve as habitat for listed species (Morton 1996, p. 69).

Threats to Guam's limestone forests

Over the past several centuries, Guam has lost much of the native forest to agriculture, a growing human population, economic development, and military activities (Mueller-Dombois and Fosberg 1998, p. 270; USFWS 2009d, p. 27). The distribution of primary limestone forest on Guam has been steadily declining (Fosberg 1960, p. 54; DAWR 2006, p. 28). Although little is known about the nature of Guam's vegetation before World War II, progressive alteration of the island's vegetation clearly began with human colonization (Fosberg 1960, p. 54). On limestone soils, native forest was cleared and replaced by coconut plantations, open fields and gardens, pasture, and secondary forest (Mueller-Dombois and Fosberg 1998, p. 242). During World War II, large areas were cleared and some habitat was destroyed during heavy fighting (Fosberg 1960, p. 54).

Currently, the remaining limestone forests on Guam face numerous threats including habitat fragmentation and loss, lack of management, introduced ungulates, invasive species, typhoons, forest conversion, and loss of pollinators (USFWS 2005a, p. 27; DAWR 2006, p. 28; USFWS 2008a, p. 17-18). These combined threats will degrade the habitat quality of remaining limestone forests and limit the acres of high quality primary limestone forest habitat available to recover listed species on Guam. Currently, forested areas cover approximately 48 percent of Guam (DAWR 2006, p. 31), with only 13 percent of Guam covered with limestone forests (Brown 2005 as cited in DAWR 2006, p. 28).

Habitat Fragmentation, Degradation, and Loss
Habitat fragmentation is a change in habitat configuration caused by clearing, development, invasive species, typhoons, and ungulates that causes remaining habitat to occur in patches among areas of non-habitat (Noss et al. 2006, p. 213). Habitat fragmentation creates edges that have different properties than the habitat itself. For example, edges often have different microclimate patterns that are drier, less shaded, and warmer than forest interiors; they are often areas with increased predation and serve as entry points into native habitats for invasive vegetation, pests, and pathogens (Noss et al. 2006, p. 228). Edges can affect avian density up to 60 m into the forest, and affect the forest canopy up to 150 m (Murcia 1995, p. 59). Habitat fragmentation and edges can result in localized extinctions, shifts in community composition, increases in invasive species, increased predation, and in suitable habitat becoming unsuitable due to pollution, invasive species, physical size, or barriers blocking access to habitats (Groom and Vynne 2006, p. 174; Noss et al. 2006, 38 pp). Habitat fragmentation has been implicated in reduced species richness, avian abundance, productivity, and food supply (Blake and Karr 1987, VanderWerf 1993, Burke and Nol 1998, Trine 1998, Porneluzi and Faaborg 1999). Overall, edges have deleterious effects to wildlife populations and ecological processes (Murcia 1995, p. 58; Laurance 2000, p. 134) and may affect forests at larger landscape scales (Laurance 2000, p. 134).

Habitat degradation and loss on Guam has been caused by various human activities including agriculture, mining, forestry, fires, infrastructure development, military training, urbanization, industry, pollution (including light, noise, and toxic chemicals), and changes in community and ecosystem structure due to invasive species (Groom and Vynne 2006, p. 164; USFWS 2008a, p. 17). Habitat loss and degradation from human activities is a threat to recovery of listed species on Guam (USFWS 2008a, p. 17; USFWS 2012c, p. 3).

Introduced Ungulates
Non-native ungulate species that occur in Guam include pigs (*Sus scrofa*), Philippine deer (*Cervus mariannus*), and Asiatic water buffalo (*Bubalis bubalis*). Ungulates have caused severe damage to Guam's forests by browsing on plants, causing erosion, inhibiting plant growth and regeneration, and facilitating the establishment of invasive plants, which can impede forest regeneration by displacing or smothering native species (USFWS 2009d, p. 27). For example, deer and pigs foraging on fallen fruits and seedlings of the native breadfruit (*Artocarpus mariannensis*), an important fruit bat food, in combination with impacts from typhoons, have resulted in a decline in the number of native breadfruit trees on Guam (Wiles 2005; p. 509).

Introduced pigs are extremely destructive and have both direct and indirect effects on native plant communities. While rooting in the soil in search of invertebrates and plant material, pigs directly affect native plants by disturbing and destroying vegetative cover and trampling plants and seedlings. They may also reduce or eliminate plant regeneration by damaging or eating seeds and seedlings. Pigs are a major vector for the establishment and spread of competing invasive non-native plant species, by dispersing plant seeds on their hooves and coats as well as through the spread of their feces (Diong 1982, pp. 169-170), and by fertilizing the disturbed soil with their feces (Matson 1990, p. 245; Siemann et al. 2009, p. 547). Pigs feed preferentially on the fruits of many non-native plants, spreading the seeds of these invasive species through their feces as they travel in search of food. In addition, rooting pigs contribute to erosion by clearing vegetation and creating large areas of disturbed soil, especially on slopes (Smith 1985, pp. 190, 192, 196, 200, 204, 230–231; Stone 1985, pp. 254–255, 262–264; Medeiros et al. 1986, pp. 27–28; Scott et al. 1986, pp. 360–361; Tomich 1986, pp. 120–126; Cuddihy and Stone 1990, pp. 64–65; Aplet et al. 1991, p. 56; Gagne and Cuddihy 1999, p. 52).

On Guam, feral pigs were introduced in the 1600s, established a feral population by 1772, and distributed island wide by the early 1900s (Conry 1988, p. 26). As documented in other locations, wallowing, rooting, and trampling are common in most forested areas and can be locally severe (Conry 1988, p. 27). A large complex of wallows and feeding sites in Tarague Basin on AAFB measured over 5.7 ac (2.3 ha), and was stripped of all ground cover with no tree regeneration (Conry 1988, p. 27). On AAFB, densities of Philippine deer and feral pigs were estimated at 1.8 deer per hectare (0.8 deer per acre) and 0.4 pigs per hectare (0.2 pigs per acre), which are some of the highest densities recorded in the world (Knutson and Vogt 2003, unpubl. manuscript).

Philippine deer were introduced to Guam in the 1770s (Safford 1905, p. 76), and are distributed throughout the island (Conry 1988, p. 27). Heavy browsing pressure has been documented, even at relatively low densities, and browse lines are common (Conry 1988, p. 27). Deer populations in the 1990s appeared to be expanding (Wiles et al. 1999, p. 193), and may be the largest in Micronesia (p. 200). Philippine deer have caused significant changes in forest structure and species composition in native ecosystems on Guam, and are not considered compatible with conservation of native ecosystems and recovery of endangered species (Wiles et al. 1999, p. 193).

The Asiatic water buffalo was introduced to Guam in the 1600s from the Philippines (Conry 1988, p. 27). High densities, and the gregarious habits of Asiatic water buffalo, have resulted in habitat damage such as mud wallows, broad trails, vegetation trampling, and tracks, and some areas were so heavily trampled that ground cover has been denuded and soil erosion scars and slumping are evident (Conry 1988, pp. 27-28). Asiatic water buffalo occur primarily on the Ordnance Annex and surrounding non-Navy lands in southern Guam, with a population estimated at 50-60 animals (USFWS 2008a, p. 18).

Conversion of Forest to Savanna in Southern Guam

Savanna areas in southern Guam are enlarging into previously forested areas as a result of human-caused wildfires and grazing (Stone 1970, p. 14; Mueller-Dombois and Fosberg 1998, p. 242). To estimate the rate of historical forest conversion to savanna, Greenlee (2010) delineated

areas that were dominated by forest vegetation in 1975 aerial photographs and compared them to recent infrared imagery. Based on this analysis, approximately 1,119 ac (453 ha) of forest was converted to savanna in southern Guam since 1975; this estimate indicates the average rate of forest loss in southern Guam is approximately 37 ac/year (15 ha/year) (Greenlee 2010).

Habitat Destruction and Modification by Typhoons
Guam has been affected by typhoons in 37 of the last 50 years (USFWS 2005a, p. 32). Super-typhoons (with wind gusts of over 240 km (150 mi) per hour) occur approximately once every five years (the last one, Pongsona, occurred in 2002). Typhoons destroy native vegetation by opening the canopy and modifying the availability of light, and create disturbed areas conducive to invasion by non-native pest species (Asner and Goldstein 1997, p. 148; Harrington et al. 1997, pp. 539-540). Typhoons also can cause defoliation (loss of leaves), uprooting of trees, and breakage of stems, branches, and trunks of trees depending on the severity and duration of the storm and its point of impact (Brokaw and Walker 1991, p.442). Super-typhoons fragment and decrease the suitability of existing habitat, and exacerbate the effects of introduced plants and ungulates (USFWS 2005a, p. 34). Following a typhoon, forest canopies may be disrupted, facilitating the establishment and spread of introduced plants. Climate models indicate that hurricanes in the northwestern Pacific are expected to increase in intensity, frequency, and duration by 2200 and continue to increase further into the future (Emanuel et al. 2008, p. 360). Therefore, we expect habitat destruction and modification by typhoons to increase in the future.

Loss of Pollinators, Seed Dispersers, and Frugivores
The loss of forest birds on Guam by brown treesnakes has caused a disruption in the ecosystem services provided by birds as pollinators, seed dispersers, and frugivores (Mortenson et al. 2008, p. 2146; Caves et al. 2013, p. 7). Seeds are dispersed significantly farther from parent trees on islands with birds compared to Guam, and seed ingestion by birds doubles to quadruples the chance of germination for plant species (Rogers 2011, p. 2). The combination of loss of seed dispersal and reduced germination can produce major changes in the spatial pattern, abundance, and diversity of Guam's forests as a result of bird loss (Rogers 2011, p. 2). In addition, seed set and seedling recruitment were significantly higher on Saipan than Guam for bird pollinated trees (Mortensen et al. 2008, p. 2146). These studies concluded that the loss of ecosystem services provided by birds will cause a loss in species diversity, distribution, and abundance; slow regeneration of degraded forests; and reduce plant species recruitment (Mortensen et al. 2008, p. 2146 and 2153; Rogers 2011, p. 2; Caves et al. 2013, p. 5).

Human Disturbance
The listed birds and bat on Guam are also threatened by disturbance from human activities including, but not limited to, noise from military training (aircraft, munitions, firing ranges, vehicles, etc.), noise from recreational pursuits (hiking, and hunting), human voices, and construction noises. These disturbances not only negatively affect species, but reach into forested interiors and degrade the quality of habitat for listed species. The listed birds and bat addressed in this consultation are all sensitive to human disturbance, and as development continues on Guam, disturbance-free forested habitats are increasingly rare on Guam.

<u>Land Management on DoD Lands</u>

The majority of remaining limestone forests on Guam are found on DoD lands at AAFB and the Naval Base Guam's NMS. As noted above, the primary limestone forest on AAFB is considered some of the best native limestone forest left on Guam to serve as habitat for listed species (Morton 1996, p. 69). The Service and the DoD (USAF, U.S. Navy, and JRM) have worked together over the past 20 years to manage DoD lands for threatened and endangered species. In 1993, a Cooperative Agreement (Agreement) was established between the USAF, U.S. Navy, and the Service for purposes of establishing and managing the GNWR Overlay on DoD lands. The GNWR includes approximately 152 ha of fee simple Service-owned land and 9,106 ha of Overlay Refuge on land owned by DoD. The Agreement, which is still in effect, affirms the parties commitment for a "coordinated program centered on the protection of endangered and threatened species and other native flora and fauna, maintenance of native ecosystems, and the conservation of native biological diversity in cooperation with the Guam Department of Agriculture-Division of Aquatic and Wildlife Resources, consistent with the national defense mission of the Navy." Notably, all signatory parties to the Agreement agreed that Navy lands included within the GNWR shall be managed and administered, consistent with the national defense mission of the Navy, for the following goal: to consult under section 7 of the Endangered Species Act (ESA) on proposed Federal actions that are funded, authorized, or carried out by the Federal government within the Refuge, inclusive of Overlay Refuge lands, "that may impact habitat of endangered or threatened species even if those species are extirpated from the affected area, but are not extinct."

Management of listed species habitat on DoD lands has occurred with some success. The approximately 73-ha (180-ac) Haputo Ecological Reserve Area (ERA) on AAFB and the 12-ha (30-ac) Orote Point ERA on NBG are but two examples. Both were established in 1984, prior to the Agreement, as mitigation for the Kilo Wharf project. The 54-ha (133-ac) Habitat Management Unit (HMU) on AAFB was developed as mitigation under the 2006, informal consultation on the Beddown of Training and Support Initiative at the Northwest Field (USFWS 2006c, p. 2), and currently serves as an experimental site for brown treesnake research and control.

However, in contrast, the DoD has recently proposed to build a LFTRC within an existing 312-acre mitigation site on Overlay Refuge at Ritidian Point on AAFB (DON 2014a, p. 22). This mitigation site is a requirement under the 2006 ISR Strike Biological Opinion (USFWS 2006b). After years of working with partners in selecting and preparing the site, constructing and maintaining the ungulate fence, and spending over $1.1 million (AAFB 2015, p. 15), the proposed construction of LFTRC may result in the loss and degradation of listed species habitat, which was to be protected for listed species, and may result in the removal (as part of this proposed action) of parts or all of the ungulate fence.

Another example showing a lack of success to protect and carry-through conservation and management actions on Overlay Refuge is "Area 50", which was established near NWF on AAFB in 1991 to exclude ungulates and control brown treesnakes in an exclosure. The DOI and USAF were working collaboratively towards building a pre-stressed concrete barrier for brown treesnake control at the site, when the USAF restricted access to the site and ended the conservation project.

In addition, cooperation between the DoD and the Service for land management actions on Overlay Refuge lands has not progressed as originally intended after signing of the Agreement. As DoD and Service staff changed, access became more and more challenging until it reached a point where Service biologists could no longer access Overlay Refuge lands. In recent years, access has improved on Overlay Refuge lands.

The DoD agencies have also not historically managed ungulates to full success on DoD lands to benefit listed species or their habitats. For many years, the DoD relied on a Volunteer Conservation Officer (VCO) program to "manage" ungulates on DoD property. These hunting efforts were not effective to manage or control the large ungulate populations on DoD lands. The lack of ungulate eradication can have significant adverse effects to native plants. Recently, the DON has installed an ungulate fence and is removing ungulates from NBG.

Finally, the Sikes Act requires the DoD to develop and implement INRMPs for military installations across the United States. INRMPs are prepared in cooperation with the Service and State/Territorial fish and wildlife agencies to ensure proper consideration of fish, wildlife, and habitat needs. The Service, Guam DAWR, and JRM have been working together to finalize a new INRMP; however, the draft INRMP has still not been approved by the Service or DAWR.

The DON also has installed approximately 4,400 ft of coated chain link fence along Route 2A on the perimeter of NBG. The fence provides an ungulate exclosure for the 3,114 ac (1,260 ha) of the main base of NBG. The fencing project is intended to effectively close off Orote peninsula from any new ungulate incursions and only entry control gates will be left unfenced. These gates are manned twenty-four hours a day/seven days a week. The fencing project was initiated in 2013 and is complete.

In addition, per negotiations in the JGPO 2010 Biological Opinion (USFWS 2010a, p. 51) the DON has committed to support the re-introduction of native endangered or threatened species on DoD lands on Guam consistent with species recovery plans. When the DON and Service mutually agree the constraints to reintroduction of native threatened or endangered species on DoD lands on Guam have been minimized to a point that a feasible and successful re-introduction of the affected species is more probable than not, the DON will work with the Service to develop a re-introduction plan and supporting programmatic biological opinion that ensures such re-introduction efforts are consistent with the species recovery plans and the military mission on Guam.

DoD has had limited success in fulfilling requirements under Biological Opinions. The lack of management on DoD lands significantly increases the uncertainty that adequate habitat will be protected and managed for the conservation of listed species on Guam.

Previous or On-going DoN Projects Addressing the Conservation and Management of the Mariana Swiftlet

- 2000-2015: USDA BTS trapping around NMS caves.
- 2010-2015:

  - Quarterly surveys of NMS caves (Mahlac, Maemong, and Fachi) to estimate population size and monitor trends.
  - Surveys for potential additional swiftlet caves on NMS.
- 2012-2015:
  - Evaluation and development of new techniques to estimate swiftlet population size.
  - BTS control (trapping, bait tubes, and hand removal) at swiftlet caves.
  - BTS surveys to assess activity and use at swiftlet caves.
  - Operational assessment of current BTS control methods around swiftlet caves and field examination of what affects interception rates.
  - Assessment of whether BTS predation on captive birds (surrogate species) increases in the vicinity of rodent-baited traps.
  - Collection, necropsy, and data analysis of BTS to evaluate diet composition and predation of swiftlets.
  - Assessment of target and non-target take at BTS bait tube stations.
- 2014: Swiftlet roosting/nesting abundance study.
- 2014: Assessment of BTS activity and control methods at caves.
- 2014: Remote monitoring system to estimate and monitor swiftlet population size, spatial distribution of roosting birds, monitor nests and rodents.

Previous or On-going DoN Projects Addressing the Conservation and Management of ESA-listed, ESA Proposed, and GovGuam-listed Plant Species

Serianthes nelsonii:

- Reconstructed the ungulate fencing around the area of the Ritidian tree.
- Monitoring of seedling emergence and growth throughout the study showed 488 seedlings emerged beneath the Ritidian tree, only 4 seedlings exhibited a lifespan greater than 200 days (DoN 2014). These results were unexpected because past reports indicated deer browsing was the major cause of in situ seedling death. The ungulate exclusion fence was intact throughout the study and deer or pigs could not have been responsible for the seedling mortality.
- Nursery propagation trials using seed from the Ritidian tree determined:
  - optimum light levels for growth. In situ and nursery insect pests that caused seedling mortality were the butterfly Eurema blanda and Acacia whitefly (Trialeurodes acacia).
  - the influence of shade on seed germination and initial seedling growth was quantified for optimal growth in nursery and in situ plants.
  - Effects of experimental treatments of nitrogen, phosporous, potassium, and mycorrhizae.

<u>Brown treesnake predation</u>

The primary threat to native forests birds on Guam for over 60 years has been the non-native brown treesnake. Since the accidental introduction of the brown treesnake to Guam around 1950, Guam's avifauna has been decimated, with most of the native birds disappearing from Guam's forests (Savidge 1987, p. 660). The brown treesnake was found to be the main cause of

the decline of the native forest birds on Guam as it opportunistically preys upon eggs, nestlings, and adult birds (Savidge 1986, 1987, p. 660; Conry 1988). Extirpations of all but two resident forest avian species in southern Guam occurred within 27 to 32 years after the accidental introduction of the brown treesnake. In northern Guam, the average time for the bird populations to decline by 90 percent was 8.9 years (Wiles et al. 2003). Brown treesnakes have been reported to prey on Mariana fruit bats (USFWS 2009d, p. 8). Data collected from 1982 to 2006 at the Pati Point fruit bat colony suggest the brown treesnake preys on non-volant fruit bat pups, thereby inhibiting fruit bat recruitment on Guam (USFWS 2010b, p. vii). Brown treesnake densities are high on Guam and in the 1990s were estimated at 20 individuals per ac (50 per ha) in favorable habitats (Rodda and Savidge 2007, p. 315). The persistence of high densities of brown treesnakes has limited recovery efforts to reestablish the Mariana crow, Guam Micronesian kingfisher, and Guam rail populations in the wild on Guam.

In 2014, the USDA-APHIS Wildlife Services, in coordination with the National Wildlife Research Center, the DoD-Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs, conducted a test of aerial application of a brown treesnake toxicant (acetaminophen) over forested areas in AAFB (Dorr et al. 2014, unpublished data). The results of this study indicated that development of a scalable automatic bait application system could be used in the near future for large landscape scale brown treesnake control and suppression (Dorr et al. 2014, unpublished data). This significant development makes reintroduction of the extirpated avian species a real possibility on Guam (USFWS 2015c). As control efforts continue, we expect that the Guam Micronesian kingfisher, Mariana crow, and Guam rail will be re-introduced onto Guam in the foreseeable future (L. Mehrhoff, USFWS, pers. comm. 2013). With the potential for brown treesnake to be controlled, it is imperative that a sufficient area of forested habitat be conserved in Guam to allow for recovery of these species (USFWS 2015c).

Control of brown treesnakes on DoD lands

The DoD has a long history of working cooperatively with natural resource agencies and stakeholders to prevent the dispersal of brown treesnakes to other Pacific islands and refine techniques to control snakes on Guam. As mentioned above, the DoD and the DOI have recently supported the successful development and application of an aerially dispersed toxicant to control brown treesnake numbers over a landscape on Guam. The DoD also provides funding and support to USDA Wildlife Services to maintain active snake traps around air and sea ports, and housing on DoD lands. As a requirement of a Biological Opinion, the DoD also maintains active snake traps in areas adjacent to the Mariana swiftlet caves at the NMS. The goal is to decrease brown treesnake numbers in swiftlet habitat and reduce the predation of swiftlets by snakes. Because swiftlet habitat within forested areas overlaps with habitat for the Guam Micronesian kingfisher, Mariana crow, Mariana fruit bat, and the Guam rail, snake trapping also benefits these species.

In fiscal year 2014, the DoD funded three projects that will explore methods to detect brown treesnakes and/or evaluate movement of snakes within a landscape. These projects potentially will provide information used to refine rapid response actions and brown treesnake eradication efforts. The DoD continues to work cooperatively with the Brown Treesnake Working Group to identify and implement future brown treesnake projects.

Climate Change

Climate models indicate that hurricanes in the northwestern Pacific are expected to increase in intensity, frequency, and duration by 2200 and continue to increase further into the future (Emanuel et al. 2008, p. 360). These storm increases will likely have a significant effect on habitat and survival of listed species on Guam. We do not expect that additional climate change features including increases in temperature, precipitation, and sea level (Australian Bureau of Meteorology and CSIRO 2011, Ch. 6, p. 178) will significantly affect listed species on Guam.

Environmental Baseline for the Guam Micronesian Kingfisher

Guam Micronesian kingfishers are extirpated from the action area; however, habitat suitable for the survival and recovery of the species (hereafter, kingfisher habitat) is present. For purposes of this Biological Opinion, the "survival condition" of the kingfisher in the wild represents the level of reproduction, numbers, and distribution necessary to support a persistent population on Guam that is fully protected by the ESA. For purposes of this Opinion, the "recovery condition" of the kingfisher is the survival condition where the threats to the species have been addressed such that the protections of the ESA are no longer necessary to ensure perpetuation of the survival condition of the kingfisher in the wild on Guam. Under those circumstances, the kingfisher would qualify for de-listing under the ESA.

As further described below, the role of the action area for the survival and recovery of the Guam Micronesian kingfisher is to provide protected habitat sufficient for two recovery populations (one in north Guam and one in south Guam) of sufficient size to each support 500 territorial breeding pairs in habitat where threats are managed and controlled. Because DON lands within the action area include approximately 75 percent of the kingfisher's habitat in northern Guam, and 43 percent in southern Guam, protection of habitat sufficient to help support two subpopulations (one in northern Guam and one in southern Guam) on DON lands in the action area is essential to the survival and recovery of the kingfisher.

Rationale for Delineation of Guam Micronesian Kingfisher Habitat

Survival and recovery of the Guam Micronesian kingfisher has required maintaining a population in captivity while threats from the brown treesnake are addressed on Guam. Retaining lands containing kingfisher habitat on Guam is essential for recovery and survival of the species. The success of such efforts is dependent on protecting a sufficient amount of habitat within the kingfisher's historical range to support two subpopulations of kingfishers upon reintroduction to northern and southern Guam.

Recently, we updated and conducted an detailed habitat assessment for the Guam Micronesian kingfisher on Guam (USFWS 2015c). Our goals were 1) to identify lands suitable for reintroduction of the species; 2) to determine how much habitat was needed to support survival and recovery of the species, based on the kingfisher recovery plan criteria (USFWS 2008a, p. vi); and 3) to develop a method to offset loss of remaining habitat so that a minimum amount of

habitat needed to support the species is permanently protected. The methods used to calculate kingfisher habitat are provided below.

Methods for Habitat Calculations for the Guam Micronesian Kingfisher

Recovery Targets
The recovery plan for the Guam Micronesian kingfisher (USFWS 2008a) requires the following criteria to be met for delisting. First, there must be two subpopulations of at least 1,000 adult kingfishers (one in northern and one in southern Guam). In addition, both populations must be either stable or increasing based on quantitative surveys or demographic monitoring that demonstrates an average intrinsic population growth rate of greater than 1.0 over a period of at least 10 consecutive years. Third, sufficient habitat, based on quantitative estimates of territory and home range sizes, must be protected and managed to support the population size and trajectory criteria identified above. Finally, brown treesnakes and other introduced predators need to be controlled over 10 consecutive years at a level sufficient to achieve the first and second criteria, above.

Habitat needed to support the Guam Micronesian kingfisher survival and recovery
The following analysis was completed to determine the amount of kingfisher habitat on Guam that must be protected and managed to support both the survival and recovery of this species. This analysis relies on known and estimated life history requirements of the kingfisher and closely related species, and the findings in the final revised recovery plan for the kingfisher (USFWS 2008a).

Delineation of Survival and Recovery Habitat
As noted in the Status of the Guam Micronesian Kingfisher section above, kingfishers utilize a mosaic of forested and open habitats for foraging and breeding. However, as forested habitats, especially mature forest, are likely limiting, the analysis focused on identifying forested habitats as recovery habitat for the kingfisher. This approach was taken for two reasons. First, kingfishers need forested habitat for breeding, so forested habitat is essential to the species. Second, typhoon impacts to forested habitat are not well understood. Therefore, by focusing on forested habitats we provide a more conservative estimate of kingfisher habitat needed for its survival and recovery in the wild on Guam.

All areas identified as limestone, ravine, coconut, and palma brava (*Heterospathe elata*) forests in the 2006 Forest Service landcover map of Guam (Liu and Fischer 2006) were considered to be potential kingfisher habitat. The amount of available habitat was updated by removing all forested areas cleared since the landcover map was completed. This process used 2011 satellite imagery of Guam (USFWS, unpublished data) and other reported clearing (USFWS, unpublished data).

The remaining forested areas were subdivided into potential and non-potential recovery habitat based on forest patch area and isolation. Forest areas that were sufficiently large to hold a kingfisher territory were identified using a “territory building” algorithm (USFWS unpublished algorithm) developed using the Raster package (Hijmans 2014) in the statistical program R. This algorithm accounted for the size of the territory and percentage of forested habitat per territory,

thereby omitting areas that were insufficient in size or placement of forested habitat to meet the criteria of a kingfisher territory. We classified forest patches as too isolated for recovery habitat if they were of insufficient size to hold three or more territories and if they were greater than 0.87 mile (1.4 km) (the maximum dispersal distance reported by Kesler and Haig 2007c for the Pohnpei Micronesian kingfisher) from the nearest neighboring forested area supporting three or more territories. The results of these analyses indicate that there is approximately 14,997 acres of kingfisher habitat in northern Guam and 13,314 acres of kingfisher habitat in southern Guam.

Estimated Population Size and Area Needed for Recovery

1. Each breeding kingfisher pair requires 20 acres of habitat (Kesler and Haig 2007a, Pohnpei subspecies of the Micronesian kingfisher). Therefore, under ideal conditions 10,000 acres of habitat will be needed to support a stable kingfisher population with 500 breeding pairs in northern Guam, where the breeding pairs are using 100 percent of the habitat throughout the year, the habitat is in ideal condition to support kingfishers, and there is never any loss of habitat due to manmade or natural disturbances such as fires or storms. These ideal conditions are unrealistic and not sustainable. Consequently additional area is needed for a more realistic estimate of kingfisher recovery habitat, as follows.

2. Density estimates for Guam Micronesian kingfisher in undeveloped areas of northern Guam give an average density of 4 acres per bird (adults and juveniles; calculated with data from northern Guam for the Guam subspecies of the Micronesian kingfisher in Engbring and Ramsey 1984). Thus, the 10,000 acres will actually support 2,500 adult and juvenile kingfishers. This density estimate includes areas that are periodically not used as territories, but are an integral part of the kingfisher habitat, allowing for natural disturbances such as storm, tree falls, landslides, etc.

3. A stable age distribution with 1,000 adult kingfishers gives a population comprised of 38.24 percent adults (calculated with data on the Tuamotu subspecies of the Micronesian kingfisher in Kesler et al. 2012). Thus, 38.24 percent of 2,500 birds are 956 adults, equaling 478 breeding pairs in 10,000 acres; each pair requiring approximately 21 acres (10,000 acres ÷ 478 pairs). An additional 22 breeding pairs (44 adults) are needed to reach the recovery threshold of 500 breeding pairs (1,000 adults). An additional 462 acres of habitat is needed for these 22 breeding kingfishers. Thus the total habitat needed to support 1,000 adults (500 breeding pairs) is 10,462 acres.

4. The 10,462 acres supports the minimum number of breeding kingfishers needed to reach recovery, and does not provide for natural population fluctuations below the recovery threshold. For instance, climate change is predicted to increase the frequency, intensity and duration of storms in the area of the Mariana Islands by several percent over the next 100 years (Emanuel et al. 2008, p. 360); this will likely increase the fluctuation of the northern Guam kingfisher population. To prevent the kingfisher population from fluctuating below the recovery threshold, additional habitat is required for protection against current and future severe storms. Severe storms (strong - category 3 and above - typhoons and super-typhoons) currently affect Guam once a year on average (FWS

analysis of the Joint Typhoon Warning Center best track data 1975-2014). Climate modeling indicates that these storms will increase in the future. A single severe storm can affect habitat, survival, and reproduction. A 10 percent increase in breeding pairs (50 pairs) requiring an additional 1,050 acres of habitat will serve as added protection against population fluctuations due to climate change and other unforeseen natural and manmade events.

5. The area needed to support a viable northern Guam kingfisher subpopulation that maintains itself above the minimum recovery threshold is estimated to be 11,512 acres. This minimum area assumes that the habitat is restored and managed as follows: restoration of kingfisher habitat requires establishing land cover to 56 percent forested that support trees greater than 17 inches in diameter, and 44 percent open or low cover areas for foraging; management of kingfisher habitat requires the continual control of invasive plants, ungulates, non-native predators such as the brown treesnake, rats, and cats, as well as protection from fire. These restoration and management activities have never been fully demonstrated on Guam and so their success remains an assumption. Predator, weed and ungulate control activities can be very difficult in open wilderness terrain where access and monitoring are difficult. Because of this uncertainty in restoration and management of kingfisher habitat, additional habitat beyond the 11,512 acres may be required to achieve the recovery of kingfisher in northern Guam. This minimum recovery area (11,512 acres) also assumes that at least 1,000 adults are breeding, thus 500 breeding pairs. The area requirements for a breeding pair (approximately 20.0 acres; Kesler and Haig, 2007a) is less than the combined area for an individual non-breeding adult male (average of 17.5 acres; Kesler and Haig 2007a) and an individual non-breeding adult female (average of 14.1 acres; Kesler and Haig 2007a). Thus the total area for recovery will be minimized by assuming all 1,000 adults are in breeding pairs. Additional area may be needed if a significant number of adult kingfishers forgo breeding in any year.

Estimated Amount of Habitat Needed to Support Kingfisher Survival and Recovery
Based on the above analysis, the final area needed to support a viable Guam Micronesian kingfisher population that maintains itself above the minimum recovery threshold is estimated to be 11,512 ac for each kingfisher subpopulation in northern and southern Guam. Collectively, a total of 23,024 ac of habitat would be needed to support the survival and recovery of the kingfisher on Guam (Figure 6).

<u>Summary of Remaining Habitat to Support the Survival and Recovery of Kingfishers on Guam</u>

We estimate that there are currently 14,997 ac and 13,314 ac of kingfisher habitat in northern and southern Guam, respectively. However, kingfishers excavate nest cavities in trees over 17 inches in diameter that are located in closed canopy forests with dense understory vegetation, and this habitat type is limited on Guam due to extensive forest clearing and ungulate effects to forest regeneration. Additionally, natural disturbance events, such as severe typhoons, will continue to affect the availability of the large forest trees necessary to support kingfisher nesting, and these typhoons are expected to increase in intensity, frequency, and duration (Emanuel et al. 2008, p. 360). Therefore, while it currently appears there is adequate potential habitat to support

kingfisher survival and recovery, the actual suitable habitat is likely less; thus any loss of potential habitat must be carefully considered in regards to whether it appreciably reduces the likelihood of kingfisher survival and recovery in the wild.

For kingfisher habitat to support the survival and recovery of kingfisher, much of it will likely have to be restored, and all of it will have to be managed. Restoration of kingfisher habitat requires establishing land cover to approximately 56 percent forested that support trees greater than 17 inches in diameter, and approximately 44 percent open or low cover areas for foraging. Management of kingfisher habitat requires the continual control of invasive plants, ungulates, non-native predators such as brown treesnakes, rats, and cats, as well as protection from fire. Predator, weed and ungulate control activities can be very difficult in open wildness terrain where access and monitoring are difficult. Because of the uncertainty in restoration and management of kingfisher habitat, the Service developed a mitigation ratio to ensure kingfisher habitat to support the recovery of kingfisher on Guam would be protected and conserved (USFWS 2015c).

Mitigation Framework
In consideration of the on-going and increased habitat loss and degradation on Guam (as detailed in the General Environmental Baseline section) the Service has endeavored to finalize the draft Mitigation Framework (USFWS 2014e), including the mitigation ratio for habitat loss, to address future habitat conservation needs for the Guam Micronesian kingfisher (USFWS 2015c). As land management actions are proposed that will affect habitat needed for the recovery and survival of the kingfisher, it will be necessary to offset these effects by assuring that durable habitat will be protected and available for species reintroduction. This can be accomplished by ensuring that any habitat that is lost is offset with permanent habitat conservation at rates that ensure an adequate amount of habitat is needed to support the survival and recovery of the kingfisher on Guam.

The mitigation ratio took into account kingfisher habitat that were already protected in northern and southern Guam. For northern Guam, approximately 571 acres of kingfisher habitat is protected. There is no kingfisher habitat protected in southern Guam. Kingfisher habitat should be protected to the maximum extent possible until restoration and management practices for kingfisher habitat are proven to work.

The Mitigation Framework provides guidance to ensuring that adequate amounts of the habitat will be available for species reintroduction in the future. We have recommended to the DON that they should assure that any habitat that is lost as a result of proposed projects is offset with permanent habitat conservation at a rate that ensures the minimum amount of habitat needed to support kingfisher conservation will ultimately be available to support the recovery and survival of the species in the wild on Guam. Although not part of the project description, please refer to the MOA (DON and USFWS 2015), for information on kingfisher habitat that will be protected to ensure the survival and recovery of the kingfisher on Guam.

Environmental Baseline for the Mariana crow

Mariana crows are extirpated from the action area; however, habitat potentially suitable for the survival and recovery of the species (hereafter, crow habitat) is present. For the purposes of this biological opinion, the "survival condition" of the Mariana crow in the wild on Guam represents the level of reproduction, numbers, and distribution of each species that is necessary to support a persistent population on Guam. Achievement of the survival condition is facilitated by recovery planning and the protections afforded to listed species under the ESA. For purposes of this biological opinion, the "recovery condition" of these species is the survival condition where the threats to the species have been addressed such that the protections of the ESA are no longer necessary to ensure perpetuation of the survival condition of the listed species in the wild on Guam and Rota. Under those circumstances, the species would qualify for de-listing under the ESA.

As further described below, the role of the action area for the survival and recovery of the Mariana crow is to provide protected habitat sufficient for two recovery populations (one in north Guam and one in south Guam) of sufficient size to each support 100 territorial breeding pairs in habitat where threats are managed and controlled. Because DON lands within the action area include approximately 75 percent of the Mariana crow's habitat in northern Guam, and 43 percent in southern Guam, protection of habitat sufficient to help support two subpopulations (one in northern Guam and one in southern Guam) on DON lands in the action area is essential to the survival and recovery of the Mariana crow.

Rationale for delineation of crow habitat

Survival and recovery of the Mariana crow has required maintaining a population off-island or in captivity while threats from the brown treesnake are addressed on Guam. Retaining unoccupied habitat on Guam is essential for recovery of the species. The success of such efforts is dependent on protecting a sufficient amount of habitat within the Mariana crow's historical range to support a crow population upon reintroduction.

We conducted an updated detailed habitat assessment for the Mariana crow on Guam (USFWS 2015c). Our goals were 1) to identify lands suitable for reintroduction of the two species; 2) to determine how much habitat was needed to support survival and recovery of the species; and 3) to develop a method to offset loss of remaining habitat so that a minimum amount of habitat needed to support the species is permanently protected. The methods used to calculate crow habitat are provided below.

Methods for Habitat Calculations for the Mariana Crow

Recovery Targets
The delisting criteria from the draft revised recovery plan for the Mariana crow calls for a minimum of 225 territorial breeding pairs (75 on Rota, 75 in northern Guam, and 75 in southern Guam) (USFWS 2005a, p. v). Since the draft revised recovery plan was published in 2005, additional work on population viability of the Mariana crow has occurred. This recent assessment of population viability indicated that 75 territorial breeding pairs may not be viable over the long-term due to potential inbreeding depression (O'Grady et al. 2006) and projected increases in tropical storm intensity, duration, and frequency (Emanuel et al. 2008), and that 100

territorial breeding pairs may be a more appropriate recovery target (Amidon 2012, unpubl. data). Therefore, we used 100 territorial breeding pairs as our recovery target for this assessment for each of the three regions identified above.

A sustainable population of territorial pairs requires a floater population of juvenile and pre-breeding Mariana crows to replace any pair members that die. We utilized demographic information from the Rota population (Morton et al. 1999, Ha et al. 2010b, Zarones et al. 2013) to estimate a stable age distribution using the popbio package (Stubben and Milligan 2007) in the statistical program R (R Core Team 2014). We then used this distribution to determine the number of non-breeders needed to support the breeding population. Based on this analysis, an additional 96 adult Mariana crows (males and females), 54 juveniles and 42 pre-breeders, would be needed to support a breeding population of 100 territorial pairs at each of the three areas described above. We assumed that each of these birds would require space for foraging and roosting.

Finally, the long-term stability of the Mariana crow population is dependent on the availability of suitable breeding habitat and successful reproduction. Typhoons are a regular occurrence on Guam and Rota and are expected to affect the availability of suitable nesting sites and overall nesting success. Unfortunately, estimates of typhoon damage to nesting trees and demographic estimates of typhoon impacts on Mariana crow breeding success are limited. This assessment should be reconsidered when these data become available. In the interim, we will use more conservative estimates of habitat requirements and delineation of habitat areas (see below) to help account for some of these effects.

Density Estimates
Morton et al. (1999, p. 2) reported that Mariana crow territories ranged from 29.65 to 91.43 ac on Rota, with a mean territory size of 54.36 ac. Therefore, we utilized 54.36 ac as our estimate of forested habitat needed to support a breeding pair. Home range estimates for non-breeders were not available, and we do not currently have information on Mariana crow territory overlap. Therefore, we assumed that each bird would need approximately half a territory, 27.18 ac (11 ha).

Delineation of Crow Habitat
As noted above, Mariana crows are more likely to occur in native dominated forest. For this assessment, we assumed that all areas identified as limestone and ravine forests on the 2006 Forest Service landcover maps of Guam and Rota (Liu and Fisher 2006a,b) are potential Mariana crow habitat. We then updated the amount of available habitat on Guam by removing all forested areas cleared since the landcover map was completed using 2011 satellite imagery of Guam (Metevier 2014, unpubl. data). We then subdivided the remaining forested areas into potential and non-potential habitat based on forest patch area and isolation. We identified forest areas that were sufficiently large to support a Mariana crow territory using a “territory building” algorithm that we developed using the Raster package (Hijmans 2014) in the statistical program R. This algorithm accounted for the size of the territory and suitability of habitat, thereby omitting areas that were insufficient in size to meet the criteria of a Mariana crow territory. We then classified forest patches as too isolated for crow habitat if they were of insufficient size to hold three or more territories and if they were greater than 3.5 kilometers (the maximum

dispersal distance reported by Ha (2012, *in litt*.) for the Mariana crow on Rota) from the nearest neighboring patch of forest capable of supporting three or more territorial pairs. Remaining habitat for the Mariana crow is shown in Figure 7.

Estimated Crow Habitat Needed
Utilizing the recovery targets for the species and density information, approximately 5,436 acres of forest is needed to support 100 territorial breeding pairs. In addition, 2,609 acres of forested habitat would be needed to support the non-breeding crow population. Therefore, a total of 8,046 acres of forest habitat would be needed at each of the three regions (Rota, northern Guam, and southern Guam) to support the survival and recovery of the Mariana crow. However, the 8,046 acres supports the minimum number of breeding Mariana crows needed for survival and recovery of crows in the wild, and does not provide for natural population fluctuations below the recovery threshold. For instance, climate change is predicted to increase the frequency, intensity, and duration of storms in the area of the Mariana Islands by several percent over the next 100 years (Emanuel et al. 2008, p. 360), and this will likely increase the fluctuation of the northern Guam Mariana crow population and increase the acres of suitable habitat needed for the survival and recovery of the crow.

To prevent the crow population from fluctuating below the recovery threshold, additional habitat is required for protection against current and future severe storms. Severe storms (strong [category 3 and above] typhoons and super-typhoons) currently affect Guam every five to 10 years (FWS analysis of the Joint Typhoon Warning Center best track data 1975-2014). Climate modeling indicates that these storms will increase in the future (Emmanuel et al. 2008, p. 360). A single severe storm can significantly affect survival and reproduction in that breeding season. A 10 percent increase in breeding pairs (10 pairs) requiring an additional 544 acres of habitat will serve as added protection against population fluctuations due to climate change and other unforeseen natural and manmade events.

Based on the above analysis, the final area needed to support a viable Mariana crow population that maintains itself above the minimum recovery threshold is estimated to be 8,590 ac for each Mariana crow subpopulation in northern and southern Guam.

<u>Remaining Crow Habitat on Guam</u>

There is currently 13,962 acres of potential Mariana crow habitat left in northern Guam. However, very little of this remaining habitat is set aside for conservation (a total of 502 acres), and even less of that habitat is managed to control threats. There is currently 10,957 acres of Mariana crow habitat left in southern Guam. No crow habitat in southern Guam is set aside for conservation or managed to control threats.

In addition to lands being set aside for conservation, crow habitat needs to be managed for threats including brown treesnakes and other predators, invasive species, and ungulates. Most of the lands set aside for conservation are not currently managed to reduce threats. Therefore, it is urgent that habitat protection and management of Guam's forests begin immediately to prepare for the reintroduction, and potential recovery, of extirpated avian species. If crow habitat is degraded enough to no longer provide the ecological functions necessary to support Mariana

crows (for example, loss of native trees necessary for crow breeding and foraging), then this habitat will need to be removed from baseline calculations.

Furthermore, the habitat model does not account for differences in habitat quality. As described above, primary limestone forest is the highest quality habitat for the Mariana crow. Secondary limestone forest is of lower quality, but due to data mapping challenges, is counted equally in the habitat model. Given the current threats from military and civilian development, typhoons, invasive species, ungulates, and forest conversion, and the small amount protected habitat, it is imperative that conservation efforts begin to protect and enhance the quality of Mariana crow habitat on Guam.

Mitigation Framework
In light of on-going and increased habitat loss and degradation on Guam (as detailed in the General Environmental Baseline section) the Service has developed a draft Mitigation Framework to address future habitat conservation needs for the Mariana crow (USFWS 2015c). As land management actions are proposed that will affect recovery habitat needed for the conservation of the Mariana crow, it will be necessary to offset these effects by assuring that durable habitat will be protected and available for species reintroduction. This can be accomplished by ensuring that any habitat that is lost is offset with permanent habitat conservation at rates that ensure the minimum amount of habitat needed to support the survival and recovery of the Mariana crow on Guam.

The Mitigation Framework provides certainty that adequate minimum amounts of the remaining habitat will be available for species reintroduction in the future. We have recommended to the DON that they assure any habitat that is lost as a result of proposed projects is offset with permanent habitat conservation at a rate that ensures the minimum amount of habitat needed to support crow conservation will ultimately be available to support recovery of the species. Although not part of the project description, please refer to the MOA (DON and USFWS 2015), for information on kingfisher habitat that will be protected to ensure the survival and recovery of the kingfisher on Guam. The habitat that will be protected pursuant to the MOA may also provide conservation benefit to the Mariana crow (DON and USFWS 2015, p.3).

Environmental Baseline for the Guam Rail

Guam rails are extirpated from the action area; however, habitat suitable for recovery of the species ("recovery habitat") is present. For the purposes of this Section 7(a)(2) analysis on a species extirpated from the action area, we define "survival" of the species in terms of the amount of habitat needed to support a target recovered Guam rail population and "recovery" of the species as a point when this population is present on recovery habitat on Guam.

<u>Rationale for delineation of recovery habitat</u>

Survival and recovery of the Guam rail has required maintaining a population off-island or in captivity while threats from the brown treesnake are addressed on Guam. Retaining unoccupied habitat on Guam is essential for the recovery and survival of the species. The success of such

efforts is dependent on protecting a sufficient amount of habitat within the rail's historical range to support a viable rail population upon reintroduction on Guam.

Methods for Recovery Habitat Calculation for the Guam rail

Recovery Targets
Before the Guam rail is considered for downlisting from endangered to threatened, the repatriation of 1,000 birds to northern Guam and 1,000 birds to southern Guam (total = 2,000 individuals; USFWS 1990a, p. 33) would need to occur and brown treesnakes would need to be controlled on Guam (USFWS 1990a, p. 33-34). As mentioned above, no criteria were defined for delisting. However, Traill et al. (2009) proposed a minimum population target of 5,000 individuals as an appropriate target for species conservation.

Density Estimates
Engbring and Ramsey (1984) estimated Guam rail densities 0.07 to 0.33 birds per ha on Guam in 1981. The weka (*Gallirallus australis*), another rail species of conservation concern, had densities ranging from 0.3 to 0.8 birds per ha (Beauchamp 1987) while the Cocos buff-banded rails (*Gallirallus philippensis andrewsi*) typically had densities from four to nine birds per ha (Reid and Hill 2005). The Guam rail and weka densities both reflect species undergoing population declines. Therefore, their density estimates may not reflect the potential densities that could be obtained from a recovered population. However, because the maximum Guam rail density does overlap with the weka estimates it does serve as a good conservative estimate of potential densities until further data are collected. Therefore, to meet the population goal of 5,000 individuals on Guam we would need 41,184 ac (16,667 ha) (5,000 birds/0.3 birds per ha) of appropriate habitat on Guam. In addition, to meet the downlisting criteria of 1,000 birds in both northern and southern Guam then 8,236 ac (3,333 ha) (1,000 birds/0.3 birds per ha) of appropriate habitat would be needed in both northern and southern Guam.

Delineation of Recovery Habitat
Guam rails were predominately observed using scrubby secondary growth areas and the edges of mixed forest areas (Jenkins 1979, Engbring and Ramsey 1984). Jenkins (1979) reports that they were seldom observed in the interior of mature limestone forests or savanna areas and did not occur in wetlands. The Forest Service vegetation map of Guam includes the following vegetation types: 1) Limestone Forest, 2) Ravine Forest, 3) Palma Brava Grove, 4) Scrub Forest, 5) Leucaena Stand, 6) Casuarina Thicket, 7) Acacia Plantation, 8) Coconut Plantation, 9) Savanna Complex, 10) Strand Vegetation, 11) Other Shrubs and Grasses, 12) Agricultural Field, 13) Urban Builtup, 14) Urban Cultivated, 15) Barren Land, and 16) Wetlands (Liu and Fischer 2006a). Of these vegetation types, only Scrub Forest, Other Shrubs and Grasses, and Urban Cultivated were considered primary Guam rail habitats because they include shrubby edge habitats. The remaining forested areas were excluded because rails were less common in interior forested areas. Rails are thought to use the edges of these vegetation types, however, these areas are likely bordered by secondary scrub, shrub, and urban cultivated vegetation types which are included. Savanna complex also was not included though they may use the edge of this habitat types. Wetlands and barren lands were not included because the available data does not list these vegetation types being used by rails. Guam rails may use agricultural fields however there was no data available indicating they use these areas. Finally, Urban Builtup was excluded because

rails were not reported in urban areas and these areas likely do not contain appropriate habitat for the species.

In addition to vegetation type, patch size and proximity or distance between patches also were considered in the delineation of recovery habitat for the Guam rail. No information is available on the average size of a Guam rail territory. A related species, Lord Howe woodhens (*Gallirallus sylvestris*) have an average territory size of one to four ha (NSW National Parks and Wildlife Service 2002) while the weka (*Gallirallus australis*) have an average territory size of two or five ha depending on location (Beuchamp 1987). If we are conservative and assume the maximum territory of a Guam rail is similar to the weka then any patch less than 10 ha (the average territory size of two weka pairs [5 ha x 2]) and over one kilometer away from the nearest patch is likely too small and isolated to be viable habitat for rail recovery. In addition, all patches less than one ha (the minimum territory size of a Lord Howe woodhen) and 125 meters (the approximate radius of a five ha territory) from the nearest patch above one ha is considered too isolated and small to be viable habitat for rail recovery. Finally, any patch less than 10 ha and completely isolated by the nearest patch by lands classified as Urban Builtup (excluding roads) by the Forest Service is considered too isolated to be viable rail habitat due to the potential for urban developed areas to impede movement of rails. The remaining recovery habitat for the Guam rail is shown in Figure 8.

Estimated Recovery Habitat Needed
Based on the density information and the population goal of 5,000 individuals on Guam to achieve conservation of the Guam rail, we would need 41,184 ac (16,667 ha) (5,000 birds/0.3 birds per ha) of appropriate habitat on Guam. In addition, to meet the downlisting criteria of 1,000 birds in both northern and southern Guam then 8,236 ac (3,333 ha) (1,000 birds/0.3 birds per ha) of appropriate habitat would be needed in both northern and southern Guam.

Remaining Recovery Habitat on Guam

Based on the above, there are approximately 24,698 ac (9,995 ha) and 24,886 ac (10,063 ha) of recovery habitat in northern and southern Guam, respectively, for the Guam rail. However, very little of this habitat is protected for the conservation of the Guam rail. Although a quantitative habitat assessment of the protected areas for use by Guam rails has not been conducted, approximately 500 acres have been protected for the Mariana crow and Guam Micronesian kingfisher in northern Guam (USFWS 2015c, p. 3). Rails would be expected to use much of the edges of forest patches, secondary forest and scrub within the approximately 500 acres of protected habitat. No recovery habitat in southern Guam is set aside for conservation.

In 2012, the GNWR proposed approximately 125 acres of habitat on the GNWR's fee simple land to be managed for Guam rails. This area would eventually support the reintroduction of Guam rails within the GNWR. However, this proposal was put on hold in 2014 because of the DON's proposed establishment of the LFTRC surface danger zone within the fee simple land. The GNWR is in the process of evaluating the feasibility of this proposal and whether to move forward with it, in consideration of the proposed action and the future access constraints to the GNWR (J. Schwagerl, USFWS, pers. comm. 2015).

Lands set aside for conservation on Guam and recovery habitat needs to be managed for threats including brown treesnakes and other predators, invasive species, and ungulates. Most of the lands set aside for conservation are not currently managed to reduce threats. In addition, the loss, degradation, and fragmentation of recovery habitat due to urban development continues to threaten the Guam rail.

Environmental Baseline for the Mariana fruit bat

Mariana fruit bat population on Guam

Other than a few isolated periods of increase, Mariana fruit bats have been declining on Guam since the early 1900's (Wiles 1987b, p. 1; USFWS 2009d, pp. 6–7 and references cited therein). Although the decline of the fruit bat was likely initiated by the introduction of firearms and increased hunting efficiency in the early 1900's, predation by the brown treesnake contributed to continued decline (Wiles et al. 1987, p.148; Lemke 1992, p. 137; Wiles et al. 1995, p. 32; Janeke 2006, p. 3; Brooke 2008, p. 2; USFWS 2009d, p. 19, 30). By 1995, nearly all of Guam's remaining fruit bats were located on AAFB (Wiles et al. 1995, p. 39). In 2006, the only known maternity colony on Guam was located on AAFB at Pati Point and had less than 100 individuals (Janeke 2006, p. 4). By 2010 the Pati Point colony no longer existed, and no other colonies are known to currently exist on Guam (SWCA 2012, p. 20, DON 2014c, p. 2).

As described below, individual bats have been detected at multiple locations on Guam in the past seven years (Figure 9):

Northern Guam (GNWR, AAFB, Finegayan, and Haputo)

- In July 2014, a large-scale survey throughout AAFB resulted in an estimate of 8-21 bats (DON 2014c, p. 2).
- Surveys on AAFB in 2012 recorded 50 detections of bats at 84 stations, some of which could be the same individuals. Bats were primarily recorded along the cliffline extending from above the Combat Arms Training and Maintenance (CATM) Range east to Pati Point, in the MSA, and in the vicinity of the HMU (SWCA 2012, p. 58).
- In 2011, three bats were observed flying west along the beach in front of the headquarters at GNWR (Schwagerl, pers. comm., 2015).
- Extensive surveys throughout AAFB from December 2010 to December, 2011, resulted in a conservative estimate of approximately 25 fruit bats (DON 2014c, p. 48)
- From 2010-2013, a single bat was observed flying across Route 3A on six occasions; four observations of a bat flying into the HMU from Finegayan, and two observations of a bat flying out of the HMU into Finegayan in the late afternoon (J. Schwagerl, USFWS, pers. comm. 2015). Fruit bats from AAFB may use forested areas of Finegayan for foraging and roosting.
- During 10 observation days in 2008, one fruit bat was observed in the Haputo ERA and one in the northeastern portion of Finegayan (Brooke 2008, p. 1). The Haputo ERA contains some of the best remaining fruit bat habitat on the DON-managed lands (Brooke 2008, p. 2; DON 2010c; DON 2013b).

Naval Magazine, Naval Base Guam, and Southern Guam

- In August, 2014, two observations of a Mariana fruit bat in flight occurred at Fena Reservoir within the NMS (L. Takano, USFWS, pers. comm. 2014).
- In May and June of 2012 seven detections of a single fruit bat were recorded during surveys on six separate occasions at four locations on the NMS; it could not be determined whether observations were of a single individual or multiple individuals (DON 2014a, p. 48).
- In 2012, fruit bat surveys were conducted within the NMS and a private lands site located in southern Guam (DON 2013b). Seven observations were recorded of a solitary fruit bat in flight at NMS, but it could not be determined if these observations represent one, or multiple bats (DON 2013b, p. 11). These observations supplement fruit bat sightings previously documented in the vicinity of the NMS where foraging and roosting habitat is present (Brooke 2008, pp 1-2). No observations were recorded at the private lands site where suitable fruit bat roosting and foraging habitat is limited. However, known food plants of Mariana fruit bats are present in the vicinity and fruit bats may use the area for roosting, foraging, and commuting (DON 2013b, p. 12).
- One bat was sighted on NBG lands in 2008 during 90 hours of fruit bat surveys at 14 survey locations on or near NBG lands. (DON 2014a, p. 48).

<u>Threats to the Mariana fruit bat on Guam</u>

In addition to the threats described in the General Environmental Baseline section, the following threats also affect Mariana fruit bat populations on Guam.

Hunting
Humans have been using Mariana fruit bats as a food source since human arrival in the Mariana Islands, and consumption of bats represents a significant Chamorro cultural tradition (Lemke 1992, p. 135; Sheeline 1991, p. 14). Demand for fruit bats for human consumption is clearly demonstrated by the large commercial trade in bats that existed in the Marianas in the late 1960's until it became illegal through the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES; Wiles and Payne 1986, p. 143; Stinson et al. 1992, p. 63-66; Wiles et al. 1997, p. 204; CITES 2015). It is estimated that approximately 221,000 fruit bats were imported to Guam between 1975 and 1989 (Wiles 1992, p. 54). Illegal hunting appears to be the key reason for the fruit bat's dramatic decline on Guam (Wiles 1987b, p. 154; Wiles and Brooke 2009; USFWS 2009d, p. vii).

Currently, although bats are protected by law on Guam, they are probably still hunted opportunistically on private property when they transit the island, and by deer hunters on AAFB (GNWR, unpublished data, 2005). For example, in 2007, construction of approach lighting at the north field on AAFB began, and included clearing of native limestone forest near Pati Point. During the construction period, reports were made of construction workers illegally hunting fruit bats at the Pati Point colony. The number of fruit bats at the colony declined from 55 bats (summer 2007) to 21 bats (December 4, 2008 survey) (PEER 2009). A recreational public hunting program has been in effect on AAFB since 1964, is still in effect (D. Lujan 2015, pers. comm.), and is managed by a small group of hunters known as the Volunteer Conservation Officers (VCOs). The public is authorized to hunt on weekends in designated areas, and VCOs may hunt after regular working hours during the week. All hunting effort is documented by the

VCOs. Currently, archery-only hunting is allowed in four areas (D. Lujan 2015, pers. comm.); shotgun and muzzle loading hunting is no longer allowed. Elimination of shotgun and muzzle-loading hunting is likely to reduce the chance of fruit bat hunting on AAFB; however, it is possible that fruit bats are still hunted opportunistically on AAFB. SWCA (2012, p. 58) reported that roosting fruit bats were approached by observers as close as 16 ft (5 m), and suggested that hunters could, without difficulty, shoot and kill a roosting bat.

Opportunistic hunting of fruit bats is suspected to occur during hunting of ungulates (Wiles 1987b, p. 154; Janeke 2006, p. 67; USFWS 2009d, p. 24; SWCA 2012, p. 60). In 2007, the Chief Conservation Officer (CCO) of the AAFB Hunting Program reported that poaching of deer was occurring in areas where hunting was not authorized. This same CCO issued Letters of Suspension to four VCOs, and a Removal from Program letter to one VCO for violations against Guam hunting regulations, Base Instructions and program depredation policies (PEER 2009).

Noise

Currently air traffic is the primary source of noise disturbance for fruit bats on Guam (SWCA 2008, p. 2-3; SWCA 2012, p. 23, 37). The first known study examining the effects of aircraft overflights on Mariana fruit bats on AAFB was conducted when a colony of approximately 400 bats still roosted at Pati Point (Morton 1996). During this study, roosting fruit bats responded to some low-altitude aircraft overflights with distress and flushing, which increased time spent in alert, aggression, and maintenance behaviors. Four-engine carriers and bombers generally elicited a greater response from roosting bats than fighter aircraft. Morton (1996, p. iii) suggested that higher levels of air-traffic volume would result in increased energy expenditure and perhaps roost abandonment by some or all of the bats.

In 2006, the effects on fruit bats from noise resulting from increased jet aircraft and helicopter use at AAFB were analyzed in the ISR Strike Biological Opinion (USFWS 2006b). In that consultation, noise effects were expected to adversely affect the Mariana fruit bat to the extent that the nearby Pati Point colony would be abandoned, and fruit bats relocating from Pati Point to other, less-protected areas on the island likely would be shot opportunistically by hunters (USFWS 2006b, p. 49). In the ISR Strike Biological Opinion, we concluded that fruit bats on Guam would be taken as a result of the proposed action, but that this take would not jeopardize the continued overall existence of the Mariana fruit bat (USFWS 2006b, pp. 49–52).

In 2007-2008, another study was conducted to document potential effects of aircraft noise on fruit bats at AAFB (SWCA 2008). During this period, the number of fruit bats at the Pati Point colony had decreased to an average of 40 bats. Aircraft noise affected the Mariana fruit bats by increasing maintenance behaviors following overflights compared to no overflights. However, the proportion of bats displaying maintenance behavior following an overflight was variable. Overflights did not appear to affect active thermoregulation. Six percent of overflights resulted in flushing events, and all flushing events were at noise levels exceeding 106 dBC, the highest reading being 122.6 dBC (SWCA 2008, pp. 2-3).

In 2010, another study was conducted to assess the effects of aircraft noise on Mariana fruit bats at AAFB (SWCA 2012). By 2010, the colony at Pati Point no longer existed. Although up to eight individual fruit bats were observed roosting there at any one time, most departed the site by

the end of each sampling period, indicating the site was no longer used as a colonial roost (SWCA 2012, p. 2). Increases in active thermoregulation (32 percent), maintenance (14 percent), locomotion (74 percent), and alertness (62 percent) were recorded during aircraft overflights. All flush events were at recorded peak noise levels above 90 dBA/101 dBC; the highest reading at 124.9 dBA/125.5 dBC (two F-15 aircraft). The observed flush events were associated with fighter, bomber, transport, and helicopter aircraft overflights (SWCA 2012, p. 23, 37).

In 2015, the MITT Biological Opinion was signed (USFWS 2015b) and the Service found that implementation of the MITT program, including aircraft overflights and other training, was compatible with a fruit bat roost site at Pati Point, but noise caused by nighttime training activities would adversely affect the foraging behavior of fruit bats at AAFB and NMS.

Some evidence suggests that fruit bats may also be affected by artillery noise at the existing CATM range at Tarague. When the fruit bat colony was still roosting at Pati Point, a DAWR Wildlife Biologist observed fruit bats avoiding the firing range area as they left the roost to fly to their foraging grounds. Some flew away from land over the ocean, and returned to land by the Tarague beach area. Others flew up to the cliff line heading towards MSA I (ISR Strike area). These observations occurred while the firing range was active around on two different days. During the time period between the two observations, the number of bats in the colony dropped from approximately 40 to less than 20 individuals. When the firing range was inactive, bats were observed to fly along the cliff line near the range (J. Quitugua, DAWR, pers. comm. 2015).

Typhoons
Mariana fruit bats evolved in the presence of typhoons, the principal natural disturbance in the archipelago, but today these storms are a threat to the species because they can exacerbate the effects of the anthropogenic threats listed above (USFWS 2009d, p. 34). Evidence from Rota suggests that typhoons may not be a substantial source of direct mortality for fruit bats (Stinson et al. 1992, p. 65; Esselstyn et al. 2006, p. 536). However, the synergistic effect of illegal hunting and severe storms on Mariana fruit bats is documented on Rota (e.g., Stinson et al. 1992; Esselstyn et al. 2006). Severe storms can alter fruit bat foraging and roosting behavior by decimating food resources, removing protective foliage cover, temporarily modifying forest structure, and changing vegetation composition, especially by facilitating encroachment of non-native species. Loss of food resources can drive bats to forage on the ground, during daylight hours, and closer to areas of human activity; thereby increasing their vulnerability to illegal hunting (Stinson et al. 1992, p. 65; Esselstyn et al. 2006, p. 532).

Recovery Criteria

A draft revised recovery plan for the Mariana fruit bat (USFWS 2009d) addressed actions needed for the survival and recovery needs of the Mariana fruit bat. Since publication of the draft revised recovery plan, new information on the Mariana fruit bat has resulted in changes to how we look at recovery for the species. We now consider recovery in terms of stable or increasing subpopulations of sufficient size distributed across Guam and the Mariana Islands. To meet recovery objectives, stable or increasing fruit bat subpopulations should at a minimum be distributed on the islands that currently have extant populations (USFWS *in review*). Actions

that reduce or eliminate the potential for self-sustaining populations of resident fruit bats on Guam may hamper or preclude recovery of the species. The reduction or elimination of this potential may take many forms: degradation or loss of habitat and resources required by the fruit bat for foraging, roosting, and reproduction; increased exposure of fruit bats to illegal hunting and other sources of human disturbance; and introduction of non-native predators that prey upon fruit bats. In order for the Mariana fruit bat's population to recover on Guam, sufficient amounts of functional habitat will need to be protected and restored on Guam (USFWS 2009d).

Guam contains a large proportion of the remaining native limestone forest in the southern inhabited Mariana Islands, and most of that habitat is located within DOD lands. Habitat loss and degradation, illegal hunting, predation by non-native predators, and human disturbance currently impact fruit bats within the action area. If threat levels increase within fruit bat habitat in the action area, it may further inhibit the potential for the species to recover.

Mariana fruit bat survival and recovery habitat

Although Mariana fruit bats have been observed in a variety of habitat types, they are more likely to occur in native primary or secondary limestone forest (see Status of the Species above). Mariana fruit bat populations that have been subject to intense hunting pressure (e.g., populations on Saipan, Tinian, Rota, and Guam) are sensitive to human presence, and in recent history, maternity roosts are not known to occur in close proximity to areas inhabited by humans (Wiles 1987b, p. 151; J. Boland, unpublished data 2008-2014). However, fruit bats may forage on or near human-inhabited lands, in spite of hunting pressure (Wiles 2006, pers. comm. as cited in USFWS 2006b; Boland 2008-2015, pers. obs.). Therefore, for this assessment, we assumed that all areas identified as limestone and ravine forests on the 2006 Forest Service landcover maps (Liu and Fisher 2006a) are potential habitat for the fruit bat on Guam. We then updated the amount of available habitat on Guam by removing all forested areas cleared since the landcover map was completed using 2011 satellite imagery of Guam (Metevier 2014, unpubl. data). Although primary limestone forest is higher quality habitat that secondary limestone forest, habitat quality was not accounted for in these calculations due to mapping challenges, and habitat quality as it relates to hunting and predation threats was also not accounted for. As such, our estimate of available survival and recovery habitat (hereafter, referred to as habitat) on Guam is likely inflated.

Using the methods above, the total area of potential fruit bat habitat on Guam was estimated to be 27,096 acres (Figure 9). In order for native limestone forest to serve as habitat for the fruit bat, it will need to be managed for threats to the species, including brown treesnakes, illegal hunting, invasive plant species, and ungulates. Only 576 acres of this habitat is set aside for conservation. Most of the lands set aside for conservation are not currently managed to reduce threats. Therefore, it is urgent that habitat protection and management of Guam's forests begin immediately to allow for recovery of the Mariana fruit bat. If habitat is degraded enough to no longer provide the ecological services necessary to support the fruit bat, then this habitat will need to be removed from baseline calculations.

Mariana fruit bat densities

Estimates of bat density have been calculated for each of the Mariana Islands (DON 2013d, p. 46). The highest bat density is found on the most protected island, Asuncion Island, and is 1.81 bats per forest hectare. Rota has the highest bat population density in the southern part of the archipelago with 0.36 bats/hectare. Using calculations established by DON 2013d (p. 26, 45), and our estimate of 27,096 acres of existing fruit bat habitat, the estimated carrying capacity for fruit bats on Guam is 14,970 bats.

Environmental Baseline for *Serianthes nelsonii*

Rationale for delineation of recovery habitat

Recovery of the *Serianthes nelsonii* requires the permanent protection of sites that contain individuals of this species (USFWS 1994, p. 27). The target for delisting *S. nelsonii* (as described above) requires augmenting existing populations and reestablishing this plant in its former range (USFWS 1994, pp. 33-36). The conservation of recovery habitat is essential, not only to reaching this target, but to ensuring the continued survival and recovery of this species.

Methods for Recovery Habitat Calculation for *Serianthes nelsonii*

On Guam and Rota, *Serianthes nelsonii* trees were reported at elevations ranging from 120 to 420 meters (USFWS 1994, p. 7) and were found primarily in native dominated forests on limestone or volcanic substrates (Raulerson and Rinehart 1991, p. 42; USFWS 1994, pp 6-7; Wiles et al. 1996, p. 229). We therefore assumed that all remaining limestone and ravine forest, as classified by the U.S. Forest Service (Liu and Fisher 2006a), between 120 and 420 meters elevation were potential habitat for the species. Therefore, approximately 11,668 acres of habitat for *S. nelsonii* remains on Guam (Figure 10).

Status of the Species in the Action Area

The action area encompasses the entire adult population of *Serianthes nelsonii* on Guam, and is comprised of one adult tree of unknown age. The last remaining adult tree continues to produce seeds, but the structure and health of the tree itself is precarious due to a variety of factors (DON 2014a, p. 58; AAFB 2015, p. 4). The tree has begun to lean in recent years (AAFB 2015, p. 4), and there has been historical storm damage, including snapping and loss of branches (J. McConnell, UOG, pers. comm. 2014). It is at further risk of toppling due to termite damage, which is visible along the trunk, and a large amount of saprophytic or epiphytic ferns which have concentrated growth within a shallow cavity on the trunk (AAFB 2015, p. 4). In addition, the canopy of the tree has experienced recent extensive defoliation, probably due to insect herbivory from *E. blanda* butterflies (AAFB 2015, p. 4).

The area surrounding the fenced tree is comprised of rugged primary limestone karst forest. Although the area around the tree is currently fenced to prevent ungulate access, researchers are trying to understand why seedling mortality around this adult is close to 100 percent mortality (DON 2014, p. 11). Ungulate incidence and browsing is evident outside the small exclosure around the tree, as are nearby areas of past disturbance from military activities (e.g., clearings, ordnance). However, the heavily forested area around the adult tree is diverse

with native plant species characteristic native limestone forests in the Marinas including, but not limited to, *Ochrosia mariannensis*, *O. oppositifolia*, *Eugenia reinwardtiana*, *Syzygium thompsonii*, *Macaranga thompsonii*, *Guamia mariannae*, and *Pisonia grandis*. Despite the presence of some pest species and habitat disturbance, the cliffline area surrounding the adult *S. nelsonii*, especially the forested karst outcrops, is relatively undisturbed, high quality, diverse habitat suitable for multiple protected species, including *S. nelsonii*.

A large portion of the LFTRC footprint is in habitat currently being managed to eradicate ungulates. This area was designated as mitigation for a previous DoD action (USFWS 2006b), and falls within the Overlay Refuge. In addition, the DoD has several current projects and projects in the near future that may affect *S. nelsonii* habitat (refer to General Environmental Effects section).

As mentioned above, several recovery actions have been initiated recently for this species. However, the adult within the footprint of this action remains the sole reproducing tree on the island of Guam. The Guam adult tree is particularly important for maintaining the genetic diversity within this species (USFWS 1994, p. 21). In addition, the individuals outplanted at the GNWR within the proposed SDZ, are offspring of the Guam adult tree. They constitute much of the entire Guam genetic lineage of *S. nelsonii*, and all are within the proposed project's footprint. Their survival is crucial to maintaining genetic diversity of this species. The 31 outplanted individuals on GNWR, four months after outplanting, have 100 percent survival and all have experienced physical growth. However, daily monitoring, netting to exclude large insects, regular watering, small insect removal by hand, and other protective treatments were applied (E. Demeulenare, pers. comm. 2015).

F. STATUS AND ENVIRONMENTAL BASELINE OF CRITICAL HABITAT

Status and Environmental Baseline of Guam Micronesian Kingfisher Critical Habitat

Approximately 376 ac (152 ha) were designated as critical habitat for the Guam Micronesian kingfisher on Guam (USFWS 2004, 46 pp). Critical habitat for the kingfisher was identified using guidelines from the Guam forest bird recovery plan (USFWS 1990a). Because the kingfisher does not exist in the wild and all suitable habitat presently is unoccupied, inclusion of unoccupied areas is essential to the conservation of this species. Recovery to the point where the protection afforded by listing is no longer necessary will require restoration of the kingfisher through release of captive birds and subsequent natural dispersal into areas of Guam that formerly were inhabited.

<u>Primary Constituent Elements</u>

The primary constituent elements required for the Guam Micronesian kingfisher for the biological needs of foraging, sheltering, roosting, nesting, and rearing of young are found in areas that support limestone, secondary, ravine, swamp, agricultural, and coastal forests

containing native and introduced plant species. These forest types include the primary constituent elements of:

1. Closed canopy and well-developed understory vegetation; large (minimum of approximately 17 in (43 cm) dbh), standing dead trees (especially *Tristiropsis obtusangula*, *Pisonia grandis*, *Artocarpus* spp., *Ficus* spp., and *Cocos nucifera*); mud nests of *Nasutitermes* spp. termites; and root masses of epiphytic ferns for breeding;
2. Sufficiently diverse structure to provide exposed perches and ground surfaces, leaf litter, and other substrates that support a wide range of vertebrate and invertebrate prey species for foraging kingfishers; and
3. Sufficient overall breeding and foraging area to support kingfisher territories of approximately 25 ac (10 ha) each.

Guam Critical Habitat Unit

The Guam critical habitat unit consists of approximately 376 ac (152 ha) of land in the fee simple portion of the GNWR. The vegetation in this designated unit consists of coastal, limestone, and secondary forests composed of native and introduced species that contain the full range of primary constituent elements required for the long-term conservation of the Guam Micronesian kingfisher in northern Guam. This unit includes forested areas along the northwestern coasts of the island that were occupied by kingfishers in the 1970s and early 1980s (USFWS 2004, p. 62951). This unit also encompasses essential conservation areas identified in the forest bird recovery plan for northern Guam (USFWS 1990a, p. 49), and areas identified for recovery in the revised recovery plan for the kingfisher (USFWS 2008a).

Current threats to Guam Micronesian kingfisher critical habitat in the action area include habitat loss, degradation, and fragmentation due to development, military training, and fire, human disturbance, introduced ungulates, invasive plants, and non-native predators. Actions that exacerbate these threats or result in new threats, individually or in combination, may result in appreciably decreasing habitat value or quality of habitat necessary for the recovery and survival of kingfishers on Guam.

Recent conservation actions in the Guam critical habitat unit include construction of a multi-species exclosure fence at the GNWR at Ritidian Point, brown treesnake trapping and ungulate removal within the exclosure fence; and outplanting of native trees.

Status of Mariana Crow Critical Habitat

In 2004, the Service designated approximately 376 ac (152 ha) on Guam, and 6,033 ac (2,552 ha) on Rota, as critical habitat for the Mariana crow (USFWS 2004, 46 pp). Critical habitat for the Mariana crow on Guam was identified using the recommendations provided by the Mariana crow recovery team for the draft revised recovery plan (USFWS 2004). The Service also used the recommendation of the recovery team to identify one unit for the Mariana crow on Rota (USFWS 2004). For the conservation of the Mariana crow, recovery recommendations and the draft revised recovery plan (USFWS 2005a) call for established populations in northern Guam, in southern Guam, and on Rota.

The Service included unoccupied habitat in the designated critical habitat for the Mariana crow on Guam because the occupied habitat (as of 2004) alone was not sufficient to provide for the conservation of the species. Mariana crows are territorial; each pair defends an area of a size determined by forest type and structure (Morton et al. 1999). The maximum density or carrying capacity of crow pairs in a particular area depends on both habitat quality (for foraging and breeding) and the spatial arrangement of territories. Because of the territorial nature of the Mariana crow, its small total population size, limited range, vulnerability to environmental threats, and recovery goals drafted for the species, inclusion of unoccupied areas on Guam is essential to the conservation of the species. Recovery to the point where listing is no longer necessary will require restoration of Mariana crows on Guam through natural dispersal, translocation, and/or release of captive birds in areas that were formerly inhabited but that are not currently occupied. For this population to persist over the long term, it must expand onto adjacent lands that now are unoccupied.

The critical habitat unit for the Mariana crow on Rota reflects the goal of establishing and maintaining a population of at least 75 territorial breeding pairs on Rota and the estimation of the areas necessary to meet this goal (USFWS 2004). However, a recent assessment of population viability indicated that 75 territorial breeding pairs may not be viable over the long-term and that 100 territorial breeding pairs may be a more appropriate recovery target (Amidon 2012, unpubl. data). Therefore, we currently 100 territorial breeding pairs as our recovery target for the Rota population; however the critical habitat unit has not yet been revised to reflect this.

Primary Constituent Elements

The primary constituent elements required by the Mariana crow for the biological needs of foraging, sheltering, roosting, nesting, and rearing of young are found in areas that support limestone, secondary, ravine, swamp, agricultural, and coastal forests composed of native and introduced plant species. Guam and Rota experience a high frequency of severe storms, and these regularly and significantly alter forest structure. Therefore, sufficient habitat area is necessary to absorb the variable impacts of these natural disturbances and still maintain the integrity of the primary constituent elements to support crow populations. These forest types provide the primary constituent elements of:

1. Emergent and subcanopy trees with dense cover for breeding such as *Neisosperma oppositifolia*, *Macaranga thompsonii*, *Intsia bijuga*, *Premna obtusifolia*, *Eugenia reinwardtiana*, *Ficus* spp., *Elaeocarpus joga*, and *Tristiropsis obtusangula*;
2. Sufficient area of predominantly native limestone forest to allow nesting at least 950 ft (290 m) from the nearest road and 203 ft (62 m) from the nearest forest edge and to support Mariana crow breeding territories (approximately 30 to 91 ac (12 to 37 ha)) and foraging areas for nonbreeding juvenile crows; and
3. Standing dead trees and plant species for foraging, such as *Aglaia mariannensis*, *Artocarpus* spp., *Cocos nucifera*, *Neisosperma oppositifolia*, *Hibiscus tiliaceus*, *Intsia bijuga*, *Leucaena*, *Ochrosia mariannensis*, *Pandanus tectorius*, *Neisosperma oppositifolia*, *Ficus* spp., and *Elaeocarpus joga*.

Threats

Threats to Mariana crow critical habitat on Rota and Guam include development, habitat clearing, human disturbance, habitat fragmentation and degradation, introduced ungulates, invasive plants, and non-native predators.

Environmental Baseline for Mariana Crow Critical Habitat

The Guam critical habitat unit consists of approximately 376 ac (152 ha) of land in the fee simple portion of the GNWR. This unit includes limestone, secondary, and coastal forests composed of native and nonnative plants and contains the full range of primary constituent elements needed for long term conservation of the Mariana crow on Guam. This area includes lands in the 1994 historical distribution of Mariana crows in northern Guam (Wiles et al. 1995) and areas that contained crows in northern Guam in 1981 (Engbring and Ramsey 1984). This unit was also identified by the Mariana crow recovery team as important recovery habitat in the draft revised Mariana crow recovery plan (USFWS 2005a).

Current threats to Mariana crow critical habitat in the action area include habitat loss, degradation, and fragmentation due to development, military training, and fire, human disturbance, introduced ungulates, invasive plants, and non-native predators. Actions that exacerbate these threats or result in new threats, individually or in combination, may result in appreciably decreasing habitat value or quality of habitat necessary for the recovery and survival of Mariana crows on Guam.

Recent conservation actions in the Guam critical habitat unit include construction of a multi-species exclosure fence at the GNWR at Ritidian Point, brown treesnake trapping and ungulate removal within the exclosure fence; and outplanting of native plants.

Status and Environmental Baseline of Mariana Fruit Bat Critical Habitat

Approximately 376 ac (152 ha) were designated as critical habitat for the Mariana fruit bat on Guam (USFWS 2004, 46 pp). Critical habitat was identified using the guidelines provided by the Mariana fruit bat recovery plan (1990). Although the current population of Mariana fruit bats on Guam is small, and most bats roost in a limited area, the foraging behavior and diverse diet of the fruit bats cause them to use most of the island for foraging, as documented by Wiles et al. (1995). Thus, all of the designated critical habitat for this species is used for foraging and/or roosting and is considered occupied.

<u>Primary Constituent Elements</u>

The primary constituent elements required by the Mariana fruit bat for the biological needs of foraging, sheltering, roosting, and rearing of young are found in areas supporting limestone, secondary, ravine, swamp, agricultural, and coastal forests composed of native and introduced plant species. These forest types provide the primary constituent elements of:

1. Plant species used for foraging, such as *Artocarpus* spp., *Carica papaya*, *Cycas circinalis*, *Ficus* spp., *Pandanus tectorius*, *Cocos nucifera*, and *Terminalia catappa*; and

2. Remote locations, often within 328 ft (100 m) of clifflines that are 260 to 590 ft (80 to 180 m) tall, with limited exposure to human disturbance and that contain mature *Ficus* spp., *Mammea odorata*, *Casuarina equisetifolia*, *Macaranga thompsonii*, *Guettarda speciosa*, *Neisosperma oppositifolia*, and other tree species that are used for roosting and reproductive activity.

Guam Critical Habitat Unit

The Guam critical habitat unit consists of approximately 376 ac (152 ha) of land in the fee simple portion of the GNWR. The vegetation in this unit consists of coastal, limestone, and secondary forests composed of native and introduced plant species and contains the full range of primary constituent elements needed for the conservation of the Mariana fruit bat. This area is important because it contains areas used for foraging by the last known Mariana fruit bat colony (currently abandoned) on Guam. This area also contains roosting and foraging sites historically and currently used by bats (USFWS 2004, p. 62951; J. Schwagerl, Service, pers. comm. 2015). This unit also encompasses essential conservation areas identified in the Mariana fruit bat recovery plan (USFWS 1990b); the draft revised recovery plan (USFWS 2009d) does not contain specific areas for recovery.

Current threats to Mariana fruit bat critical habitat in the action area include habitat loss, degradation, and fragmentation due to development, military training, and fire, human disturbance, introduced ungulates, invasive plants, and non-native predators. Actions that exacerbate these threats or result in new threats, individually or in combination, may result in appreciably decreasing habitat value or quality of habitat necessary for the recovery and survival of fruit bats on Guam.

Recent conservation actions in the Guam critical habitat unit include construction of a multi-species exclosure fence at the GNWR at Ritidian Point, brown treesnake trapping and ungulate removal within the exclosure fence; and outplanting of native plants including *Serianthes nelsonii*.

G. EFFECTS OF THE ACTION

Exposure Analysis Approach

The Service has developed an analysis framework for section 7 consultations that incorporates the general structure, primary concepts, and nomenclature of the U.S. Environmental Protection Agency's ecological risk assessment framework (USFWS 2005c). Factors causing adverse effects are called "stressors" and beneficial effects are called benefits. In this approach, the Service determines the resources that will be exposed to the proposed action's stressors and benefits by evaluating the location, timing, duration, frequency, and intensity of potential exposure to each stressor and benefit, and identifying the physical, chemical, and biotic features that will be directly and indirectly exposed. Then the causal relationships between sources of stressors and benefits and the response of listed resources are analyzed. The exposure analysis

also estimates future changes in the abundance or distribution of listed species expected to result from exposure to stressors and benefits.

The proposed action's stressors and benefits may include the following actions:

- Construction and operation of the main cantonment at Finegayan
- Construction and operation of family housing on AAFB
- Construction and operation of the LFTRC
- Utilities and site improvements
- Construction of well field and associated AAFB distribution system
- Roadway projects
- Training at NMS
- Construction of facilities at Apra Harbor
- Construction of new facilities at AAFB
- Hand grenade range at Andersen South
- Aviation training at NMS and AAFB
- Forest enhancement project at Finegayan
- Brown treesnake exclosure projects
- Invasive species planning

For purposes of this analysis, the term of effects associated with the permanent destruction of listed species habitat caused by the above construction projects and associated with the operation of the above facilities is considered to be indefinite.

NOTE: As mentioned above, although not part of the project description, an MOA between the DON and the Service regarding conservation of the Guam Micronesian kingfisher recovery habitat in northern Guam was signed on June 11, 2015. The purpose of the MOA is to ensure that a sufficient amount of suitable survival and recovery habitat is conserved and managed in accordance with Federal agency obligations under section 7(a) of the ESA in northern Guam to support the reintroduction of the Guam Micronesian kingfisher and to ensure that the DON meet the purpose and need for the proposed action (DON and Service 2015c, p. 1). Because of the signatory level of the MOA, it provides a high level of assurance that commitments in the MOA will be carried forward to benefit the kingfisher and its habitat on Guam. However, in the absence of implementation of the MOA, our analysis in this Biological Opinion may need to be revisited.

General Effects of the Action

The following section discusses the likely effects of the proposed action on listed species and habitats. The analysis is followed by an assessment of how those effects will specifically affect the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, Guam rail, and *Serianthes nelsonii*, and their habitats.

<u>Habitat Loss, Degradation, and Fragmentation (All Species)</u>

The proposed action will result in habitat loss, degradation, and fragmentation (including edge effects) from clearing, indirect and induced development, fire, and noise. Definitions and descriptions of habitat fragmentation and edge effects are described above in the Environmental Baseline section. The habitat loss, degradation, and fragmentation will decrease the amount of suitable habitat for recovery of listed species on Guam. Habitat suitable for the survival and recovery of the Guam Micronesian kingfisher, Guam rail, Mariana crow, Mariana fruit bat, and *Serianthes nelsonii* has been delineated on Guam (Amidon *in litt*., 2012). The amount of habitat for each species that will be cleared by the proposed action is shown in Table 6.

Table 6. Anticipated loss of listed species habitat on Guam resulting from project-related development.

	Habitat Cleared (acres)			
PROJECT	***Serianthes nelsonii***	**Mariana Crow**	**Guam Rail**	**Guam Micronesian Kingfisher & Mariana fruit bat**
North				
2010 ROD Related Project Areas	43.41	50.39	345.58	51.53
Communication Utilities	19.32	17.53	68.05	17.47
Electrical and Water Off Site Utilities	6.40	11.42	34.91	11.32
LFTRC Northwest Field	160.27	183.77	40.17	186.66
LFTRC Northwest Field Off Site Utilities and Access Road	15.19	7.23	18.89	7.40
LFTRC Stand Alone Hand Grenade Range	0.00	0.00	8.91	0.00
MC/FH Finegayan/AAFB	596.43	640.31	436.42	640.50
MC/FH Finegayan/AAFB Off Site Utilities	9.02	10.12	12.01	10.14
Water Well Development Area	90.00	90.00	90.00	90.00
Total for Northern Guam	940.05	1010.77	1054.93	1015.01
South				
2010 ROD Related Actions	4.99	5.09	37.35	5.96
Communication Utilities	0.00	0.00	50.83	0.05
Guam High School Expansion	0.00	0.00	2.08	0.00
Total for Southern Guam	4.99	5.09	90.26	6.01
Total	**945.05**	**1015.86**	**1145.19**	**1021.02**

The most severe effects on listed species habitat from habitat fragmentation and edge effects will be on AAFB near Ritidian point from construction of the LFTRC. This area currently contains a

large expanse (over 350 acres) of high-quality primary limestone forest that serves as occupied habitat for the Mariana fruit bat and *Serianthes nelsonii*, and unoccupied habitat for the Mariana crow, Guam rail, and Guam Micronesian kingfisher (see figures 11 and 12). This primary limestone forest is also adjacent and contiguous with the Guam National Wildlife Refuge, providing an even larger forested area serving as habitat for listed species. In total approximately 90 acres of primary limestone forest and 91 acres of secondary limestone forest would be cleared for construction of the LFTRC (DON 2014b, p. 5-339).

In addition to the approximately 194 acres of listed species habitat that will be cleared for the LFTRC (Table 6), approximately 10,000 m (6 mi) of new edge will be created (Figure 12). As discussed in the Environmental Baseline, edge effects have deleterious effects to wildlife populations and ecological processes (Murcia 1995, p. 58; Laurance 2000, p. 134). Edge effects can affect avian density up to 60 meters into the forest, and affect the forest canopy up to 150 m (Murcia 1995, p. 59), and may affect forests at larger landscape scales (Laurance 2000, p. 134). In combination with the effects of increased noise from operation of the LFTRC and additional overflights from AAFB (see below), we expect that the habitat quality of some of the remaining primary limestone forest near Ritidian point will be degraded and no longer provide the same ecosystem services it currently does. This will have an adverse effect on the potential for the remaining habitat to serve as habitat for listed species. As discussed in Environmental Baseline, there is little remaining primary limestone forest on Guam. The result of construction of the LFTRC is habitat degradation and permanent loss of some of the best remaining primary limestone forest on Guam.

In total, approximately 1,020 ac of habitat will be cleared and permanently lost as a result of the proposed action in both north and south Guam. The loss of limestone forest and listed species habitats furthers the long-term trajectory of loss of native forested habitat on Guam, and threatens the future potential for recovery of listed species on Guam. Given the small amount of habitat left on Guam off-setting measures to protect remaining limestone forest and listed species habitats is needed. The effects of habitat degradation and loss are further discussed in the species-specific sections below

Habitat Conservation and Management
Under the proposed action, the DON will implement a forest enhancement project on approximately 1,000 ac in Finegayan to offset loss of listed species habitats. This project could lead to enhanced and better-quality habitat for listed species at the forest enhancement project site. However, there is some level of uncertainty that the forest enhancement site would be protected in the long term because the DON has a history of proposing military development within established mitigation sites. For example, as part of this proposed action, the DON will clear primary limestone forest that was intended to be conserved for listed species and demolish the surrounding ungulate fence built by the USAF as mitigation in the ISR Strike BO (USFWS 2006b) and NWF Beddown (USFWS 2006c).

In addition, as part of DON 2010 (USFWS 2010a, p. 64), the DON also planned to develop a portion of the Federal Aviation Administration (FAA) Mitigation Area on Tinian developed for the Tinian monarch (*Monarcha takatsukasae*). This mitigation area (936 acres) was designated in a Biological Opinion (1-2-98-F-06) for the Federal Aviation Administration dated

January 4, 1999. The DON also entered into agreement with the CNMI to designate this mitigation area as a conservation area for the protection of the endangered and threatened species, particularly the Tinian monarch. This agreement and assurance of protection of the conservation area is further discussed in the final rule to delist the Tinian monarch (USFWS 2004, pp. 56360-56371). However, the DON's upcoming CNMI Joint Military Training (CJMT) EIS also contains alternatives which would develop a portion of the FAA mitigation site (DON 2015d). Further, as described above in the Environmental Baseline, the DON did not follow through on agreements to conduct brown treesnake research and control at Area 50 on AAFB after years or work at the site.

The DON's history of planning for development in previously established mitigation sites required by Biological Opinions, or at long-term research sites, leads us to question the certainty as to whether this forest enhancement site will still be present when listed species addressed in this Biological Opinion are reintroduced to Guam. However, recent discussions with DON and the recently signed MOA by Deputy Assistant Secretary reaffirms DON's commitment for listed species recovery on Guam. We expect the conservation measures in the proposed action to be implemented fully and the MOA to have a long-term beneficial effect to listed species.

Under the MOA, the DON will protect and manage approximately 5,234 acres of Guam Micronesian kingfisher habitat on DON lands in northern Guam for conservation and restoration of kingfisher habitat (DON and USFWS 2015). While the MOA that was signed to protect these lands focuses on kingfisher habitat, the protection and management of these lands may also benefit the Mariana crow, Guam rail, Mariana fruit bat, and *Serianthes nelsonii*.

Under the MOA, the DON will work cooperatively with the Service to identify, develop and implement specific management activities and projects on the 5,234 acres to support the following: 1) brown treesnake control and suppression to facilitate the larger goal of suppressing snake population levels that will ultimately support kingfisher survival and recovery; 2) support for brown treesnake control and eradication methods development, focusing on tools and techniques needed for landscape level survival and recovery of the kingfisher; 3) ungulate fencing and eradication; 4) control of small mammalian predators; 5) invasive plant control and eradication; 6) native plant restoration; and, 7) localized control of introduced invertebrates that may negatively impact kingfisher nesting/fledging. The DON has funded and initiated a number of projects to support the seven focal activities identified above. The DON will continue these activities with items (2) and (3) prioritized for continued funding (DON and USFWS 2015, p. 3) The level of funding for these activities may vary depending on the activities to be implemented in a given year, but will not exceed $2 million annually for the first ten years (starting in fiscal year 2016) (DON and USFWS 2015, pp. 4-5). Upon the expiration of the ten-year period, the DON and Service would reassess the progress of recovery efforts pursuant to the MOA.
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DoD Civilian Employee and Indirect/Induced Development (All Species)
The proposed action will result in a population increase on Guam. Between the years 2021 and 2023 the population with the proposed action is projected to be 5.6 percent higher than it otherwise would have been without the proposed action (DON 2014b, page 4-419). During the construction period, additional off-island workers will move to Guam to fill non-Federal non-

construction jobs such as teacher and food service worker. The DON refers to this population increase as "indirect" or "induced" growth. There would be a maximum estimated population increase of 1,082 persons from indirect/induced growth; the number of indirect/induced population growth ranges from 89 people in 2015 to 1,082 people in 2021, and decreases to a steady-state of 453 people by 2028 (DON 2014b, page 4-126).

We derived the area that will be developed by the new civilian population within each U.S. Census Subdivision on Guam by calculating the current development footprint per person within each Census subdivision and applying that to the Census subdivision's anticipated increase in population. We assumed the induced population size would remain at 453 people (DON 2014b, p. 4-126) past 2028. Based on the U.S. Forest Service 2002 land cover map (U.S. Forest Service 2002) and 2008 U.S. Census Bureau data (U.S. Census Bureau 2008), we calculated that each person has a development footprint of 0.09 ac. We applied this anticipated new development evenly across areas zoned for development based on current Government of Guam land use plans (Government of Guam 2009, p. 2-14 and 2007, p.1) on slopes less than 30 percent and calculated anticipated effects of development resulting from the indirect/induced population. Based on this, we calculated that no more than three acres of habitat in north Guam for the kingfisher, crow, *Serianthes* tree, and fruit bat and no more than 17 acres for the rail will be lost as a result of induced population growth. In addition, the induced population growth will increase human disturbance throughout the island of Guam to wildlife and their habitats.

Wildfire (All Species)
The proposed action may result in wildfires burning listed species habitat. Fires could start from live-fire training (including use of tracers), bivouacking with campfires, arson, barbeques, debris burning, cigarette smoking, aircraft mishaps, and vehicular malfunctions. Between 1991 and 2002, an average of 28 fires per year burned on DON lands on Guam (DON 2013e, p. 4-8), with 429 ac (174 ha) burned per year. Most of the area burned was savanna grasslands (DON 2013e, p. 4-8). This is approximately double the average annual number of fires on DON lands from 1979 to 1989, though the burned acreage on DON lands was similar (425 ac per year (172 ha per year)). Arson and debris burning account for approximately 70 percent of fires, and 87 percent of area burned, on DON lands from 1979 to 2002. Smoking (8 percent), unknown (3 percent), and miscellaneous causes (including children, campfires, and equipment) account for approximately 4 percent of fires on DON lands on Guam (Nelson 2009, Ch. 3 p. 4).
Fires can lead to a variety of direct, indirect, and interrelated affects to wildlife and their habitats. Fire can burn habitat resulting in habitat loss, fragmentation, and degradation, and loss of foraging and breeding habitat. Fires could expose Mariana fruit bats to smoke, resulting in respiratory distress.

To minimize the effects to listed species resulting from fire burning listed species habitats, the DON proposes to develop and implement a fire management plan, a component of the Range Management Plan,at the LFTRC. The fire management plan will be prepared to minimize fire threat associated with the firing ranges on surrounding habitat and listed species, specifically the adult *Serianthes nelsonii* tree. The fire management plan will be developed and implemented to ensure that any fire sparked during training will not spread beyond the firing range and into forested habitat. Because the LFTRC is surrounded by recovery habitats, the development and

implementation of this fire management plan will be critical to ensure that the *S. nelsonii* tree, and listed species habitat, is not lost due to training activities.

In addition, the DON proposes to develop and implement a comprehensive Wildland Fire Management Plan for JRM lands (DON 2013e, p. 4-8). The goal of the plan is to protect high-value natural resource areas and operational facilities from catastrophic wildfire while conserving resources and military operational flexibility (DON 2013e, p. 5-66). The fire management plan will minimize the effects of fire from arson, debris burning, cigarette smoking and other activities from JRM operations on Guam. Additionally, the stationing of additional large helicopters on Guam, as part of the proposed action, may facilitate increased DON contributions to the suppression of fires threatening forest habitat on Guam.

Because a comprehensive Wildland Fire Management Plan for JRM lands and a fire management plan for the LFTRC will be developed, as described above in the Conservation Measures section, we anticipate that no additional habitat will be lost due to wildfires igniting as a result of the proposed action. Although the DON's comprehensive fire management plan may also minimize fire impacts on DoD lands on Guam by instituting fire prevention, detection, and suppression programs as well as implementing landscape-level fuel modifications in the Naval Munitions Site, the beneficial effects of this DON action are difficult to assess because these projects have not been adopted by DON at this time.

Ungulates (All Species)
As described in the Environmental Baseline, non-native ungulates have caused severe damage to Guam's native limestone forests. Construction of the main cantonment at Finegayan and the LFTRC at Ritidian Point will clear a large area of limestone forest currently used by ungulates and would displace and concentrate ungulates into adjacent areas, resulting in even higher densities and potentially greater habitat damage. These adjacent areas are often habitats for listed species. Therefore, increased ungulate density in adjacent habitats will degrade the habitat quality of these areas and reduce their suitability to serve as habitat for listed species. The JRM INRMP (DON 2013e, Appendix L) includes an Ungulate Management Plan for AAFB. The plan's objectives are to reach and maintain a sustained reduction of deer and pigs in 23 unfenced areas of the AAFB, and to completely remove ungulates from fenced management areas (DON 2013e, p. ES-1); however, this action has not yet been fully implemented and ungulates are still prevalent across AAFB.

<u>National Wildlife Refuge Overlay</u>

In 1993, a Cooperative Agreement (Agreement) was established between the Air Force, DON, and the Service for purposes of establishing and managing the GNWR Overlay on DOD lands. The Refuge includes approximately 152 hectares of fee simple Service land and 9,106 hectares of Overlay Refuge on land owned by DOD. The Agreement, which is still in effect, affirms the parties commitment to "provide habitats essential to the survival and recovery of endangered species" on Guam and to "develop and implement a long-term, comprehensive program to conserve and recover endangered and threatened species… not limited to brown treesnake control and eradication, wildlife habitat and ecosystem protection, endangered and threatened species recovery and reintroduction…". Notably, all signatory parties to the Agreement agreed

to consult under section 7 of the Endangered Species Act (ESA) on proposed Federal actions that are funded, authorized, or carried out by the Federal government within the Refuge, inclusive of Overlay Refuge lands, "that may impact habitat of endangered or threatened species even if those species are extirpated from the affected area, but are not extinct."

To date, only a limited amount of critical habitat has been designated on Guam - for the kingfisher, crow, and the Mariana fruit bat – all on lands owned and administered by the Guam National Wildlife Refuge (GNWR). Department of Defense lands on Guam include a substantial percentage of the total habitat available for recovery of the kingfisher, rail, and the crow. Seventy-two to seventy-five percent of the critical habitat proposed in 2002 was within the Overlay Refuge land (67 FR 63738 63772); however, only the 152 hectares of fee simple GNWR land were ultimately designated for the kingfisher, crow, and bat in 2004 (69 FR 629447 629446). In recognition of the commitments made by the DON and the Air Force under the Agreement, the Service exempted DOD lands from the designation of critical habitat on Guam in 2004.

Approximately 1,400 ac (567 ha) of the proposed action's project footprint within Guam National Wildlife Refuge Overlay boundaries are in the areas that were proposed as critical habitat for the Guam Micronesian kingfisher, Mariana crow, and Mariana fruit bat (67 FR 63738-63764). These areas were excluded from critical habitat designation pursuant to the Sikes Act (16 USC 670a-670o, 74 Stat. 1052, Public Law 86-797), as amended. These 1,400 ac will be cleared as part of the proposed action, and over 300 ac will lose their conservation function due to noise (see analysis below).

<u>Surface Danger Zone over the Guam National Wildlife Refuge (All Species)</u>

The proposed action will create a SDZ over approximately 68 percent of the GNWR at Ritidian Point during operation of the LFTRC. The SDZ will cover the GNWR access road, visitor center, offices, and other facilities and thereby limit access to the GNWR while firing occurs at the LFTRC. The limited access that GNWR staff will have to the refuge property during the 39 weeks per year the LFTRC is active will limit the amount of management that can occur at the GNWR. This could have an adverse effect on listed species by 1) preventing maintenance of the predator exclusion fence at the GNWR, 2) restricting brown treesnake efforts below what is necessary to remove brown treesnakes from the fenced exclosure, 3) limiting maintenance of native outplantings, 4) limiting invasive plant control, 5) limiting effective ungulate control, and 5) restricting the ability to manage the re-introduction of the Guam Rail. Per Section 2822 (Establishment of surface danger zone, Ritidian Unit, Guam National Wildlife Refuge) in the 2015 National Defense Authorization Act, the Service and the DON may enter into an agreement to establish and operate a SDZ over the GNWR. The agreement may include relocation and reconstruction of GNWR facilities, mitigation for impacts to wildlife species, and use of DoD personnel to complete GNWR conservation actions; however, this agreement is not in place yet. Therefore, we assume that the operation of the LFTRC will have an adverse effect on listed species by preventing the management, research, and monitoring that would have otherwise occurred at GNWR.

<u>Noise (Guam Micronesian kingfisher, Mariana crow, Guam rail, Mariana fruit bat)</u>

Overview of Noise Resulting From the Proposed Action
The proposed action will generate noise from the use of a variety of vehicles (construction equipment, trucks, fixed-wing aircraft, helicopters, , and other convoy vehicles) and weapons (small arms, demolitions, and other ammunition), and loud voices. Noise resulting from weapons training and construction on Guam will affect areas occupied by listed species and affect their habitat. Increased jet and helicopter aircraft traffic at Andersen Air Force Base will regularly expose the Mariana fruit bat to high levels of noise. Portions of the habitat for the Guam Micronesian kingfisher, Guam rail, Mariana crow, and Mariana fruit bat are in areas where elevated noise from jet and helicopter aircraft traffic, and weapons firing, will occur.

Below is a general overview of effects of noise on avian species; detailed species-specific accounts are provided in the effects analysis to each species.

Noise review
Studies on the effects of noise on wildlife report a wide range of reactions depending on the biology of the species, its previous exposure to the source noise, whether the species is breeding, the type of noise, and the lateral distance between noise source and the species. The variability in these reactions and their specific circumstances make it difficult to be certain how a particular species will react to noise from the proposed action.

A recent review of noise studies found that many, but not all, species abandon noisy areas (Francis 2015, p. 2). This review found that birds across all locations tended to avoid noisy areas, but that there were trait-specific differences including vocal frequency, nest placement, diet, and foraging location (Francis 2015, p. 1). Omnivorous species and species with animal-based diets were more sensitive to noise then birds with plant-based diets, potentially because noise interferes with prey detection (Francis 2015, p. 1). The review concluded that anthropogenic noise is an important ecological force that shapes the distribution of species by disrupting an organisms' ability to acoustically interact with its environment (Francis 2015, p. 11).

Avian responses to noise may range from flushing and body shifting to physiological responses such as an increase in heart rate or hormone balance (Brown 2000, p. 11; Barber et al. 2010, p. 181). Specific reactions will vary by species and by an individual's previous exposure to noise disturbance (Manci 1998, p. 15). Individuals with previous exposure to the noise may display less reaction to it then individuals without previous exposure (Andersen et al. 1989, Conomy et al. 1998a). This reduced reaction is believed to be a sign of habituation; however, the habituation may be individual or species specific. In general, a species can often habituate to human-generated noise when the noise is not followed by an adverse effect. Even when a species appears to be habituated to a noise, the noise may produce a metabolic or stress response (increased heart rate results in increased energy expenditure) though the response may or may not lead to changes in overall energy balance. Anthropogenic noise disturbance is known to alter animal behavioral patterns and lead to population declines (Barber et al. 2010, p. 181). Species that are commonly hunted often demonstrate behavioral (e.g., flushing, startle response) or physiological responses (e.g., increased heart rates, increased respiration rates) to gunshot sounds Larkin et al. (1996, pp. 21-52). Conomy et al. (1998a, p. 1,135-1,142) found that black ducks

(*Anas rubripes*) did not become habituated to noise. Larkin (1996, p. 1) in a review of noise effects on wildlife, reported that decreased responsiveness from wildlife after repeated noise is frequently observed and attributed to habituation. However, the degree of disturbance to which a species can habituate may be limited (National Park Service 1994, p. 5.17). Francis et al. (2011a, pp. 6-7) state that overall most species, even urban-adapted species, respond negatively to noise.

Habitat Degradation

There are multiple ways for anthropogenic noise to cause habitat degradation including noise pollution, masking of avian acoustic signals, changes in predation risk, and reduction in reproductive success. Noise pollution is defined as undesirable human noise, and has increased in most environments over the last century (Ortega 2012, p. 7). Noise pollution can affect birds in numerous ways including physical damage to ears; stress, fright and avoidance responses; changes in reproductive success and in vocal communication; and interference with ability to hear predators and other sounds (Ortega 2012, p. 8). Anthropogenic noise could be a factor driving bird species out of urban areas, even when other habitat requirements are still sufficient (Slabbekoorn and Ripmeester 2007, p. 73).

Most studies on habitat degradation from noise have focused on highways and gas drilling compressor pads, and these studies demonstrate that habitat near a noise source is less suitable than habitat farther away. Francis et al. 2011b (p. 1269 and 1278) found that compressor noise at gas wells caused a five percent lower occupancy of avian species near the pads. Bayne et al. (2008, p. 1190) found that passerine density was significantly influenced by chronic anthropogenic noise from gas compressors, and that noise levels from compressor stations affected birds up to 700 meters into the surrounding forest. The willow warbler (*Phylloscopus trochilus*) had a much lower density of territorial males within 0-200 meters from a highway compared to habitat farther away, yearling males were found 50 percent more often in the road zone, and the study indicated that the road zone probably serves as a sink for young males due to reduced habitat quality from noise (Foppen and Reijnen 1994, p. 99). These studies generally show that noise pollution can cause habitat degradation.

Masking

Anthropogenic noise that drowns out vocal communication between birds is called masking. Masking can have serious consequences because birds communicate vocally to attract mates and defend territories (Slabbekoorn and Ripmeester 2007, p. 1; Barber et al. 2010, p. 180; Ortega 2012, p. 10). Masking of communication necessary for territory defense and mate attraction may have a negative impact on reproductive success and exclude birds from otherwise suitable habitat (Halfwerk et al. 2011, p. 210). Halfwerk et al. (2011, pp. 217-218) suggest four mechanisms related to masking that could reduce avian reproductive success: (1) female birds interpret male songs masked by high noise as of lower quality and put less energy into the breeding cycle; (2) a noisy territory may be perceived of as being a lower quality and avoided, reducing the number of available territories for breeding; (3) increased noise levels cause physiological stress due to reduced foraging opportunities if prey are less easy to detect or because the bird has to spend more time scanning for predators; and, (4) noise could have a negative impact on parent-offspring communication.

Breeding
Anthropogenic noise can have negative effects on avian breeding (Slabbekoorn and Ripmeester 2007, p. 2; Halfwerk et al. 2011, p. 210; Ortega 2012, p. 10). Noise may affect egg production, incubation, brooding and nest abandonment (Ortega 2012, p. 10). Halfwerk et al. (2011, p. 210) found that females laid smaller clutches in noisier areas, and that noise recorded in April had a negative effect on the number of great tit fledglings independent of clutch size, compared to noise in March. High noise levels could lead females to breed later, allocate less energy to care of eggs and chicks, and cause communication difficulties between parents and offspring (Halfwerk et al. 2011, pp. 217-218).

Habib et al. (2007, p. 176) found that ovenbird pairing success was reduced, and more inexperienced birds were breeding for the first time, near noisy compressor sites compared to noiseless sites. This reduction in ovenbird pairing success near compressor sites was likely caused by noise interfering with a male's song, thereby inhibiting communication with females and reducing pair success (Habib et al. 2007, p. 176). Foppen and Reijnen (1994, p. 95) found that the zones nearest to a highway served as a sink for male willow warblers, and that the proportion of successful yearling males was 50 percent lower in the road zones compared to zones farther away from the highway. Delaney et al. (2002, p. 54) found that the nesting success of red-cockaded woodpeckers (*Picoides borealis*) near Fort Stewart, Georgia, was not significantly affected by experimental and passive military training noise. However, red-cockaded woodpeckers did flush from their nests repeatedly due to nearby (less than 100 meters) artillery and blank fire events, but returned to their nests quickly and without impact to nesting success (Delaney et al. 2002, p. 59).

In a study of the effects of helicopter noise from the Marine Corps Air Station Miramar (MCAS) on California gnatcatcher (*Polioptila californica californica*) reproduction, Hunsaker and Rice (2006, p. 101) found that noise levels at MCAS did not affect reproductive success. California gnatcatchers found and inhabited suitable nesting sites in spite of the noise environment, and the factors affecting nest success were habitat, topography, and rainfall. Awbrey and Hunsaker (1997, p. 3177) found that fixed-wing aircraft noise at Naval Air Station Miramar was correlated with fewer California gnatcatcher nest attempts and eggs laid, but that once a nest was established with eggs in it, military aircraft noise had no detectable influence on reproductive success. In Hawaii, Vanderwerf (2000, p. 9) studied the response of Oahu elepaio (*Chasiempis sandwichensis ibidis*) at eight nests to military noise (artillery blasts ranging from 89-116 dB). No elepaio flushed from a nest in response to artillery noise. A mild response was only observed twice by the same incubating male who raised his head and scanned the area after an artillery blast then resumed preening after 1-2 seconds (Vanderwerf 2000, p. 38).

There may be differences between the effects of chronic noise and intermittent loud noise in the responses of breeding birds. Birds that select nest sites with chronic noise may "accept" the noisy conditions and not abandon nests in response to the noise. However, birds that select nest sites during quiet times, and then become disturbed by noisy conditions later, may abandon nests (Ortega 2012, p. 10).

Hearing (for avian species, see Mariana fruit bat section below for bats)

Birds may also suffer physical damage to their ears from loud noise (Barber et al. 2010, p. 181). Damage can occur from single blasts (>140 dBA), multiple blasts (>125 dBA) or continuous exposure to noise at greater than 110 dBA (Ortega 2012, p. 9; Dooling and Popper 2007, p. 23). Birds are able to regenerate the sensory cells of the inner ear providing a way for them to recover from physical damage to the ear from loud noise, and so do not suffer permanent hearing loss like mammals (Dooling and Popper 2007, p. 5 and p. 25). However, in their review, Dooling and Popper (2007, p. 27) state that the effects of short, intermittent, and high intensity sounds on avian hearing are much less known than that from highway noise. Many birds appear to tolerate noise that can cause pain in humans, for example: seabirds at airports, wild turkeys (*Meleagris gallopavo*) near a rocket testing plant in Florida, and ospreys (*Pandion haliaetus*) at the Naval Surface Warfare Center, Dahlgren (Larkin et al. 1996, p. 31, and references within).

Noise from Construction (for avian species, see Mariana fruit bat section below for bats)
Noise from construction may affect habitats for listed birds. Construction as part of the proposed action will occur from 2015 to 2028; however, construction will be phased and will not occur at all places at once, or for the entire construction time period. Construction equipment will include standard heavy equipment including bulldozers, graders, haulers, large trucks. No blasting or use of dynamite will occur as part of the proposed project. The use of heavy equipment can reach noise levels of 96 dB (USFWS 2006a, p. 15). Based on ambient noise studies conducted above the cliff line at AAFB (DON 2014a, p.66), we expect that noise within the listed species habitats in Guam to range from 55 to over 65 dB. Therefore, noise from the construction of the proposed action may reach between 20-40 dB above ambient conditions.. Noise from construction of the proposed action would be temporary and intermittent. Construction noise reaching listed species habitats may rise above the disturbance threshold for listed species; however, this noise will be short-term in duration and will not lead to a permanent reduction in the capability of adjacent habitat to support the future survival and recovery of listed birds.

Noise from Aircraft (Guam Micronesian kingfisher, Mariana crow, Guam rail, Mariana fruit bat)
Studies on the impacts of aircraft overflights to wildlife have been primarily limited to work on ungulates (e.g., Krausman et al. 1998; Maier et al. 1998; Frid 2003; Landon et al. 2003; Krausman et al. 2004; Lawler et al. 2005), birds of prey (e.g., Andersen et al. 1989; Watson 1993; Trimper et al. 1998; Delaney et al. 1999; Palmer et al. 2003), and waterbirds (e.g. Ward et al. 1999; Conomy et al. 1998 a,b; Komenda-Zehnder et al. 2003). These studies report a wide range of reactions to overflights depending on the biology of the species, its previous exposure to overflights, whether the species is breeding, the type of aircraft, the altitude of the aircraft, and the lateral distance between aircraft and the species. The variability in these reactions and their specific circumstances make it difficult to be certain how a particular species will react to aircraft overflights.

Noise from aircraft is complex and wildlife response may depend on the type of aircraft and the species involved. In a literature review of waterfowl response to aircraft, avian response to aircraft was (cautiously) generalized as more intense with helicopters than fixed-wing aircraft, and stronger with slower fixed-wing aircraft than fast fixed-wing aircraft (Plumpton 2006, p. 3-1, 3-2). The proposed action will result in an increase in aircraft overflights over listed species

habitat. Therefore, we conclude that noise disturbance over listed species habitat in the flight paths will increase; however, the effects will be species-specific and are discussed further below.

Noise from LFTRC (Guam Micronesian kingfisher, Mariana crow, Guam rail, Mariana fruit bat)
Upon operation of the LFTRC, live-fire operations would occur between 7:00am and 7:00pm for up to 39 weeks per year, plus night operations (two nights per week over 39 weeks per year) would occur between 7:00pm and 10:00pm or 6:00am to 7:00am. The noise disturbance from the training will be impulse noise with very intense sounds of short duration (e.g., the discharge of a weapon). Firing noise from single shots merged in bursts, machine gun burst, and concurrent firing of multiple weapons would result in short periods of intense firing followed by periods of silence. Live-fire operations may occur for hours at a time, for 5 days a week, or not occur for multiple weeks in a row.

The DON conducted a noise study at AAFB at three sampling sites near the LFTRC and found that ambient noise was never below 50 dB, and on some days was above 65 dB almost 100 percent of the time (DON 2014a, p. 66). The DON provided averaged daily noise level (ADNL) in the Biological Assessment (DON 2014a, p. 68) and SEIS (DON 2014b, p. 5-356) for areas surrounding the LFTRC. In the areas closest to the training ranges the ADNL would increase approximately 20 to 25 dB over baseline conditions, with average daily sound levels rising above 85 dB.

However, peak noise is a more appropriate measure of noise for wildlife, and the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) recommends using peak decibel levels when discussing impulsive noise (USACHPPM 2005 in MCB Hawaii 2014, p. 33). The DON provided the Service with peak noise levels for the MPMG range using a formula to calculate peak noise levels at a specified distance from the source. Because the peak noise calculation did not account for sound attenuation from the directional nature of the noise generated by the muzzle blast, terrain, ambient noise, vegetation, temperature, humidity, and other factors, the Service developed a model to estimate peak noise from the LFTRC (USFWS 2015a).

The loudest noise would occur at the firing point, which in a worst-case scenario is at the MPMG firing line at 160 dB. Overall, we do not anticipate that the firing range will be able to be heard on most days outside the 65 dB line (though what is heard will vary based on a species' hearing range); and if it is heard we expect it to be a soft distant noise. It is known that at distances of several kilometers, received noise level can vary by as much as 50 dB above and below the mean due to changes in meteorological conditions (Delaney et al 2002, p. 57); however it is not possible for us to model those conditions at this time. A species-specific noise model is presented for each species below. This conclusion relies heavily on the noise modeling outcomes described above, and if noise from the LFTRC is different than expected, the conclusions described below must be revisited.

Effects from noise
We do not expect any listed birds to be close enough to the firing ranges' firing lines to be exposed to noise levels that cause physical damage to their ears, and therefore we do not expect hearing loss in birds to occur due to the proposed action. The DON will not begin, or continue,

firing at the LFTRC if a fruit bat is present in the area, and therefore we do not expect fruit bats to be exposed to noise levels that cause physical damage to their ears. However, we do expect that listed species habitat adjacent to the firing lines will be adversely affected by operation of the firing ranges. Species-specific details can be found in the sections below.

ISR Strike Ungulate Fence at Ritidian Point (Guam Micronesian kingfisher, Mariana crow, Mariana fruit bat)

As described above, the proposed action will demolish the ungulate fence built as mitigation required under the ISR Strike Biological Opinion (USFWS 2006b) to offset effects to the kingfisher, crow, and fruit bat. The DON proposed three alternatives for the fence. The first alternative, in Finegayan, was in much lower quality habitat than the primary limestone forest at Ritidian Point. The second two alternatives were located at Ritidian Point, adjacent to the LFTRC. As described below, most of this area will be too loud from operation of the LFTRC to support the kingfisher, crow, and fruit bat. Therefore, these locations cannot be considered adequate alternatives to the current ungulate fence at Ritidian Point.

Invasive Species (All species)

Implementation of the proposed project is likely to increase the risk of introducing or spreading non-native terrestrial and aquatic invasive species including plants, animals, and microbes. Pathways associated with anthropogenic activities have a relative risk of introducing and dispersing non-native invasive species. Hulme et al. (2008) described three broad mechanisms for non-native species introductions: importation as a commodity (e.g., purposeful importation as biocontrol, pet trade), arrival via transport vector, and natural dispersal. Of these mechanisms, Hulme et al. (2008) further described a framework for introductions that is supported by six principal pathways of which two could potentially occur via the implementation of DON: contaminant of a specific commodity and stowaway (independent of a commodity, like ballast water or airfreight). The pathways of contaminant and stowaway include, but are not limited to species transported via: construction equipment, personal protective equipment, delivery of supplies, materials, goods, foot traffic, vehicles or vessel traffic. Invasive species introduced as contaminants and stowaways could occur as a result of inadequate sanitation and inspection during and prior to movement. The repeated or routine movement of equipment and people increases the risk of introduction and establishment of a non-native invasive species.

It is important to understand that the "risk" of introduction and establishment of invasive species is highly variable across taxa and habitats. Identifying and analyzing risk for all the species that could be moved via DON-related activities is not practicable. Instead, a more efficient approach is to address pathways where numerous species from different taxa may be inadvertently introduced and implement prescriptive measures to control risks from the pathways. A pathway risk assessment will provide a structure for assessing where the greatest "risk" for a non-native species introduction occurs and locations where managing ingress or egress of these species is most efficient for control. Pathways must be controlled because repetition of an action has a direct effect on propagule pressure which as stated above increases the likelihood of a species to become established.

To address pathways and encourage a more holistic approach to managing invasive species, the DON funded the development of a Regional Biosecurity Plan (RBP) for Micronesia and Hawaii (formerly referred to as the Micronesia Biosecurity Plan). Individual activities for various species will continue, but the DON and others agree it is more efficient to manage pathways and prescribe corrective measures for a suite of species that will be monitored at discrete control points over time. The RBP will provide stakeholders in Micronesia and Hawaii with a platform for coordination and integration of inter-agency invasive species management efforts such as control, interdiction, eradication, and research. Several of the recommendations of the RBP are incorporated into the project action, and are detailed in the Conservation Measures to Minimize the Effects of Invasive Species section.

The DON is also committed to a comprehensive brown treesnake interdiction program, also detailed in the Conservation Measures section, to ensure that military activities, including the transport of civilian and military personnel and equipment to and from Guam, do not contribute to the spread of brown treensnakes (DON 2014a, p. 38). Brown treesnake interdiction requirements (e.g., trapping and inspections at ports, cargo facilities, and aircraft, inspections of household goods, biosecurity plans for training events) are specific in DoD instructions (i.e., 36 Wing Instruction 32-7004, *Brown Tree Snake Control Plan* and COMNAVMAR Instruction 5090.10A, *Brown Tree Snake Control and Interdiction Plan*) as well as the annual Work Financial Plan that is developed in cooperation with USDA Wildlife Services (DON 2014a, pp. 38-39).

In addition, the DON will fund any increase of current federally funded brown treesnake interdiction measures (in Guam, CNMI, and Hawaii) where the increase is related to direct, indirect and induced growth caused by the USMC relocation to Guam. The fiscal year (FY) 2010 level of funding for the Federal interagency brown treesnake interdiction effort on Guam, CNMI, and Hawaii and 2010 transportation levels associated with outbound cargo from Guam for the U.S. or U.S. territories will be used as the baseline. That funding will continue and become part of the DON's brown treesnake interdiction funding under authority of the Brown Tree Snake Control and Eradication Act (7 USC § 8501 note). The Service agrees that it is not DON's responsibility to fund increased interdiction measures *that are identified* more than one year after the end of the fiscal year both USMC relocation construction has ended and the permanent non-transient USMC military units have relocated to Guam. However, the Service understands the DON will continue to provide a baseline level of interdiction funding related to the direct, indirect, and induced-growth effects of its proposed action beyond one year.

Because of the DON's commitment to the RBP and brown treesnake interdiction and with full implementation of the biosecurity measures proposed as part of this action, we anticipate that the proposed action will prevent the introduction and spread of invasive species both within the action area, and beyond the borders of Guam.

<u>Conservation Measures Associated with the Action (All Species)</u>

In addition to measures to minimize the risk of invasive species described above, the proposed action also includes other measures, listed below and described in the Conservation Measures section, which will have a beneficial effect on listed species.

- Forest enhancement project in Finegayan
- Funding of selected projects identified as priorities in the Brown Treesnake Technical Working Group Strategic Plan
- Measures to minimize effects of construction including contractor education, following the Guam Landscaping Guidelines, contract specifications to avoid unintended clearing of habitat, and monitoring of implementation of conservation measures.

Effects of the Action – Guam Micronesian kingfisher

The Guam Micronesian kingfisher was once distributed throughout Guam, but significant population declines, resulting primarily from predation by the brown treesnake, resulted in their extirpation from Guam by 1988 (Wiles et al. 2003, USFWS 2008a). Currently, the kingfisher survives only in captivity. The Service is planning for the reintroduction of the kingfisher to Guam during the term of the proposed action. The success of the reintroduction is dependent on the protection and management of suitable habitat essential to kingfisher's survival and recovery in the wild on Guam. Kingfisher habitat is very limited on Guam and has been severely degraded by habitat fragmentation and loss, lack of management, introduced ungulates, invasive species, typhoons, and forest conversion due to the loss of birds that function as pollinators, seed dispersers, and frugivores in the forest.

In addition to the general effects of the action discussed above, a species-specific effects analysis for the Guam Micronesian kingfisher is provided below.

<u>Noise</u>

Aircraft
As detailed in the general effects of the action section, birds tend to avoid noisy areas but their response to noise may vary depending on the traits of the species or individual. There is no information on the effects of chronic and peak aircraft noise levels on Guam Micronesian kingfisher. The effect of aircraft noise on the kingfisher is likely similar to other Guam native species; frequent loud over-flights may alter behavior, impair reproduction, and change habitat use in habitat next to the airfields at AAFB (Wiles et al. 1995, p. 46), although the extent of these effects are unknown for the kingfisher.

Potential effects of aircraft overflights have been conducted on Mariana crows (Morton 1996) another Guam bird species and another cavity-nesting bird, the red-cocked woodpecker (*Picoides borealis*). Morton (1996, p. 62) found no evidence that aircraft overflights contributed directly to nest abandonment or nest failure during the study. However, Morton (1996, p. 61) did report three observations of Mariana crows reacting to aircraft. The most severe of these interactions was a pair leaving their nest several times in response to a helicopter flying less than or equal to 400 ft (120 m) above the ground. In general, the observations of Mariana crows flushing from nests were all due to aircraft below 1,000 ft (305 m) above the ground (Morton 1996, p. 61). Delaney et al. (2002, p. 42) determined that breeding red-cocked woodpeckers did not flush from their nests during incubation or early brooding phase when military helicopters were greater than 98.4 ft (30 m) from nests.

Operation of the LFTRC
As described in the Environmental Baseline, the Service has delineated habitat on Guam to provide a sufficient amount of habitat for the Guam Micronesian kingfisher so the species can be reintroduced to Guam once threats are controlled. The forest within the footprint of LFTRC and adjacent areas is habitat for the kingfisher (Figure 6) and includes some of the most pristine primary limestone habitat in northern Guam. In order to serve as suitable habitat for kingfishers, the area must be free of threats that would preclude kingfishers from using the habitat as a nesting territory (for example, brown treesnakes and human disturbance). The noise pollution from operation of the LFTRC would cause disturbance to breeding kingfishers during courtship and nesting stages. As stated in the Status of the Species, the nest excavation and courtship stages are crucial to successful reproduction for the kingfisher. During the breeding season, it is important to minimize disturbance within the territorial range of breeding pairs. Based on experience with the managed population, Guam kingfishers are especially sensitive to stress which would likely be increased by noise and disturbance, and compounded during the breeding season (B. Bahner, Philadelphia Zoo, pers. comm. 2015). The noise from the LFTRC would result in the habitat degradation within the footprint and immediately adjacent to the LFTRC, and therefore make the habitat unsuitable for breeding kingfishers.

Guidance on potential effects of noise on endangered wildlife was taken from USFWS (2006a), Pater et al. (2009), and Dooling and Popper (2007). The Service guidance for noise disturbance to spotted owls (*Strix occidentalis caurina*) and marbled murrelets (*Brachyramphus marmoratus*) state that noise disturbance will reach the level of take when 1) project-generated sound exceeds ambient nesting conditions by 20-25 decibels (dB) and 2) project-generated sound, when added to existing ambient conditions, exceeds 90 dB (USFWS 2006a, p. 1). Noise from operation of the LFTRC meets both these criteria for disturbance reaching the level of take. In addition, for the purposes of noise disturbance, extreme noise is defined as 101-110 dB, and any noise above that level is not covered by the guidance (USFWS 2006a, p. 5). For extreme sound levels of 101-110 dB (the highest analyzed in the guidance document) disturbance of spotted owls or marbled murrelets is expected up to 400 m (1320 ft) from the source noise (USFWS 2006a, p. 8). In addition, Delaney et al. (2000, 2001) and Pater et al. (1999) developed noise response thresholds for the red-cockaded woodpecker based on a number of military noise sources. Their results showed that woodpeckers did not flush during the nesting season when the sound exposure levels (SEL) for .50-caliber blank fire was less than 82 dB and for small-caliber live fire events were less than 79 dB (Delaney et al. 2002, p 18).

As stated above, the habitat adjacent to the LFTRC would likely become unsuitable for breeding Guam Micronesian kingfishers (in the future when kingfishers are reintroduced to Guam). Based on the Service guidance above, disturbance reaching take could occur at 20 dB above ambient conditions (ambient is 60 dB) or when noise exceeds 90 dB. Given the sensitivity of breeding kingfishers to noise and disturbance, the Service's guidance, Delaney et al. 2002 study (*e.g.* woodpeckers did not flush at nose levels less 79 dB), we have chosen the 80-dB threshold for noise disturbance of kingfisher as a conservative estimate that would preclude them from using suitable habitat for breeding. Based on the 80-dB threshold and the Service's noise modeling (Figure 13), approximately 319 acres of kingfisher habitat will be degraded by noise from the LFTRC and not suitable habitat for the kingfishers once the LFTRC becomes operational.

Habitat Loss, Degradation, and Fragmentation

There is currently 14,997 ac and 13,314 ac of kingfisher habitat in northern and southern Guam, respectively. The proposed action will directly and permanently remove approximately 1,015 ac in northern Guam and three ac will be lost to induced growth. Furthermore, as stated above, we estimate 319 ac will be exposed to noise at levels that will likely prevent Guam Micronesian kingfisher breeding activities, for a total habitat loss of 1,334 ac of kingfisher habitat in northern Guam. The 1,334 acres of habitat lost would have been able to support 63 breeding kingfisher pairs (1,334 ac ÷ 21 ac per breeding pair) or approximately 12 percent of the 500 pairs needed in northern Guam for recovery. In southern Guam, the proposed action will directly remove six acres of mostly low quality kingfisher habitat.

For northern Guam, the removal and degradation of habitat includes some of the best remaining primary forest on Guam, at Ritidian Point on AAFB. As discussed in the General Effects section, the most severe effects on recovery habitat from habitat fragmentation and edge effects will be on AAFB at Ritidian Point from construction of the LFTRC. This area currently contains a large expanse (over 350 acres) of high-quality primary limestone forest within the Overlay Refuge. This primary limestone forest is also adjacent and contiguous with critical habitat for the kingfisher within the fee simple land of the GNWR, together providing an even larger forested area serving as habitat for the kingfisher. This area will be further fragmented by the presence of over six miles of additional habitat edges on AAFB alone, and three acres will be lost to induced growth (as detailed in the General Effects section).

Other Human Disturbance

The proposed training at the NMS in southern Guam and the operation of the main cantonment facilities at Finegayan will increase human presence and noise in kingfisher habitat in these areas. The cantonment is near the Haputo ERA and other areas of kingfisher habitat (Figure 6). Increased human disturbance in these areas could deter kingfishers, when reintroduced back to Guam, from utilizing these areas for sheltering, foraging and breeding.

Conservation Measures for the Kingfisher

The DON has proposed to offset, in part, these adverse effects by implementing conservation measures. Risks will be minimized by best management practices regarding spread of non-native species and fire. The DON also has proposed to implement biosecurity conservation measures including landscape-level brown treesnake eradication and control, recommendations from the RBP, HACCP planning, and brown treesnake interdiction program, which will be beneficial to the kingfisher because it will help reduce the current brown treesnake population and potentially prevent other invasive species from becoming established on Guam.

As part of the proposed action, the DON also proposes to implement a forest enhancement project at Finegayan, in low-quality secondary forest, to benefit listed species, including the kingfisher. This forest is not currently usable by kingfishers and will likely require a decade or more of growth and management before it can support kingfishers. However, the DON has proposed the enhancement of the site to include installation of ungulate exclusion fences around

the 1,000 acres; active removal of ungulates (i.e. trapping, snaring, shooting) with the goal of eradication within the fenced areas; invasive plant removal; and the propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats. Therefore, although this site would not fully compensate for the loss of primary limestone forest, the enhancement of forest and protection of the site is expected to provide some benefit to the kingfisher.

Summary

As described in the Status of the Species and Environmental Baseline sections, habitat fragmentation and loss, lack of management, introduced ungulates, invasive species, typhoons, and forest conversion have continued to negatively affect forest habitat on Guam to an extent that the current amount of remaining forest habitat suitable for the kingfisher is severely degraded and nearly at the minimum needed for its survival and recovery in the wild. The loss of 1,334 ac of habitat that could support 63 breeding kingfisher represents a loss of approximately nine percent of remaining kingfisher habitat in northern Guam and the capacity to support approximately 12 percent of the 500 breeding pairs needed for recovery. Although the six ac of habitat in southern Guam would not support a breeding pair, the loss of six ac would reduce the overall amount of kingfisher habitat in southern Guam.

Among the adverse effects to the kingfisher as detailed above and in the General Effects section, the habitat loss and degradation of the limestone forest in northern Guam, including the loss of the habitat to support 63 breeding kingfishers in Guam, is the most significant, persistent, and adverse effect to the kingfisher as a result of the proposed action. In addition, the increased human disturbance within the action area could deter kingfishers, when reintroduced back to Guam, from utilizing these areas for sheltering, foraging and breeding. However, implementation of the conservation measures and DON's protection and management of approximately 5,234 acres of kingfisher habitat in northern Guam per the MOA will mitigate for the loss of kingfisher habitat, and will help ensure that kingfisher habitat will be available for the survival and recovery of the species on Guam.

Effects of the Action – Mariana Crow

In addition to the general effects of the action discussed above, a species-specific effects analysis for the Mariana crow is provided below.

Noise

Aircraft
From 1994 to 1995 a study was conducted at AAFB on the potential effects of aircraft overflights on Mariana crows (Morton 1996). No evidence was found that aircraft overflights contributed directly to nest abandonment or nest failure during the study (Morton 1996, p. 62). In fact, one nest was constructed within one km (0.6 mi) of the north runway during a large aircraft training exercise (Tandem Thrust). However, Morton (1996, p. 61) did report three observations of Mariana crows reacting to aircraft. One observation was of alarm calling and an increase in vigilant, alert, and standing behavior from an adult attending a nest after an unknown

aircraft (76-92 dBA, > 1,000 ft (305 m) above ground level) flew over the nest. Another observation was of a Mariana crow returning to a nest while an unidentified cargo aircraft flew overhead. The adult remained standing at the nest and alarm calling for the duration of the overflight (approximately two minutes). No sound levels or altitude was reported for the aircraft. The final observation was of a pair of Mariana crows responding to six F-16s and four KC-135s (≤ 86 dBA, no altitude reported) departing the base. The pair was observed alarm calling and flying for 12 minutes after the overflights. In addition to these observations, Morton (1996, pp. 60-61) also summarized previous observations of Mariana crow and aircraft interactions by other biologists on Guam. The most severe of these interactions was a pair leaving their nest several times in response to a helicopter flying less than or equal to 400 ft (120 m) above the ground. Other observations also included adults flushing from the nest and leaving eggs unattended. In general, the observations of Mariana crows flushing from nests were all due to aircraft below 1,000 ft (305 m) above the ground (Morton 1996, p. 61). Mariana crows reacting to aircraft by alarm calling and other minor behaviors occurred when aircraft were above this elevation.

The proposed action will increase the frequency and duration of aircraft noise on Guam and the increased noise may affect the potential for habitat to be suitable in the future for Mariana crows. Current and previous DoD consultations have implemented flight restrictions in the Northwest Field area of AAFB (USFWS 2010a, p. 63; USFWS 2015b, Appendix B, p. 10) to minimize noise disturbance to listed species and their habitats. Because the proposed action has no flight restrictions in this area, there will be an increase in the frequency and duration of aircraft noise above that currently in operation at AAFB, and this may affect the suitability of crow habitat in the area. As noted above, Mariana crows have been observed to flush from their nests in response to aircraft below 1,000 ft (305 m) (Morton 1996, p. 61). Therefore, we expect that habitat in the NWF area of AAFB may be unsuitable in the future if Mariana crows are reintroduced and flight restrictions not implemented. We do not anticipate that the increase use of aircraft will preclude the use of habitat by the Mariana crow elsewhere on Guam.

Operation of the LFTRC

Mariana crows are known to be highly susceptible to disturbance from human activities (Morton 1996, p. 60, 62, 72; Ha 2015, pers. com.; Ha et al. 2011, p. 5). Based on observations of disturbance of crow nests on Guam, Morton (1996, p. 72) recommended a 300-meter radius for a buffer zone around active crow nests; Morton's recommendations were based on observations of crows reacting to facility/grounds maintenance, brown treesnake trapping, research activities, loud music, and human voices. One Mariana crow nest on Guam was abandoned due to disturbance from maintenance activity and from radio noise coming from a sound system 150 meters away (Morton 1996, p. 62). Ha et al. (2011, p. 236) found that nest sites were always greater than 300 meters from any buildings, and that actual nest sites were almost twice as far from roads and buildings as random sites. Captive Hawaiian crows (Alala, *Corvus hawaiiensis*) exhibited signs of distress, including pathological auto-plucking, distress calling, and reduced food intake, in response to military activities at Pohakuloa Training Area in Hawaii (Morton 1996, p. 60).

As described in the Environmental Baseline, the Service has delineated habitat on Guam to provide a sufficient amount of habitat for the Mariana crow so the species can be reintroduced to Guam once threats are mitigated. The forests adjacent to the LFTRC are classified as Mariana

crow habitat (Amidon 2012, *in litt*.). In order to serve as suitable habitat for the Mariana crow, the area must be free of threats that would preclude the crow from using the habitat as a nesting territory (for example, brown treesnakes and human disturbance). The noise pollution from operation of the LFTRC could lead to habitat degradation adjacent the LFTRC, and make the habitat unsuitable for nesting Mariana crows. The habitat may still be suitable for foraging or dispersing juvenile crows.

Guidance on potential effects of noise on endangered wildlife was taken from Service (2006a), Pater et al. (2009), and Dooling and Popper (2007). The Service guidance for noise disturbance to spotted owls (*Strix occidentalis caurina*) and marbled murrelets (*Brachyramphus marmoratus*) says that noise disturbance will reach the level of take when 1) project-generated sound exceeds ambient nesting conditions by 20-25 decibels (dB) and 2) project-generated sound, when added to existing ambient conditions, exceeds 90 dB (USFWS 2006a, p. 1). We used the spotted owl and marbled murrelet guidance as a surrogate for the Mariana crow as it is the best available noise disturbance framework for listed species.

Noise from operation of the LFTRC meets both these criteria for disturbance reaching the level of take. In addition, for the purposes of noise disturbance, extreme noise is defined as 101-110 dB, and any noise above that level is not covered by the guidance (USFWS 2006a, p. 5). For extreme sound levels of 101-110 dB (the highest analyzed in the guidance document) disturbance of spotted owls or marbled murrelets is expected up to 400 m (1320 ft) from the source noise (USFWS 2006a, p. 8). In addition, Delaney et al. (2000, 2001) and Pater et al. (1999) developed noise response thresholds for the red-cockaded woodpecker based on a number of military noise sources. Their results showed that woodpeckers did not flush during the nesting season when the sound exposure levels (SEL) for.50-caliber blank fire was less than 82 dB (Delaney et al. 2002, p 21).

Unlike the spotted owl or marbled murrelet example above, no disturbance take of Mariana crows is currently expected as they are extirpated from Guam. However, the habitat adjacent to the LFTRC may be unsuitable for Mariana crows in the future when crows are reintroduced to Guam. Based on the Service guidance above, disturbance that meets the definition of take could occur at 20 dB above ambient conditions (ambient is 60 dB) or when noise exceeds 90 dB. Given the sensitivity of crows to noise both on Guam and Rota, we have chosen the 80 dB threshold for noise disturbance of crows that would preclude them from using suitable habitat for breeding. Based on the Service's noise modeling described above, approximately 319 acres of Mariana crow habitat will be degraded by noise from the LFTRC and not suitable habitat for Mariana crows once the LFTRC becomes operational (Figure 14).

As described above, a species can often habituate to human-generated noise when the noise is not followed by an adverse effect. However, even when a species appears to be habituated to a noise, the noise may produce a metabolic or stress response (increased heart rate results in increased energy expenditure) though the response may or may not lead to changes in overall energy balance. Based on our knowledge of Mariana crow behavior, we assume that reintroduced crows may habituate to noise levels below 80 dB, but not above it.

<u>Habitat Loss, Degradation, and Fragmentation</u>

There is currently 13,962 ac and 10,957 ac of potential Mariana crow habitat in northern Guam and southern Guam, respectively. The proposed action will directly and permanently remove approximately 1,010 ac of crow habitat and three ac will be lost to induced growth. Furthermore, as stated above, we estimate 319 ac will be exposed to noise at levels that will likely prevent Mariana crow breeding activities, for a total habitat loss of 1,332 ac of Mariana crow habitat. The 1,332 ac of habitat lost to the proposed action would have been able to support 24 territorial crow pairs or 24 percent of the 100 pairs needed in northern Guam for recovery. In southern Guam the proposed action will directly remove approximately five acres of low quality Mariana crow habitat.

In northern Guam, the removal and degradation of habitat includes some of the best remaining primary limestone forest on Guam, at Ritidian Point on AAFB. As discussed in the General Effects of the Action section, the most severe effects on crow habitat from habitat fragmentation and edge effects will be at Ritidian Point from construction of the LFTRC. This area currently contains a large expanse (over 350 ac) of high-quality primary limestone forest within the Overlay Refuge. This primary limestone forest is also adjacent and contiguous with critical habitat for the Mariana crow within the fee simple land of the GNWR, together providing an even larger forested area serving as habitat for the Mariana crow. This area will be further fragmented by the presence of over six miles of additional habitat edges on AAFB alone.

Habitat Conservation and Protection

The protection and management of approximately 5,234 acres of kingfisher habitat on DON lands in northern Guam per the MOA (DON and Service 2015c) will benefit the Mariana crow because habitat for crow habitat also would be protected and managed. Thus, adverse effects to the crow would be offset, in part, by implementing the actions in the MOA but also the conservation measures in this consultation. Risks will be minimized by best management practices regarding spread of non-native species and fire.

In addition, as part of the proposed action, the DON proposes to implement a forest enhancement project at Finegayan, in low-quality secondary forest, to benefit listed species, including the crow. This forest is not currently usable by crows and will likely require a decade or more of growth and management before it can support crows. However, the DON has proposed the restoration of the site to include installation of ungulate exclusion fences around the 1,000 acres; active removal of ungulates (i.e. trapping, snaring, shooting) with the goal of eradication within the fenced areas; invasive plant removal; and the propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats. Therefore, although this site would not fully compensate for the loss of primary limestone forest, the restoration of forest and protection of the site is expected to provide some benefit to the crow.

Other Human Disturbance

The proposed training at the NMS in southern Guam and the operation of the main cantonment facilities at Finegayan will increase human presence and noise in crow habitat. The cantonment is near the Haputo ERA and other areas of crow habitat (Figure 15). Increased human

disturbance in these areas could deter Mariana crows, when reintroduced back to Guam, from utilizing these areas for sheltering, foraging and breeding.

Summary

As described in the Status of the Species and Environmental Baseline sections, habitat fragmentation and loss, lack of management, introduced ungulates, invasive species, typhoons, and forest conversion have continued to negatively affect forest habitat on Guam to an extent that the current amount of remaining forest habitat suitable for the Mariana crow is severely degraded and close to the minimum needed for its survival and recovery in the wild. The loss of 1,332 ac of habitat represents a loss of approximately 10 percent of remaining crow habitat in northern Guam. The proposed action will adversely affect the Mariana crow by permanently clearing areas of crow habitat which, in the absence of the project, would have remained intact to provide for the future recovery of the species. In addition, project-related noise will further reduce the amount of crow habitat suitable for this species' breeding, feeding and sheltering. However, the DON's protection and management of 5,234 acres of crow habitat in northern Guam will off-set the loss of Mariana crow habitat from project construction, and will help ensure that crow habitat will be available for future survival and recovery of the species on Guam. The DON also has proposed to implement biosecurity conservation measures including landscape-level brown treesnake eradication and control, recommendations from the RBP, HACCP planning, and brown treesnake interdiction program, which will be beneficial to the crow because it will help reduce the current brown treesnake population and potentially prevent other invasive species from becoming established on Guam.

Effects of the Action – Guam Rail

The Guam rail was once distributed throughout Guam, but significant population declines, resulting primarily from habitat loss and predation by the brown treesnake and feral cats, resulted in their extirpation from Guam by 1987 (Wiles et al. 1995, p. 38). The Guam rail is now found only in captivity and in one experimental population on Rota consisting of between 60 to 80 birds (Wenninger 2008, pers. comm.). The Rota population is a designated non-essential experimental population under section 10 of the Act. As of June 2008, there were approximately 158 Guam rail in captivity on Guam and in mainland zoological institutions (USFWS 2008c, p. 5). Because the Guam rail is extirpated from the wild on Guam, no adverse effects to individual rails are expected to be caused by the proposed action. However, recovery of the species on Guam will depend on the re-establishment of a wild population on Guam and sufficient habitat to support a recovered population, as summarized in the Status and Baseline section. Project impacts to recovery habitat, effects of brown treesnake introduction to Rota, and beneficial effects of project conservation measures are detailed below.

Noise

Aircraft
As detailed in the General Effects section, birds tend to avoid noisy areas but their response to noise may vary depending on the traits of the species or individual. There is no information on the effects of chronic and peak aircraft noise levels on Guam rails. However, the effect of

aircraft noise on the Guam rail is likely similar to other Guam native species; frequent loud over-flights may alter behavior, impair reproduction, and change habitat use in habitat next to the airfields at AAFB (Wiles et al. 1995, p. 46). In 1981, surveys were conducted within habitats adjacent to runways at AAFB and NWF on Guam. Results from the surveys indicated that Guam rails were absent in these areas (Engbring and Ramsey 1984, p. 13-16). Although there could be factors other than aircraft noise that attributed to their absence in these areas, a review of noise studies indicates that many species abandon noisy areas (Francis 2015, p.2).

The proposed action will increase the frequency and duration of aircraft noise on Guam and the increased noise may affect the potential for habitat to be suitable in the future for Guam rails. Current and previous DoD consultations have implemented flight restrictions in the Northwest Field area of AAFB (USFWS 2010a, p. 63; USFWS 2015b, Appendix B, p. 10) to minimize noise disturbance to listed species and their habitats. Because the proposed action has no flight restrictions in this area, there will be an increase in the frequency and duration of aircraft noise above that currently in operation at AAFB, and this may affect the suitability of rail habitat in the area. Because of the lack of information on rail response to aircraft overflights, it is difficult to know if an increase in aircraft overflight noise will preclude the use of habitat by Guam rails in the NWF area in the event rails are reintroduced. We do not anticipate that the increase use of aircraft will preclude the use of habitat by the Guam rail elsewhere on Guam..

Operation of the LFTRC

As described above, Guam rails are secretive and wary, and respond to disturbance from human activity. At the Guam DAWR captive facility, Guam rails negatively respond to bushcutters, which produce a noise level of 87 db (http://www.makita.biz/mm4.html). In response to this noise disturbance, captive rails destroy their nests (S. Medina, DAWR, pers. comm. 2015). Captive Guam rails also destroy their eggs and chicks (less than 10 days old) in response to human disturbance within 11 to 15 m (36 to 49 feet) of their nest. However, this behavior may be attributed to a combination of the disturbance and the stress of breeding in captivity (S. Medina, DAWR, pers. comm. 2015). On Rota, wild Guam rails have been observed to flush from their nest in response to an approaching human, but would return to incubate the eggs in a short period of time. In other instances, incubating birds would remain on their nests when approached by a person (P. Wenninger, DON, pers. comm. 2015).

The LFTRC will be in operation during day and night hours for 39 weeks out of the year, with thousands of DoD personnel using the ranges throughout the year. The total annual ammunition usage at the LFTRC is 6,719,190 rounds. The noise disturbance from the live-fire training will result in impulse noise with very intense sounds of short duration (e.g., the discharge of a weapon). Given the intensity and frequency of human activity and noise levels at the LFTRC, we anticipate that Guam rails would avoid the LFTRC and surrounding area completely while the ranges are in operation. Although there is limited information on Guam rail's tolerance to noise, based on the best available information, we know that Guam rails negatively respond to noise levels of 87 db. Therefore, we have chosen 85 dB as a conservative threshold for noise disturbance that would preclude Guam rails from using recovery habitat for breeding, foraging, or sheltering. We can reasonably expect that all recovery habitat within a 85-db noise contour would be avoided by rails. Therefore, we predict that approximately 51 acres of Guam rail

recovery habitat surrounding the LFTRC will be unsuitable for Guam rails because of the noise (Figure 16).

Habitat Loss and Degradation Caused by the Proposed Action

There are approximately 24,698 ac and 24,886 ac of recovery habitat in northern and southern Guam, respectively, for the Guam rail. Approximately 1,055 ac of recovery habitat in northern Guam and 90 ac in southern Guam will be developed within the project vegetation clearing footprint as a direct result of the proposed action (Table 6, Figure 16). Therefore, there will be 23,643 ac of potential recovery habitat in northern Guam and 24,796 in southern Guam remaining after implementation of the proposed project.
In addition, approximately 17 ac of Guam rail recovery habitat on Guam are expected to be cleared through indirect or induced development impacts of the action throughout the island. After implementation of development directly and indirectly related to the proposed project, the project will result in the loss of 1,162 ac of rail habitat or two percent of the remaining rail habitat on Guam.

Although the degradation and loss of habitat, lack of management, introduced ungulates, invasive species, typhoons, and forest conversion continue to negatively affect habitat for rails on Guam (as described in the General Effects) and the proposed project will contribute to this declining habitat baseline, the amount of habitat loss is not expected to appreciably reduce the likelihood that the remaining habitat would support the recovery and survival of the Guam rail. Furthermore, this area will be fragmented by the presence of over six miles of additional habitat edges on AAFB alone, however, negative effects to rails from fragmentation would be minimal because this species is able to use edge habitat. Similarly, because the Guam rail utilizes shrubby vegetation and edges, fires caused by training in the vicinity of the Andersen South and Route 15 Range Complex and other training areas are not expected to result in loss of habitat for the Guam rail.

Conservation Measures to Benefit the Guam Rail

Recovery habitat remaining on DoD lands comprises a substantial percentage of the total habitat available for the recovery of the Guam rail. The DON's proposed conservation measures are intended to support reintroduction of native endangered or threatened species on DoD lands on Guam consistent with species recovery plans. In further support of such recovery efforts, the DON intends to actively participate in recovery committees for endangered or threatened species on Guam.

The DON has committed to provide sustained funding throughout the construction phase of the project for the development of methods to eradicate or significantly suppress brown treesnakes island-wide to facilitate the recovery of listed species on Guam. If successful, landscape-level implementation of brown treesnake suppression on DoD and other lands will facilitate reintroduction of the Guam rail. This in turn is expected to reduce the rate of nest predation and adult bird mortality.

In addition, as part of the proposed action, the DON proposes to implement a forest enhancement project at Finegayan, which will benefit the rail. The DON has proposed the restoration of the site to include installation of ungulate exclusion fences around the 1,000 acres; active removal of ungulates (i.e. trapping, snaring, shooting) with the goal of eradication within the fenced areas; invasive plant removal; and the propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats.

The protection and management of approximately 5,234 acres of kingfisher habitat on DON lands in northern Guam per the MOA (DON and Service 2015c) may benefit the rail because an undetermined amount of habitat for the rail also would be protected and managed within the 5,234 acres. Thus, adverse effects to the rail would be offset, in part, by implementing the actions in the MOA but also by implementing the conservation measures in this consultation.

Summary

As described in the Status of the Species and Environmental Baseline sections, the degradation and loss of habitat, lack of management, introduced ungulates, invasive species, typhoons, and forest conversion have continued to negatively affect habitat for the Guam rail. Noise from the operation of the LFTRC will diminish the value of the surrounding recovery habitat for Guam rails. This disturbance, combined with the loss of (1,162 ac + 51 ac) 1,213 ac recovery habitat on Guam, further degrades and decreases the amount of habitat that would be available to recover the Guam rail. The increased human disturbance in the NMS, Haputo ERA, and habitat within the Finegayan area would likely result in these areas becoming less suitable for Guam rails.

The DON's implementation of biosecurity conservation measures including landscape-level brown treesnake eradication/control, recommendations from the RBP, HACCP planning, and brown treesnake interdiction program, will be beneficial to the Guam rail because it will help reduce the current brown treesnake population and potentially prevent other invasive species from becoming established on Guam. In addition the DON will protect and managed approximately 5,234 ac in northern Guam and conduct a forest enhancement project on approximately 1,000 acres in Finegayan of habitat, which also will provide some benefit to the rail.

Effects of the Action – Mariana Fruit Bat

In addition to the general effects of the action discussed above, a species-specific effects analysis for the Mariana fruit bat is provided below.

The Service proposes that recovery of the Mariana fruit bat will require subpopulations on each island where they are currently extant, and those subpopulations must be of sufficient size to avoid genetic and demographic risks associated with small populations (USFWS *in review*). Less than 50 wild fruit bats are estimated to remain on Guam (USFWS 2009d, p. 8 and references therein; SWCA 2012, p. 32; USFWS *in review*, p. 7-8 and references therein). Resilience of the Guam fruit bat population is expected to be low given the critically small

starting population, the species' slow reproductive rate (USFWS 2009d, p. 17 and references therein), infrequent and unpredictable immigration from other islands (DON 2013d, p. 78), and abundant, widespread, and uncontrolled threats (USFWS 2009d, p. 19-33 and references therein). Based on our estimate of 27,096 acres of existing survival and recovery habitat for the Mariana fruit bat (Metevier 2014, unpubl. data), the estimated carrying capacity for fruit bats on Guam is 19,847 bats (DON 2013d, p. 26, 45).

Given the small population of Mariana fruit bats remaining on Guam, recovery will likely depend on immigration or translocation of fruit bats from Rota (Esselstyn et al. 2006, p. 531) and long-term conservation and maintenance of fruit bat habitat on Guam. The Mariana fruit bat has high energetic demands associated with flight and year-round breeding, and as such depends on a steady and ample supply of fruiting and flowering plants that are distributed patchily through space and time (Wiles and Fujita 1992, pp. 26-31; USFWS 2009d, p. vi,; Amitai et al. 2010, p. 2693; Downs et al. 2012, p. 344). To meet requirements for breeding, feeding, and sheltering, a self-sustaining population of Mariana fruit bats will rely on threat-managed, native limestone forest habitat containing diverse food resources that are available throughout the year.

Noise

Most of the bat species in the genus Pteropus do not echolocate, and less information is available about their hearing than for bats that echolocate. We have no specific information on hearing for the Mariana fruit bat. The available literature indicates that fruit bats are most sensitive to noise frequencies between 10 and 20 kHz, insensitive to frequencies below one kHz, and able to detect frequencies 40 kHz or greater (DON 2014a, p. 64 and references within). From approximately four kHz to just under 20 kHz the fruit bats have more sensitive hearing than humans (DON 2014a, p. 64). Overall, fruit bat audiograms are similar to humans (DON 2014a, p. 64), and it is possible that noise from the proposed action would be heard by fruit bats as it would be heard by humans.

There is limited understanding of what sound levels may adversely affect Mariana fruit bats, and most information is from observations of fruit bat reactions to aircraft overflights. The following reactions to aircraft noise have been reported:

- Fruit bats have been reported to flush at noise levels exceeding 106 dBC (SWCA 2008, pp. 2-3) and at peak noise levels above 90 dBA/101 dBC (SWCA 2012, p. 23, 37).
- Fruit bats at a maternity colony on Rota flushed when a helicopter was within 200 m and a military jet aircraft (type unknown) flew overhead within 300 m (J. Boland, pers. obs., 2009 and 2010).
- Successive launches of F-14 repeatedly flushed 50 bats from a roost site and F-14s (95, 106 dBA) also caused agitated vocalization and flushing (Grout 1993 in Morton 1996, p. 67).
- Increases in active thermoregulation (32 percent), maintenance (14 percent), locomotion (74 percent), and alertness (62 percent) of Mariana fruit bats were recorded after aircraft overflights (SWCA 2012, p. 23, 37).

Based on this information, we can assume that aircraft overflights resulting in noise over 90 dB may flush roosting Mariana fruit bats. However, flush rates may not adequately reflect a

species' sensitivity to human disturbance (Peters and Obis 2006, p. 1383). Effects to individual Mariana fruit bats are only documented in the SWCA (2012) study, which occurred after the Pati Point colony site was no longer used; however, this study did not report noise levels of overflights that may have disturbed (other than flushing) individual fruit bats. Therefore, we do not have direct data on how an individual fruit bat on Guam will react to noise disturbance from the proposed action. For the purposes of this consultation, we will assume that, at a minimum, noise over 90 dB may flush a roosting Mariana fruit bat. Noise levels above ambient levels and below 90 dB are likely to cause other stress reactions, including increases in active thermoregulation, maintenance, locomotion, and alertness.

Stress reactions caused by human disturbance can have an adverse effect on fruit bats by increasing energetic demands, disrupting hormonal balance, and forcing relocation to lower quality habitat (Klose et al. 2006, p. 347, and references therein; CNMI 2010, p. 7). All of these factors can lead to reduced time foraging, sheltering, or breeding and adversely affect survival. When a disturbance is experienced by a Mariana fruit bat colony, individuals may disperse on their own or in smaller groups (CNMI 2010, p.6). In some cases, the degree of colony dispersal (i.e., how many individuals leave the main colony) may be related to the degree and/or type of human disturbance. For example, if hunters are frequently targeting bats along commuter flyways near the colony roost site, some individuals may disperse away from the roost site temporarily, but eventually return. However, if hunters fire directly into a colony at their day roost, the entire colony abandons the site (CNMI 2010, p. 7). When fruit bats on Rota are forced to disperse from colonies as a result of human disturbance, infant mortality may increase because dependent, non-volant pups that are too big for the mother to carry are likely abandoned. Forced dispersal may negatively affect the reproductive potential of the population because access to mates is compromised (CNMI 2010, p. 7). Even without dispersal, high levels of stress from any disturbance can disrupt reproductive cycles and/or lead to miscarriage (Wingfield et al. 1998, p. 192-193, Heideman 2000, p. 169-199, Klose et al. 2006, p. 347).

Construction noise

Noise from construction of the proposed action may affect Mariana fruit bats in the vicinity of the construction. Construction of the proposed action will occur from 2015 to 2028; however, construction will be phased and will not occur at all places at once, or for the entire construction time period. Construction equipment will include standard heavy equipment including bulldozers, graders, haulers, large trucks. No blasting or use of dynamite will occur as part of the proposed action. The use of heavy equipment can reach noise levels of 96 dB (USFWS 2006a, p. 17). "Based on ambient noise studies conducted at AAFB (DON 2014a, p. 66), we expect that ambient noise in fruit bat habitats on Guam to range from 55 to above 65 dB. Ambient noise levels at clifflines is likely louder than ambient noise inside the forest (DON 2015a). We expect that noise from construction of the proposed action will rise, at times, above ambient conditions, and above the disturbance thresholds discussed above for the Mariana fruit bat.".

Mariana fruit bats in the vicinity of construction could be disturbed or harassed by noise and human presence. In order to avoid disturbance to Mariana fruit bats in the vicinity of construction, the DON will conduct surveys for Mariana fruit bat one week prior to onset of construction in areas within or in the vicinity of fruit bat habitat. If a fruit bat is present within

492 ft (150 m) of the project site, the work will be postponed until the bat has left the area (DON 2014a, p. 33). The DON clarified that this conservation measure does not mean that work will halt if a fruit bat enters the vicinity of a construction site while construction is on-going (C. Cobb, DON, 2015, pers. comm.). In general, Mariana fruit bats are likely to avoid construction sites due to human presence and noise disturbance, and seek other locations to roost and forage. If a fruit bat is present near a construction site and not seen (for example, roosting below a cliffline) then it may be harassed or harmed by the proposed action.

Noise from construction of the proposed action would be temporary and intermittent. Construction noise reaching fruit bat habitat may rise above the disturbance threshold for the Mariana fruit bat; however, this noise will be short-term in duration and will not lead to a permanent reduction in the capability of the habitat to serve as suitable habitat for the Mariana fruit bat.

Aircraft
As described above, and in the Environmental Baseline, most of the disturbance information for Mariana fruit bats is based on studies from aircraft overflights. The proposed action will result in an increase in military jet traffic and helicopter operations over occupied Mariana fruit bat habitat on AAFB. Based on the documented effects of noise on Mariana fruit bats and other wildlife (described above and in the "General Effects" section) and the best available information about the response of Mariana fruit bats to aircraft noise (USFWS 2006b, pp. 35-39 and references cited therein; Morton 1996; SWCA 2008; SWCA 2012; SWCA 2013), the adverse impacts of noise caused by the proposed action on the Mariana fruit bat on AAFB are expected to be substantial.

Noise effects were reviewed under the ISR Strike Biological Opinion (USFWS 2006b) and were determined to adversely affect the Mariana fruit bat to the extent that the remaining colony site would be abandoned. Ongoing and anticipated noise resulting from jet aircraft and helicopter use of the main runways at AAFB (actions analyzed in the ISR Strike Biological Opinion) was expected to result in the incidental take of the remaining bats at Pati Point, due to harassment from aircraft noise (USFWS 2006b, p. 49). In addition, harassed bats moving from Pati Point to less protected areas were expected to be lost to opportunistic hunting (USFWS 2006b, p. 37). The Pati Point colony has been abandoned, and only scattered bats remain on AAFB (DON 2014c, p. 2). These remaining bats are likely to be further harassed from the increase in aircraft overflights from the proposed action. Because noise from the ISR Strike Biological Opinion and this Biological Opinion will occur contemporaneously, it would not be possible to attribute the take to a single project.

Mariana fruit bats are suspected to migrate from Rota to Guam periodically following typhoons, and the migrants are suspected to return to Rota when the effects of the storm have subsided (Wiles and Glass 1990, p. 3; Esselstyn et al. 2006, p. 536). Migrants from Rota are thought to have occupied the Pati Point roost site on Guam in the past (Esselstyn et al. 2006, p. 535-536; Wiles and Glass 1990, p. 2-3). We suspect that if Rota migrants are greeted by unacceptable levels of noise disturbance from increased air traffic at AAFB, it may cause them to return to Rota prematurely. A premature return to Rota under post-typhoon conditions may expose bats to high levels of hunting and decreased food and habitat availability.

It is also possible that the increased noise near Pati Point, and on AAFB in general, will preclude the reestablishment of a fruit bat colony in northern Guam. If the fruit bat population on Guam were to increase, individuals and colonies are not likely to establish roost sites in areas with high levels of human foot, vehicular, or aircraft traffic, due to hunting-induced sensitivities to human-presence (i.e., humans are predators), and sensitivity to loud noise and vibration from aircraft (see data presented above and in Environmental Baseline).

Operation of the LFTRC
As described above, Mariana fruit bats are known to be highly susceptible to disturbance from human activities, including from firing ranges. Mariana fruit bats have been observed avoiding the CATM range while it is active, by flying out to sea or in the opposite direction (J. Quitugua, pers. comm. 2015). Operation of the LFTRC is expected to be louder than the CATM range, and therefore we anticipate that fruit bats will avoid the LFTRC while it is active.

Species that are commonly hunted often demonstrate behavioral (e.g., flushing, startle response) or physiological responses (e.g., increased heart rates, increased respiration rates) to gunshot sounds (Larkin et al. 1996). Knight et al. (1987; p. 175) found that American crows nesting in urban areas were less wary of people than American crows nesting in rural habitat and attributed the difference to the hunting of rural crows. Barron et al. (2012; p. 915) found that American crows avoided areas with live-fire exercises in a similar fashion and suggested that species hunted by humans will be more adversely affected by human activity, including military training (e.g., live-fire training) than species that are not hunted. As stated by Morton and Wiles (2002, p. 161), "Poaching is a particularly insidious activity because not only does it impact fruit bats through mortality, it reinforces behavioral avoidance of humans. Consequently, roosting or foraging fruit bats that might not otherwise be disturbed by some human activities … may become unduly sensitized to them because of illegal hunting." Based on observations Rota, fruit bat colonies on Rota have abandoned areas where they were hunted and have not returned to occupy those areas in recent history (CNMI 2010; J. Boland 2015, pers. comm.). In addition, anecdotal evidence from numerous individuals who have conducted fruit bat research on Guam and the CNMI for many years indicate that fruit bats do avoid areas that have been previously subjected to hunting and also areas that experience live-fire activities (G. Wiles, Washington Department of Fish and Wildlife, personal communication, 2014; T. Mildenstein, University of Montana, personal communication, 2014; D. Janeke, HDR, Inc., personal communication, 2014). Further, in one study on AAFB, 84 percent of fruit bat observations during station counts were in areas without hunting or limited access hunting (SWCA 2012, p. 6).

There have been only three fruit bat observations within the proposed site for the LFTRC on AAFB since 2005 (DON 2014b and references therein, p. 5-332). Recent surveys by SWCA did not detect any Mariana fruit bats in the vicinity of the LFTRC (SWCA 2012, p. 27). However, Mariana fruit bats have been observed at the GNWR below the cliffline of the LFTRC, and the cliffline below the LFTRC is likely used by bats commuting between roosting areas and foraging grounds. Most fruit bats will depart from roost sites to foraging areas from one hour before to one hour after sunset (J. Boland unpublished data, 2008-2011). Therefore the range will be operational when bats can be expected to be commuting to foraging areas. We expect that any Mariana fruit bats that are able to hear that LFTRC in operation will avoid the area and seek out

a less disturbed area. While bats are capable of flying outside the disturbance zone, bats seeking alternate commuting corridors and/or foraging areas may be forced into lower quality habitat or exposed to increased risks of poaching and harassment. In addition, bats in the vicinity of the LFTRC when firing begins will likely flush and flee the area. As mentioned above, if reproductive females are exposed to stressors that cause flushing and dispersal, it can disrupt reproductive cycles, cause miscarriage, and cause abandonment of non-volant young (Wingfield et al. 1998, p. 192-193, Heideman 2000, p. 169-199, Klose et al. 2006, p. 347). Under current conditions, we would not anticipate that fruit bats will be close enough to the firing line to suffer any hearing damage; however an increase in bat populations on Guam could result on the presence of more bats near the firing lines of the LFTRC.

In addition, the forested habitats surrounding the LFTRC are classified as habitat for the Mariana fruit bat. In order to serve as suitable habitat for the Mariana fruit bat, the area must be free of threats that would preclude bats from using the habitat for foraging, roosting, or breeding (for example, brown treesnakes and human disturbance). The noise pollution from operation of the LFTRC will likely lead to habitat degradation in habitat adjacent the LFTRC, and make the habitat unsuitable for Mariana fruit bats.

Given the sensitivity of Mariana fruit bats to noise and human disturbance both on Guam and Rota, and because of the reaction of Mariana fruit bats to hunting disturbance (i.e. gunshots), we anticipate that Mariana fruit bats will avoid the LFTRC and surrounding areas completely while it is in operation. For this reason, we have conservatively chosen a 65 dB threshold for noise disturbance of Mariana fruit bats that would preclude them from using habitat for breeding, foraging, or sheltering. The 65 dB threshold is based on the high-end of current ambient noise levels; we can reasonably expect that all habitat with noise louder than 65 dB would be avoided by fruit bats given the level and type of noise (i.e., gunshots). Therefore, we predict that approximately 309 acres of Mariana fruit bat habitat in the vicinity of the LFTRC will be unsuitable for Mariana fruit bats (Figure 17).

Other Human Disturbance

The proposed construction of the main cantonment at Finegayan will increase human presence and noise in the area. The cantonment is near the Haputo ERA, which contains high-quality fruit bat habitat, where fruit bats have been observed in the past. Increased use of the Haputo ERA by humans could deter fruit bats from utilizing these areas for foraging or roosting.

Training will also occur at the NMS in southern Guam, where fruit bats are routinely observed. Training will include company-level patrolling, jungle training, land navigation, and air-ground operations on five to seven consecutive days, 12 weeks per year, day and night, for a total annual throughput at the NMS of 1,440 Marines. Training at the NMS will also include terrain flight, ground threat reaction, defensive maneuvering, confined area landing, and external load training. These training activities will result in an increase in noise and other human disturbance at the NMS. Solitary bats flushed as a result of project noise may travel to another area where the likelihood of poaching or harassment is greater overall than it is on DoD lands. Flight restrictions will limit low-level flights over much of the NMS and this will minimize, but not completely avoid, adverse noise impacts to the bat in this area.

Habitat Conservation and Protection

The protection and management of 5,234 acres of kingfisher habitat on DON lands in northern Guam per the MOA will have a beneficial effect on the survival and recovery of the Mariana fruit bat in Guam because these two species use similar habitat.

As part of the proposed action, the DON also proposes to implement a forest enhancement project at Finegayan, in low-quality secondary forest, to benefit listed species, including the fruit bat. The DON has proposed the enhancement of the site to include installation of ungulate exclusion fences around the 1,000 acres; active removal of ungulates (i.e. trapping, snaring, shooting) with the goal of eradication within the fenced areas; invasive plant removal; and the propagation, planting, and establishment of dominant and rare species characteristic of native limestone forest habitats. Although this site would not fully compensate for the loss of primary limestone forest in northern Guam, the enhancement of forest and protection of the site is expected to provide some benefit to the fruit bat

Summary

The proposed action is likely to adversely affect the Mariana fruit bat on Guam. Noise from construction, aircraft, operation of the LFTRC, and other military training activities will harm and harass fruit bats in the vicinity of the actions. This disturbance, combined with existing threats to the fruit bats in the Action Area (as described in the Environmental Baseline), will make reestablishment of a Mariana fruit bat colony at Pati Point unlikely. Increased human disturbance at AAFB, Finegayan and Haputo and the NMS may alter fruit bat behavior, increase stress reactions, or preclude use of high-quality foraging areas. Based on the increased disturbance throughout AAFB, shere bats are most common, it is likely that individual bats may be harassed repeatedly by the proposed action. Because AAFB was the last refuge for Mariana fruit bats on Guam, the increased human disturbance in this area will substantially inhibit future efforts for recovery of the Mariana fruit bat.

Further, any bats migrating from Rota to Guam after a typhoon or hunting event, may encounter unsuitable habitat and return to Rota prematurely. A premature return to Rota under post-typhoon conditions may threaten their survival through exposure to high levels of hunting and decreased food and habitat availability. Since the timeframe of the action is indefinite, it is reasonable to assume that a migration event will occur during the timeframe of this action.

In addition, roughly four percent of the remaining Mariana fruit bat habitat on the island will be lost or degraded directly or indirectly as a result of the proposed action (see Table 6) and induced growth. The areas of fruit bat habitat that are permanently cleared are areas which, in the absence of the project, would have remained intact to provide for the future survival recovery of the species. Although this loss will not preclude the recovery or survival of the Mariana fruit bat, it will reduce the total number of bats the island can support. The proposed action will reduce the current estimate for the carrying capacity of fruit bats on Guam (see Environmental Baseline above) by approximately 983 bats.

However, the DON's protection and management of 5,234 acres of fruit bat habitat in northern Guam will off-set the loss of Mariana fruit bat habitat from project construction, and will help ensure that fruit bat habitat will be available for survival and recovery of the species on Guam. In addition, the DON's implementation of the forest enhancement project at Finegayan and the biosecurity conservation measures including landscape-level brown treesnake eradication/control, recommendations from the RBP, HACCP planning, and brown treesnake interdiction program, will be beneficial to the Mariana fruit bat because it will reduce the snake population on Guam and also help prevent spread of brown treesnakes to Rota and other Mariana islands.

Effects of the Action – *Serianthes nelsonii*

Records on the distribution and abundance of *Serianthes nelsonii* indicate that although never abundant, it was historically more abundant and more widely distributed than it is now. Surveys and samples from the early part of the 20th century had been taken from a number of trees both in northern and southern Guam, and subsequent records exist of trees both in the northern and southern parts of the island (USFWS 1994, p. 8). No individuals exist at the sites of Nelson's original collections, which today are the eastern portion of AAFB in northern Guam and Mt. Tenjo and Mt. Alutom in central/southern Guam. Since the 1970's, six mature trees have been recorded in the wild in Guam: three at Ritidian Point, one at Pati Point, and two others near the Tarzan River in the Government of Guam Cotal Conservation Area in south-central Guam (USFWS 1994, p. 8). All have since been cut down or have died with no surviving offspring except for the one remaining mature tree within the project's action area. Surveys in 1995 estimated 121 trees in 16 subpopulations on the island of Rota (Wiles et al. 1996, p. 232). However, current estimates indicate only about 40-50 of these trees have survived (J. Manglona CNMI DLNR, pers. comm. 2015). In addition, successful regeneration in the wild has not been documented since more widespread inventories began in approximately the 1970's (USFWS 1994, p. 8; J. Manglona, DLNR, pers. comm. 2015; AAFB 2015, pp. 4-5). Genetic studies are needed to determine population differences or similarities between the Guam and Rota trees. Current research and recovery efforts have kept *S. nelsonii* seeds from the two islands separate until future genetic work can determine how distinct the Guam tree is from the Rota trees.

Habitat Loss and Degradation Caused by the Proposed Action

This project will clear 945 acres of *S. nelsonii* recovery habitat and result in the loss of three acres from induced human population growth, out of approximately 11,668 acres available on Guam, leaving approximately 10,720 acres of recovery habitat. To construct the MPMG firing range, DON proposes to clear approximately 65 acres of limestone karst forest around the only adult *S. nelsonii* in Guam, leaving a minimum 100-ft buffer of forested area. An approximate 100 acres will be cleared for smaller ranges. The proposed action will clear limestone karst forest with historical locations of *S. nelsonii* near the adult tree.

Effects from Land Clearing and Training Activities

The proposed construction of the MPMG range will convert 65 acres of limestone karst habitat around the adult *S. nelsonii* tree to a cleared area with sparse vegetation, which may require

outside fill. To construct the LFTRC small ranges, DON will grade the limestone karst substrate, and move fill from an outside location for ground cover (DON 2014a, p. 18). Accidental additional clearing of habitat around the adult *S. nelsonii* and the introduction of potentially harmful species through personnel and equipment to *S. nelsonii* habitat will be minimized through best management practices outlined in Table 2-2 of the BA (DON 2014a). As part of the proposed action, ungulate eradication is also planned for this area (See Conservation Measures section). Ungulates can damage seedlings and surrounding habitat by uprooting, herbivory, or trampling; and they can damage adult trees by rubbing. If carried out in a timely fashion, eradication will prevent damage and mortality to the adult *S. nelsonii* and seedlings from ungulates.

The construction and maintenance of the LFTRC will convert the forest immediately surrounding the adult *S. nelsonii* tree from contiguous primary limestone karst forest habitat to fragmented edge habitat, which has implications for abiotic features such as microclimate and humidity, as well as biotic features such as species composition and frequency of interaction with animal species (Murcia 1995, pp. 59-60; Laurance 2000, p. 134). The specific changes and their extent into edge habitat are largely site specific (Murcia 1995). However, most empirical studies indicate that edge effects happen in up to 492 ft (150 m) of the created edge, and in a few cases, will extend further (Laurance et al. 1997, p. 1118; Laurance 2000, p. 135). This measurement is at least four times greater than the total width of the fragment of forest habitat containing the last *S. nelsonii* adult tree on Guam that will remain after the area is cleared for the LFTRC. Most studies indicate that the effects from created forest edges are largely negative, including increases in damaging wind penetration, decreased biomass, and increased susceptibility to fires and invasive species (Murcia 1995, pp. 59-60; Laurance et al. 1997, p. 1118; Nascimento and Laurance 2004, p. S136; Holway 2005, p. 565). Therefore, the proposed project will likely result in edge affects to the *S. nelsonii* tree, although the extent of the effects is unknown at this time.

Most of the area with modification and vegetation clearing for the MPMG range will be to the east of the adult *S. nelsonii*, increasing the tree's, and the remaining fragmented forest's, exposure to wind. The dominant wind direction in Guam is from the east or northeast (Guard et al. 1999, p. 2-6), and storms often approach from the east or southeast (Mendehlson et al. 2012, p. 206). Keeping the area east of the *S. nelsonii* buffer clear of vegetation will increase the tree's exposure to stronger winds such as those in tropical storms and typhoons, as well as persistent lower-speed winds, which can desiccate the tree and surrounding vegetation (Chen et al. 1995, p. 83; Gelhausen et al. 2000, p. 31; Laurance et al. 2002, p. 608). This effect will likely be exacerbated by decreased biomass characteristic of forest fragments and edges (Laurance 1997, p. 1118; Nascimento and Laurance 2004, p. S134). Because the structure of the tree has been weakened by previous storms, termite damage, epiphyte load, and defoliation due to insect damage (DON 2014a, p. 58; AAFB 2015, p. 4), increasing wind load to this tree could result in mortal structural damage. In addition, the adult *S. nelsonii* is taller than most surrounding canopy that would remain in the fragment. Larger trees and areas near unimpeded spaces, such as the firing range, are more susceptible to storm damage (Brokaw and Walker 1991), meaning the adult tree will be particularly susceptible to damage from future storms. To minimize adverse effects to the adult Guam *S. nelsonii*, the DON proposed bracing the tree. However, because of the tree's current structural condition, it is possible that this could do more damage

than help, and the Service has advised against this measure. Typhoon data for Guam collected since 1959 indicates that on average four typhoon events (sustained winds greater than or equal to 74 mi per hour (119 km per hour)) could occur each decade (DON JTWC pers. comm. 2010). Therefore, typhoons are likely to occur during the life of this project. Given that a cleared area would be maintained directly east of the *S. nelsonii* adult, there is an increased likelihood that high wind during a typhoon would break tree limbs or the trunk, causing mortal damage to the tree.

In addition to mechanical wind effects, conditions in the fragment containing the adult *S. nelsonii* will likely exhibit a decrease in humidity, increased evapotranspiration, and an increase in solar radiation to the understory (Laurance 2000, p. 134; Gelhausen, et al. 2000, p. 31). It is difficult to predict how this would affect adult and seedling survival and species composition within the *S. nelsonii* fragment in the action area. However, natural conditions in limestone karst forests are shaded, and Guam, as a whole, is normally very humid (greater than 70 percent humidity) (Guard et al. 1999, pp. 2-5). Seed crop, seedling germination, and growth increase during the rainy season (AAFB 2015, p. 9; Wiles et al. 1996, p. 233), implying moisture is important for seedling germination and growth. Preliminary results from light experiments on *S. nelsonii* seedlings showed higher growth in shade conditions greater than 50 percent (AAFB 2015, p. 4). This research also showed very high seedling turnover at the site of the mother tree (AAFB 2015, p. 4), but research is ongoing to pinpoint the causes. If methods for improving seedling survival are developed, conditions within the forest fragment may not be ideal for implementing them when the humidity, radiation, and wind conditions are less favorable as a result of the fragmentation. The health of the adult tree itself may also be compromised by drier conditions within the fragment.

Although measures to prevent invasion are proposed in best management practices, the increased invisibility of edges, especially those created through human modification, is well documented in other systems (Holway, 2005, pp. 561-565; Cadenasso and Pickett, 2001, p. 95; Didham et al. 2007, p. 490). Further, the edges and gaps that currently exist in the proposed action area are comprised of mostly invasive plants such as *Miscanthus* grasses, *Bidens alba*, and other weeds (A. Gawel, USFWS, pers. obs. 2011 – 2015). Plant invasions in the fragment will likely inhibit seedling growth, and invasive vines or epiphytes could increase structural damage or smother the *S. nelsonii* adult tree and seedlings. Invasive insects and other animals are also likely to increase in disturbed edge habitat (Holway, 2005, pp. 563; Laurance, et al. 2002, p. 608). Insect pests are one of the major threats to *S. nelsonii* (USFWS 1994, p. 15-19), and increased insect disturbance is expected on the adult and seedlings when edge habitat is created from this project.

In addition to increased vulnerability to invasive species, fragmented habitat may lead to a decrease in native species composition, including use by beneficial animals such as pollinators and seed dispersers. When habitat is fragmented, wide-ranging species, such as fruit bats, known to be important pollinators and seed dispersers (Banack 1998, pp. 1959-1960; Shilton et al. 1999, p. 222; Hodgkison et al. 2003, p. 498), are likely to decline (Woodroffe and Ginsberg 1998, p. 2127). The pollinators and seed dispersers of *S. nelsonii* are unknown, although records exist of Mariana fruit bats visiting *S. nelsonii* flowers in Rota (USFWS 1994, p. 13). Aside from fragmentation, the operation of the LFTRC may discourage fruit bats from using the area, even as a corridor between feeding and roosting sites (see analysis above). Even when the LFTRC is

not in operation, fragmented and disturbed habitat is less likely to be used by other native species such as Mariana crows (NRC 1997, p. 6) and possibly native seed-dispersers.

Fire management guidelines for the LFTRC and the hand grenade complex are described in the BA (DON 2014a, pp. 21-22). Implementation of these fire prevention measures will decrease the risk of wildlife fire and destruction near the adult *S. nelsonii*. Regardless, while savannah and other non-forest cover types of habitat are at greatest risk for fire in Guam (Guam Department of Agriculture 2010, p.22), forest edge areas experience considerable damage, even if fires do not penetrate far into forests (Guam Department of Agriculture 2010, p.33). Therefore, fire presents a risk to both the area with the adult tree and *S. nelsonii* habitat within and near this project area, especially the edges. Over 6.7 million rounds of ammunition are anticipated to be fired in the LFTRC annually, over 1.4 million of which are anticipated in the MPMG (DON 2014b, p. 2-9). With persistent gunfire, tracers, and rotating personnel smoking cigarettes, there will be constant risk of igniting a fire. Each incident that burns forest edges will create more opportunities for future fires to penetrate deeper into forest areas, and may decrease the buffer area within the fragment containing the adult *S. nelsonii* tree.

Effects to Research and Recovery

The proposed project will limit access to the adult *S. nelsonii* tree and seedlings for research, monitoring, and recovery. Currently, although the tree is located on a military installation, researchers with base approval have regular access to the adult tree. While DON proposes to allow access during the operation of this project, the additional process of coordinating access to an area that will have increased safety and security concerns, and that is proposed to be active for an estimated 39 weeks out of the year, will limit regular access. The LFTRC will likely have an unpredictable schedule that will adapt to the training needs of multiple DoD entities. This will have implications for regular monitoring of and potential response to threats to the adult tree and seedlings. It is also will likely limit the kinds of research that can be done on the tree and seedlings.

In addition, the proposed MPMG will require establishing a SDZ over the GNWR fee simple land, which will limit access to this area for research and recovery. The GNWR is currently an outplanting site for *S. nelsonii* because of its status as a conservation area, the availability of suitable habitat, and the Refuge's leadership in *S. nelsonii* recovery through a national grant that implements recovery actions for this species. Outplanting and maintenance of *S. nelsonii* seedlings has begun and is planned to continue in a number of suitable areas within the Refuge that fall within the SDZ (J. Cruce, USFWS, pers. comm. 2015). Limestone karst habitat suitable for *S. nelsonii* on the Refuge is mostly located within the SDZ. Areas of the Refuge fee simple that would fall outside of the SDZ are mostly comprised of strand, coconut plantation, or other habitats that would not be suitable for *S. nelsonii* outplanting. Operation of the MPMG may limit access to these outplanting sites. Seedling survival has been extremely limited in previous outplanting efforts, and the causes are still being investigated, but is likely due, in large part, to damage from insect herbivory and boring for egg-laying (J. McConnell, GPEPP, pers. comm. 2014; AAFB 2015, p.10). A large amount of time and labor are required to ensure seedling establishment, control for insect pests, and monitoring and response to any health changes (E. Demeulenaere, GPEPP, pers. comm. 2015). When the operation of the MPMG begins in 2021,

most of the seedlings outplanted on the Refuge will be between seven and five years old. As evidenced by the Tarague outplantings from 1999 (AAFB 2015, p. 6), the lack of regular maintenance, even when trees are over five years old, may result in mortality. Although DON proposes to coordinate access to the adult tree, the Refuge fee simple area will be closed during operation of LFTRC ranges, estimated at 39 weeks of the year (DON 2014b, p. 3-58). Unless regular access is coordinated for management actions, this will negatively affect the outplanted individuals on the Refuge, thereby adversely affecting the largest recovery action for this species in Guam thus far.

Summary

The proposed action will adversely affect the last remaining adult *S. nelsonii* tree in Guam and result in the loss of 948 acres of recovery habitat for this species. It also will negatively impact recovery efforts by limiting access to the adult tree, the wild seedlings around it, and outplanted *S. nelsonii* saplings at the Refuge. The fragmentation of habitat will cause ecological degradation that extends beyond the proposed vegetation clearing due to edge effects. As detailed above, the proposed action will likely damage the adult tree and seedlings by creating abiotic conditions less favorable to growth and survival, increasing fire risk, increasing invasability, increasing wind load, and decreasing the likelihood of pollination and seed dispersal. Of the impacts detailed above, increased wind load is likely the most significant, persistent, and unmitigated adverse effect. In the event of a severe wind storm, with the clearance of forest vegetation to the east of the adult tree that would otherwise act as a buffer to strong winds, structural damage or injury to the adult tree is highly likely, resulting in mortality. The adult tree and its descendants comprise the entire Guam genetic representation of *S. nelsonii*. Studies have not been done on its distinction, if any, from the Rota *S. nelsonii* trees, but the loss of this tree and its seedlings may significantly impact the genetic diversity of the species. These impacts will be offset, in part, by the conservation measures (see Conservation Measures section above).

The conservation measures, as well as continuing recent recovery efforts, will help to ensure the survival of the Guam population of *S. nelsonii*. The DON has proposed to outplant and maintain into adulthood 30 individuals parented from the Guam adult tree in a protected area. Therefore, adverse effects from the loss of genetic diversity, such as inbreeding depression, would be minimized. Because of new methods being employed and their success so far on outplanted seedling survival, these 30 individuals will have a high likelihood of survival if properly maintained, and if the area that they are outplanted to is truly protected from threats. DON has also proposed to fund seed storage and viability research, which will help preserve the genetic stock of the Guam population. Multiple ongoing interagency efforts, such as the maintenance of outplanted individuals at the GNWR, innovations in seedling and adult protection, and recent outplanting efforts in Rota will help ensure the continued survival of this species. The implementation of these conservation measures and best management practices, combined with the existence of adult trees in Rota, the existence of over 200 individuals in nurseries, and improved seedling survival strategies on both islands, make it unlikely that this project will preclude the recovery and survival of *S. nelsonii*. This determination is contingent on the full implementation of the conservation measures described above. If these conservation measures are not fully implemented, if new information suggests that the Guam population is distinct from

S. nelsonii in Rota, or if the baseline for this species experiences an unforeseen major decline, this determination will need to be reconsidered.

Effects of the Action – Guam Micronesian Kingfisher Critical Habitat

The Guam Micronesian kingfisher critical habitat on Guam was designated to support the recovery of the kingfisher by including unoccupied habitat that kingfishers can be translocated or released into when threats are managed (USFWS 2004). Critical habitat for the kingfisher was identified using guidelines from the Guam forest bird recovery plan (USFWS 1990a). Because the kingfisher does not exist in the wild and all suitable habitat presently is unoccupied, inclusion of unoccupied areas containing the primary constituent elements is essential to the conservation of this species. Survival and recovery of the kingfisher will require reintroduction of the kingfisher through release of captive birds and subsequent natural dispersal into areas of Guam that formerly were inhabited. Actions that affect the ability of the critical habitat unit to provide the conservation function for which it was designated may adversely affect critical habitat, regardless of whether the habitat features are actually physically altered.

The proposed project will not clear any designated critical habitat for the Guam Micronesian kingfisher.

The proposed LFTRC will be constructed immediately adjacent to, and above the cliff from, the Guam critical habitat unit at the Guam National Wildlife Refuge (Figures 11 and 12). The critical habitat unit is approximately 400 ft (122 m) below the nearest edge of the MPMG firing range. As discussed in the Effects of the Action – Guam Micronesian kingfisher, above, the noise from the firing range will rise substantially above ambient levels, and may preclude adjacent habitats from use by kingfishers in the future due to noise disturbance.

<u>Noise from Construction of LFTRC</u>

Construction of the MPMG range will take place over approximately three years beginning in 2021. Construction equipment will include standard heavy equipment including bulldozers, graders, haulers, large trucks. No blasting or use of dynamite will occur as part of the proposed project. The use of heavy equipment can reach noise levels of 96 dB (USFWS 2006a, p. 15). Noise levels within critical habitat, at the base of the cliff below the MPMG firing range, are anticipated to be 5-15 dB less than that above the cliff line (personal communication, M. Downing, Blue Ridge Research and Consulting, February 2014 in DON 2014b, p. 5-230). Therefore, we anticipate that noise from construction of the LFTRC would range between 81-91 dB within the critical habitat unit (without accounting for noise attenuation due to vegetation, humidity or other factors). Ambient noise within the critical habitat unit will depend on wind and surf conditions, and distance from the ocean. Based on ambient noise studies conducted above the cliff line at AAFB (DON 2014a, p. 66), we expect that ambient noise within the critical habitat unit is at least 60 to 65 dB. Therefore, noise from the construction of the MPMG firing range on AAFB may reach between 16 to 26 dB above ambient conditions in the critical habitat unit.

Noise from construction will not be heard within the entire critical habitat unit. While it is difficult to estimate what portions of the critical habitat unit will be affected, we assume that the noise above ambient levels would be heard in the portions of critical habitat immediately below the MPMG cliff line. In a conservative scenario, construction noise may be heard in a 100 ac (41 ha) portion of the 376 ac (152 ha) critical habitat unit (or 27 percent of the critical habitat unit).

Noise from construction of the MPMG would be temporary and intermittent. Noise reaching the critical habitat unit would likely only come from construction activities at the far north end of the MPMG range, which might occur for a few months to a year of the total construction time.

Construction noise within the critical habitat unit (81-91 dB) may rise above the disturbance threshold for the Guam Micronesian kingfishers of 80 dB (described in the Effects of the Action – Guam Micronesian kingfisher section). However, this noise will be short-term in duration and will not lead to a permanent reduction in the capability of the critical habitat unit to support recovery and survival of the kingfisher within the critical habitat unit.

Noise from Operation of LFTRC

The only noise from operation of the LFTRC that is likely to be heard within the Guam Micronesian kingfisher critical habitat unit is that from weapons firing at the MPMG range. Noise from the MPMG range will be long-term, intermittent, and high intensity noise occurring over multiple years for an indefinite period of time.

Based on the noise data shown in Figure 13, approximately two acres of Guam Micronesian kingfisher critical habitat, along a cliffline, will be exposed to noise levels above 80 dB. Therefore, we anticipate that noise from the MPMG range will only reach a small portion of the critical habitat unit. However, if environmental conditions are right (i.e. low surf and high winds blowing west) it is possible that firing at the range will be heard over a broader area; however we expect the sound would be very soft and barely above ambient levels. Therefore, operation of the MPMG range will not lead to a permanent reduction in the capability of the critical habitat unit to support recovery and survival of the kingfisher.

Effects of the Action – Mariana Crow Critical Habitat

Mariana crow critical habitat on Guam was designated to support the recovery of the Mariana crow by including unoccupied habitat that Mariana crows can be translocated or released into when threats are managed (USFWS 2004). Recovery of the Mariana crow requires restoration of a Mariana crow population on Guam (USFWS 2004; USFWS 2005a). Because the Mariana crow does not exist in the wild and all suitable habitat presently is unoccupied, inclusion of unoccupied areas containing the primary constituent elements is essential to the conservation of this species. Survival and recovery of the crow will require reintroduction of the crow through release of captive birds and subsequent natural dispersal into areas of Guam that formerly were inhabited. Actions that affect the ability of the critical habitat unit to provide the conservation function for which it was designated may adversely affect critical habitat, regardless of whether the habitat features are actually physically altered.

The proposed project will not clear any designated critical habitat for the Mariana crow.

The proposed LFTRC will be constructed immediately adjacent to, and above the cliff from, the Guam critical habitat unit at the Guam National Wildlife Refuge (Figures 11 and 12). The critical habitat unit is approximately 400 ft (122 m) below the nearest edge of the MPMG firing range. As discussed in the Effects of the Action – Mariana Crow, the noise from the firing range will rise substantially above ambient levels, and may preclude adjacent habitats from use by Mariana crows in the future due to noise disturbance.

Noise from Construction of LFRTC

Construction of the MPMG range will take place over approximately three years beginning in 2021. Construction equipment will include standard heavy equipment including bulldozers, graders, haulers, large trucks. No blasting or use of dynamite will occur as part of the proposed project. The use of heavy equipment can reach noise levels of 96 dB (USFWS 2006a, p. 15). Noise levels within critical habitat, at the base of the cliff below the MPMG firing range, are anticipated to be 5-15 dB less than that above the cliff line (personal communication, M. Downing, Blue Ridge Research and Consulting, February 2014 in DON 2014b, p. 5-230). Therefore, we anticipate that noise from construction of the LFTRC would range between 81-91 dB within the critical habitat unit (without accounting for noise attenuation due to vegetation, humidity or other factors). Ambient noise within the critical habitat unit will depend on wind and surf conditions, and distance from the ocean. Based on ambient noise studies conducted above the cliff line at AAFB (DON 2014a, p. 66), we expect that ambient noise within the critical habitat unit is at least 60 to 65 dB. Therefore, noise from the construction of the MPMG firing range on AAFB may reach between 16 to 26 dB above ambient conditions in the critical habitat unit.

Noise from construction will not be heard within the entire critical habitat unit. While it is difficult to estimate what portions of the critical habitat unit will be affected, we assume that the noise above ambient levels would be heard in the portions of critical habitat immediately below the MPMG cliff line. In a conservative scenario, construction noise may be heard in a 100 ac (41 ha) portion of the 376 ac (152 ha) critical habitat unit (or 27 percent of the critical habitat unit).

Noise from construction of the MPMG would be temporary and intermittent. Noise reaching the critical habitat unit would likely only come from construction activities at the far north end of the MPMG range, which might occur for a few months to a year of the total construction time.

Construction noise within the critical habitat unit (81-91 dB) may rise above the disturbance threshold for Mariana crows of 80 dB (described in the Effects of the Action – Mariana Crow section). However, this noise will be short-term in duration and will not lead to a permanent reduction in the capability of the critical habitat unit to support recovery of the Mariana crow.

Noise from Operation of LFTRC

The only noise from operation of the LFTRC that is likely to be heard within the Mariana crow critical habitat unit is that from weapons firing at the MPMG range. Noise from the MPMG

range will be long-term, intermittent, and high intensity noise occurring over multiple years on end.

Based on the noise data shown in Figure 14, approximately two acres of Mariana crow critical habitat, along a cliffline, will be exposed to noise levels above 80 dB. Therefore, we anticipate that noise from the MPMG range will only reach a small portion of the critical habitat unit. However, if environmental conditions are right (i.e. low surf and high winds blowing west) it is possible that firing at the range will be heard over a broader area; however we expect the sound would be very soft and barely above ambient levels. Therefore, operation of the MPMG range will not lead to a permanent reduction in the capability of the critical habitat unit to support recovery of the Mariana crow.

Effects of the Action – Mariana Fruit Bat Critical Habitat

The proposed action may affect Mariana fruit bat critical habitat and its primary constituent elements (USFWS 2004). Although the current population of Mariana fruit bats on Guam is small, the foraging behavior and diverse diet of the fruit bats cause them to use most of the island for foraging, as documented by Wiles et al. (1995). Thus, all of the designated critical habitat for this species is used for foraging and/or roosting and is considered occupied. Recent sightings of Mariana fruit bats at the GNWR within the critical habitat unit confirm this. Actions that affect the ability of the critical habitat unit to provide the conservation function for which it was designated (serving as habitat for roosting and foraging bats) may adversely affect critical habitat, regardless of whether the habitat features are actually physically altered.

The proposed project will not clear any designated critical habitat for the Mariana fruit bat. However, the proposed action will create disturbance that may affect the PCE (described above) requiring remote locations on clifflines with limited exposure to human disturbance. As described below, this primary constituent element will be adversely affected by the proposed action.

<u>Construction</u>

Construction of the MPMG range will take place over approximately three years beginning in 2021. Construction equipment will include standard heavy equipment including bulldozers, graders, haulers, large trucks. No blasting or use of dynamite will occur as part of the proposed project. The use of heavy equipment can reach noise levels of 96 dB (USFWS 2006a, p. 15). Noise levels within critical habitat, at the base of the cliff below the MPMG firing range, are anticipated to be 5 to 15 dB less than that above the cliff line (personal communication, M. Downing, Blue Ridge Research and Consulting, February 2014 in DON 2014b, p. 5-230). Therefore, we anticipate that noise from construction of the LFTRC would range between 81-91 dB within the critical habitat unit (without accounting for noise attenuation due to vegetation, humidity or other factors). Ambient noise within the critical habitat unit will depend on wind and surf conditions, and distance from the ocean. Based on ambient noise studies conducted above the cliff line at AAFB (DON 2014a, p. 66), we expect that ambient noise within the critical habitat unit is at least 60 to 65 dB. Therefore, noise from the construction of the MPMG

firing range on AAFB may reach between 16 to 26 dB above ambient conditions in the critical habitat unit.

Noise from construction will not be heard within the entire critical habitat unit. While it is difficult to estimate what portions of the critical habitat unit will be affected, we assume that the noise above ambient levels would be heard in the portions of critical habitat immediately below the MPMG cliff line. In a conservative scenario, construction noise may be heard in a 100 ac (41 ha) portion of the 376 ac (152 ha) critical habitat unit (or 27 percent of the critical habitat unit). Noise from construction of the MPMG would be temporary and intermittent. Noise reaching the critical habitat unit would likely only come from construction activities at the MPMG range, which might occur for a few years of the total construction time.

Construction noise within the critical habitat (81-91 dB) will rise above the disturbance threshold for Mariana fruit bats (described in the Effects of the Action – Mariana Fruit Bat section). This noise will be short-term in duration and will not lead to a permanent reduction in the capability of the critical habitat unit to support recovery of the Mariana fruit bat. However, during construction, the critical habitat unit will not serve as a remote location with limited exposure to human disturbance and this will limit the fruit bat's use of the clifflines for roosting or reproductive activity. Construction noise at this time, and for a period of time after while fruit bats still avoid the area, may have an adverse effect on the critical habitat unit serving as a remote location.

Operation of the LFTRC and aircraft overflights

Noise disturbance from the LFTRC and aircraft overflights could expose the critical habitat unit to increased human disturbance and preclude Mariana fruit bat roosting and reproductive activity. Based on the noise data shown in Figure 17, approximately two acres of fruit bat critical habitat, along a cliffline, will be exposed to noise levels above 65 dB. This includes approximately 150 linear meters (492 linear ft) of cliffline. There are approximately 2,500 m (6,652 feet) of cliffline within the critical habitat unit. Therefore, the amount of cliffline critical habitat precluded from use by the Mariana fruit bat is small.

In addition, based on the map of noise contours for aircraft at AAFB from the 2010 DON EIS (DON 2010b, Vol. 2, p. 6-25), we do not expect aircraft noise over the critical habitat unit to rise above ambient conditions.

H. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

The extent to which future development is addressed as a cumulative effect in the following analysis excludes any such future development that is expected to be interdependent with or

interrelated to construction of federally-funded roads or is likely to be caused by other Federal actions that will be addressed in future section 7 consultations.

Overview of Cumulative Effects

Future state, local, or private actions that are reasonably certain to occur in the action area are listed below.

1) Development
    a. Civilian
        i. Commercial
        ii. Residential
        iii. Agriculture
    b. Territorial or local government
        i. Infrastructure projects
        ii. Other development
    c. Tourism
        i. Hotels and resorts
        ii. Roads and other infrastructure to support tourism
2) Wildfire
3) Invasive Species / Biosecurity
4) Natural Resource Management Projects

These actions may result in loss, fragmentation, or degradation of habitat for the listed species addressed in this Biological Opinion, or provide beneficial effects to listed species.

<u>Development</u>

The DON provided a list of known future projects lacking a Federal nexus on Guam in their Biological Assessment (DON 2014a, p. 85), and provided information on whether the future projects may affect terrestrial biological resources. No specific information was provided on whether the projects may potentially be located within habitats for the listed species addressed in this Biological Opinion. The DON presented fifteen reasonably foreseeable projects that may result in adverse cumulative effects to terrestrial biological resources on Guam. However, this list does not include projects deemed "present" and the Service assumes that some of these projects may be delayed into the future and thus contribute towards cumulative effects.

Guam's land use planning maps (Government of Guam 2009, p. 2-14) indicate housing and industrial development will be targeted to minimize effects to listed species habitat areas. However, development is likely to result in increased noise and predator densities in the vicinity of sites occupied by listed species. Population increases will result in increased human noise disturbance in urban areas as well as in outdoor recreation areas.

Civilian development

Because the information in the Biological Assessment did not provide data on how much listed species habitat may be lost from cumulative effects, we calculated an estimate based on population growth, density, and development zoning.

From 1950 to 2000, Guam's population grew at an average rate of 21 percent per decade (about 2.1 percent annually). However, population growth has slowed and is expected to stabilize over the next 20 years at around 1.5 percent per year (DON 2014b, p. 4-113). The population of Guam in 2010 was 159,358 (U.S. Census data in DON 2014b, p. 4-113). Using 2010 data, population density within developed areas on Guam (assuming all people live in the developed areas) was calculated to be 4.5 people per acre.

If we apply the projected annual growth of 1.5 percent to the next 20 years, the population of Guam, in the absence of the proposed project, would be 231,220 in 2035 (an increase of 71,862 people since 2010). Most future development will occur in north and central Guam (V. Torres, Government of Guam, pers. comm., 2010). Based on our analysis, if population density remains unchanged, the additional people will spread development into all the developable land in northern Guam zoned for non-tourist civilian development. Therefore, we estimate that 423 acres of remaining Guam Micronesian kingfisher habitat and 286 acres of remaining Mariana crow habitat would be developed in the absence of the proposed action by 2035.

Territorial or local government development
Many territorial or local government development projects may be funded by Federal monies, and therefore would not be included in this cumulative effects analysis. Based on the list of projects the DON provided that may affect terrestrial biological resources, such as a 60 MW power plant, a territorial prison, Guam airport expansion, and road projects, we expect that the majority of territorial and local government projects will be Federally funded and subject to a section 7 consultation.

Tourism development
Significant areas of listed species habitat are zoned for development as tourist/resort (Government of Guam 2009, p. 2-14). The Guam Tourism 2020 Plan calls for an increase in five-star luxury hotels and upgrades to existing private resorts (GVB 2014, p. 30). The Plan calls for growth of 1,500 hotel rooms by 2020, or six additional hotels (GVB 2014, p. 38). In 2012, Guam received 1,308,035 visitor arrivals and projects that by 2020 visitor arrivals could reach two million people, an increase of over 30 percent (GVB 2014, p. 34). The Plan also calls for tourism development to follow the World Tourism Organization's sustainable tourism principles that call for tourism to be developed in conjunction with maintaining essential ecological process and biological diversity (GVB 2014, p. 34).

It is our understanding that development of many of the tourist/resort areas will entail creation of federally-funded roadways and infrastructure; therefore these projects will be addressed in separate section 7 consultations. Other tourist/resort development may occur without Federal funding, but we are unable to project at this time how much listed species habitat will be lost due to these future developments.

<u>Wildfire</u>

The conversion of forest to savanna in southern Guam has been on-going for decades. Although there is ongoing debate regarding the formation of savannah areas in Guam (Hunter-Andersen 2009; Athens and Ward 2004), savannah areas have encroached into previously forested areas as a result of human-caused wildfires. Of the approximately 750 wildfires that burn on Guam each year, 80 percent are caused by arson (Guam Department of Agriculture 2010, p. 117). From 1979 to 2006 the number of acres burned by wildfire averaged 1.7 ha (4.2 ac) per year (Burdick et al. 2008, p. 471). We anticipate the area burned by wildfires will continue to decline as a result of efforts by the U.S. Forest Service, Federal Emergency Management Agency, and the DOI Office of Insular Affairs. The U.S. Forest Service, for instance, anticipates providing funds to develop a robust fire suppression force led by a skilled fire management officer on Guam (Mahoney 2010, pers. comm.).

To estimate the rate of historical forest conversion to savannah, Greenlee (2010) compared aerial photographs from 1975 and 2005 and estimated that 1,119 ac (453 ha) of forest has been converted to savannah in southern Guam since 1975. This estimate indicates the average rate of forest loss in southern Guam is approximately 37 ac/year (15 ha/year) (740 ha/20 years). However, the trend in annual area burned has been declining and we anticipate it will continue to decline as a result of ongoing and future Federal support of the development of local fire suppression resources. Therefore, we reduced the anticipated acreage burned over the next 20 years by 30 percent to 518 ha/20 years.

Invasive Species / Biosecurity

Guam is a central pass-through point for the transport of goods and people from Asia and North America, and represents the local consolidation hub for the rest of Micronesia (e.g. approximately 1.1 million people enter Guam per year and Guam is the primary shipment hub for cargo). As such, Guam is often the first island of introduction of non-native species entering Micronesia and represents the geographic first line of defense for invasive species prevention in many of the US-affiliated islands in the western Pacific as well as for preventing potential introduction pathways westward from Asia to Hawaii and North America. Over 1,000 species of introduced animals and plants are likely established on Guam, with dozens severely affecting the island's natural systems (Aubrey Moore pers. comm. in BTS TWG 2015). The most damaging alien invader to establish on Guam thus far is the brown treesnake, and the primary focus of biosecurity efforts on Guam has been preventing the spread of the brown treesnakes to other locations; however, other invasive species on Guam, such as the coconut rhinoceros beetle and little fire ant, also warrant attention. The Regional Biosecurity Plan (RBP), the Regional Invasive Species Council (RISC), and the Guam Invasive Species Advisory Committee (GISAC) have all been developed to reduce the risk of the introduction, establishment, and spread of invasive species to Guam. These comprehensive and collaborative efforts will reduce the risk of adverse cumulative effects from invasive species to the listed species covered in this Biological Opinion. The Department of Interior – Office of Insular Affairs (OIA) also funds brown treesnake suppression efforts for natural resource benefits, research on brown treesnake control, the implementation of brown treesnake barriers, and overall brown treesnake coordination efforts.

Natural Resource Management Projects

Most natural resource management projects that would benefit the listed species covered in this Biological Opinion will be federally funded. However, small scale projects may occur funded by the territorial or local governments. These projects may benefit listed species; however, their scale is likely to be insignificant compared to the loss of habitat from the proposed action or cumulative effects.

Species-Specific Cumulative Effects

Guam Micronesian kingfisher and Mariana crow
In northern Guam, habitat for the kingfisher and crow may be lost as a result of cumulative effects from civilian development. We estimate that 423 acres of remaining kingfisher habitat and 286 acres of remaining crow habitat would be developed in the absence of the proposed action by 2035. For the kingfisher this represents 3.6 percent of the potential remaining habitat in northern Guam. For the crow, this habitat loss represents 2.6 percent of the potential remaining habitat in northern Guam.

In southern Guam, habitat for the kingfisher and crow may be lost as a result of cumulative effects from wildfire. However, since the trend in annual area burned has been declining, and since we anticipate it will continue to decline as a result of ongoing and future Federal support of the development of local fire suppression resources, the amount of habitat lost to wildfire should decline.

Guam Rail
Habitat for the Guam rail may be lost from development or wildfire. Because the Guam rail utilizes edge habitat and shrubby areas, the effects of future development and human-caused wildfire (which increase the amount of edge habitat and shrubby areas) to the Guam rail on Guam are expected to be insignificant.

Mariana fruit bat and Serianthes nelsonii
In northern Guam, habitat for the Mariana fruit bat and *Serianthes nelsonii* may be lost as a result of cumulative effects from civilian development. Because the two species are not as habitat limited as the kingfisher and crow, we did not calculate the amount of remaining habitat for these species that would be lost as a result of cumulative effects; however we expect it to be in the range of what we estimated for the crow and kingfisher. We do not expect that the fruit bat or *Serianthes nelsonii* will become habitat limited as a result of cumulative effects.

In southern Guam, habitat for the fruit bat and *Serianthes nelsonii* may be lost as a result of cumulative effects from wildfire. However, since the trend in annual area burned has been declining, and since we anticipate it will continue to decline as a result of ongoing and future Federal support of the development of local fire suppression resources, the amount of listed species habitat lost to wildfire should decline.

I. CONCLUSION

After reviewing the current status of the listed species addressed in this Biological Opinion, the environmental baseline, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the action, as proposed is not likely to jeopardize the continued existence of the Guam Micronesian kingfisher, Mariana crow, Guam rail, Mariana fruit bat and *Serianthes nelsonii*; and is not likely to adversely modify Guam Micronesian kingfisher critical habitat, Mariana crow critical habitat, and Mariana fruit bat critical habitat. The Service reached these conclusions based on the following findings, the basis for which is presented in the preceding sections of this document.

Guam Micronesian Kingfisher

The endangered Guam Micronesian kingfisher is endemic to Guam. The kingfisher is currently extirpated in the wild due to predation by the introduced brown treesnake, but a captive population is being maintained on the mainland for the purpose of reintroduction onto Guam. The reintroduction is dependent, in part, on protecting and managing 11,512 acres of kingfisher habitat to support a persistent population of 500 breeding pairs of the kingfisher in northern Guam where the proposed action is primarily located. A breeding population of 500 kingfisher pairs is also needed in southern Guam.

Currently, there are 14,997 acres of kingfisher habitat in northern Guam and 13,314 acres of kingfisher habitat in southern Guam that could potentially support 714 and 634 breeding pairs of the kingfisher, respectively. However, significant portions of this habitat are currently degraded and will require intensive management and restoration (e.g., ungulate and invasive plant control or eradication) before the habitat regains the capacity to effectively support kingfisher reproduction.

The proposed action will permanently destroy, fragment, or degrade approximately 1,334 acres of kingfisher habitat, including some of the best remaining primary forest in northern Guam. An additional 423 acres of kingfisher habitat in northern Guam is likely to be permanently destroyed by future, non-Federal actions reasonably certain to occur within the action area. The (1,334 ac + 423 ac) 1,760 ac of kingfisher habitat would have supported 83 pairs of breeding kingfishers or approximately 17 percent of the 500 breeding pairs needed for the recovery of this species in northern Guam. Therefore, the proposed action significantly reduces the potential for the remaining habitat in the north to support a subpopulation of kingfishers. Both subpopulations in northern and southern Guam are needed to ensure the survival and recovery of kingfishers.

Overall, the effect of the proposed action, when added to the environmental baseline for northern Guam, will significantly degrade and reduce the amount of kingfisher habitat in northern Guam. However, the protection and management of 5,234 ac of the kingfisher habitat in northern Guam pursuant to the MOA and implementation of conservation measures as detailed above will help ensure that sufficient amount of kingfisher habitat will be available for the survival and recovery of the kingfisher once the species is reintroduced to Guam. Therefore, the proposed action is not likely to appreciably reduce the likelihood of the survival and recovery of the Guam Micronesian kingfisher.

Mariana Crow

The Mariana crow is currently extirpated from the wild on Guam, and only is surviving outside the action area on the island of Rota. Therefore, direct impacts to individuals will not occur as a result of the proposed action. However, we have determined that the proposed project will adversely affect the Mariana crow by removing areas of Mariana crow habitat which, in the absence of the project, would have remained intact to provide for the feeding, breeding, and sheltering of this species once it is reintroduced to Guam. In southern Guam only six acres of Mariana crow habitat will be cleared by the proposed action, and thus the focus of our analysis in on northern Guam.

In northern Guam, potential crow habitat is limited relative to that needed to support a persistent crow population due to habitat loss and degradation, lack of management, and the presence of introduced ungulates, invasive species, and typhoons. Currently, there are potentially 13,962 acres of crow habitat in northern Guam that could potentially support 156 breeding crow pairs and 150 non-breeding crows. However, significant portions of this habitat are currently degraded and will require intensive management and restoration (e.g., ungulate, predator, and invasive plant control or eradication) before the habitat regains the capacity to effectively support crow reproduction.

The proposed action will permanently destroy, fragment or degrade approximately 1,332 ac of crow habitat, including some of the best remaining primary forest on Guam. An additional 286 acres of crow habitat is likely to be permanently destroyed by future, non-Federal actions reasonably certain to occur within the action area. About 8,590 acres of crow habitat is needed in northern Guam to support crow conservation in the wild. After the proposed action there will be approximately 12,344 ac or 87 percent of the remaining crow habitat in northern Guam. While 1,618 ac of habitat loss is substantial, considering the quality of habitat, there will be enough remaining crow habitat in northern Guam, after the proposed action and future non-Federal actions, to support the survival and recovery of the crow in northern Guam once the species is reintroduced.

The DON will protect and manage 5,234 ac of kingfisher habitat in northern Guam per the terms of the MOA. Within this 5,234-ac footprint, a large amount of habitat will be crow habitat. Therefore, the DON's protection and management of 5,234 acres of crow habitat in northern Guam will off-set the loss of Mariana crow habitat from project construction, and will help ensure that crow habitat will be available for the survival and recovery of the species on Guam. The DON also has proposed to implement a forest enhancement project and biosecurity conservation measures including landscape-level brown treesnake eradication and control, recommendations from the RBP, HACCP planning, and brown treesnake interdiction program, which will be beneficial to the crow because it will help reduce the current brown treesnake population and potentially prevent other invasive species from becoming established on Guam.

Overall, the effect of the proposed action, when added to the environmental baseline for northern Guam, will reduce the amount of Mariana crow habitat in northern Guam, but implementation of the conservation measures and the MOA would ensure an sufficient amount of crow habitat is

protected and managed to recover the crow in northern Guam. Therefore, the proposed action is not likely to appreciably reduce the likelihood of the survival and recovery of the Mariana crow.

Guam Rail

Although the proposed project will result in the loss and degradation of habitat for Guam rails, there will still remain an adequate amount of habitat to provide for recovery and survival of the species. Based on our analysis, there will be 23,643 ac of recovery habitat in northern Guam and 24,796 in southern Guam remaining after implementation of the proposed project. Approximately 48,439 ac of recovery habitat on Guam would be left to support the minimum Guam rail population size required to meet recovery goals.

The DON's implementation of biosecurity conservation measures including landscape-level brown treesnake eradication/control, recommendations from the RBP, HACCP planning, and brown treesnake interdiction program, will be beneficial to the Guam rail because it will help reduce the current brown treesnake population and potentially prevent other invasive species from becoming established on Guam.

The DON will protect and managed approximately 5,234 ac in northern Guam pursuant to the MOA and conduct a forest enhancement project on approximately 1,000 acres in Finegayan of habitat, which also will provide some benefit to the rail. In addition, the DON will implement brown treesnake control work to help prevent the spread to Rota (where an experimental population of rails are present) and reduce numbers of brown treesnakes on Guam.

Based on the above measures and our analysis, including the loss of habitat and increased human disturbance to habitat, and in consideration of cumulative effects (described above), the Service concludes that the effects of the proposed action, including the cumulative effects, are not likely to appreciably reduce the likelihood of both the survival and recovery of the Guam rail in the wild, because there will be enough remaining potential rail habitat on Guam, after the proposed action and future non-Federal actions, to support the survival and recovery of the rail once the species is reintroduced to Guam.

Mariana Fruit Bat

The proposed action will adversely affect the Mariana fruit bat on Guam. Roughly four percent of the remaining Mariana fruit bat habitat on the island will be lost or degraded directly or indirectly as a result of the proposed action, and although this loss will not preclude the recovery of the fruit bat, it will reduce the total number of bats that the island can support by approximately 983 bats. In addition, the proposed action will substantially increase disturbance levels at AAFB from construction projects, operation of the LFTRC, and an increase in aircraft overflights. This disturbance will result in take, in the form of harassment, of any Mariana fruit bats in the area, is likely to repeadtedly harass individual bats, and may preclude the future reestablishment of a maternal roost colony at AAFB.

The DON will protect and manage 5,234 ac of kingfisher habitat in northern Guam per the terms of the MOA. Because the habitat for kingfisher and fruit bats are similar, protection and

management of 5,234 ac pursuant to the MOA will have direct benefits to the fruit bat. In addition, the DON's proposed forest enhancement project may help enhance some of the available Mariana fruit bat habitat at Finegayan. The DON's brown treesnake interdiction and control work will help prevent the spread of brown treesnakes to other Mariana Islands that support the Mariana fruit bat, and the implementation of the brown treesnake exclosure projects will facilitate the future successful recolonization or reintroduction of the Mariana fruit bat to Guam. On the basis of these findings, the Service concludes that the effects of the subject action, taken together with cumulative effects, is not likely to appreciably reduce the likelihood of both the survival and recovery of the Mariana fruit bat in the wild because sufficient habitat and populations are likely to persist throughout its range at levels that retain the potential for recovery of this species.

Serianthes nelsonii

The proposed action will adversely affect the last remaining adult *Serianthes nelsonii* tree and its surrounding seedlings in Guam and result in the removal of 948 acres of habitat for this species. As detailed above in the Effects of the Action- *Serianthes nelsonii*, the proposed action will damage the adult tree and also negatively impact recovery efforts by limiting access to the adult tree at NWF, the wild seedlings around it, and outplanted *S. nelsonii* saplings at the GNWR. However, among the potential adverse effects to the tree, the increased wind load is likely the most significant, persistent, and unmitigated adverse effect. In the event of a severe wind storm, with the clearance of forest vegetation to the east of the adult tree that would otherwise act as a buffer to strong winds, structural damage or injury to the point of mortality of the adult tree is highly likely.

The DON has proposed to offset, in part, these adverse effects by implementing the conservation measures detailed above, including the Finegayan enhancement project. Although not included as a conservation measure, the MOA (DON and Service 2015c) also will provide a benefits to *Serianthes nelsonii* because a portion of the habitat within the 5,234-ac protected site would include habitat for *S nelsonii*. In addition, risks will be minimized by best management practices regarding spread of non-native species and fire. As stated above, seedling survival, both wild and outplanted, has been very low. However, research and renewed recovery efforts through recent projects are likely to improve survival in outplanted seedlings. The proposed outplanting of 30 individuals (seedlings from the Guam adult *Serianthes* tree to ensure the genetics of the Guam *Serianthes* population is maintained into the future) and maintaining these individuals to adulthood and the ability to continue to access (although potentially limited) the tree for research, seedling rescue, and seed collection will help to ensure the continued existence of this tree species in the wild on Guam.

Overall, the potential loss of the last remaining Guam adult *Serianthes* tree as a result of the proposed action is highly likely and cumulative effects are substantial. However, in consideration of the presence of adult *Serianthes* trees on Rota; the amount of remaining habitat on Guam to support outplanting efforts on Guam; the proposed enhancement and protected sites, and most importantly, the DON's proposal to maintain 30 individuals to adulthood on Guam, the Service concludes that the proposed action is not likely to appreciably reduce the likelihood of both the survival and recovery of the *Serianthes nelsonii* in the wild.

Guam Micronesian kingfisher critical habitat

The Guam critical habitat unit for the Guam Micronesian kingfisher consists of approximately 376 acres of land in the fee simple portion of the Guam National Wildlife Refuge. Upon operation of the LFTRC, noise from gunshots will reach a small portion (approximately two acres) of the critical habitat unit. Because only two acres of the critical habitat unit will be affected, this noise is unlikely to diminish the value of the critical habitat for the conservation of the species in the long-term. Therefore, we determine that the proposed action will not adversely modify the Guam critical habitat unit for the Guam Micronesian kingfisher.

This conclusion relies heavily on the noise modeling outcomes described above, and if noise from the LFTRC is heard over a greater area within the critical habitat unit, this conclusion must be revisited.

Mariana crow critical habitat

The Guam critical habitat unit for the Mariana crow consists of approximately 376 acres of land in the fee simple portion of the Guam National Wildlife Refuge. Upon operation of the LFTRC, noise from gunshots will reach a small portion (approximately two acres) of the critical habitat unit. Because only two acres of the critical habitat unit will be affected, this noise is unlikely to diminish the value of the critical habitat for the conservation of the species in the long-term. Therefore, we determine that the proposed action will not adversely modify the Guam critical habitat unit for the Mariana crow.

This conclusion relies heavily on the noise modeling outcomes described above, and if noise from the LFTRC is heard over a greater area within the critical habitat unit, this conclusion must be revisited.

Mariana fruit bat critical habitat

The Guam critical habitat unit for the Mariana fruit bat consists of approximately 376 acres of land in the fee simple portion of the Guam National Wildlife Refuge. The critical habitat unit is currently occupied, and is located at the base of the cliff below the LFTRC. Upon operation of the LFTRC, noise from gunshots will reach a small portion (approximately two acres) of the critical habitat unit. This noise may preclude the Mariana fruit bat from using this area for roosting as a remote place free of human disturbance. However, because only two acres will be affected, this noise is unlikely to diminish the value of the critical habitat for the conservation of the species in the long-term. Therefore, we determine that the proposed action will not adversely modify the Guam critical habitat unit for the Mariana fruit bat.

This conclusion relies heavily on the noise modeling outcomes described above, and if noise from the LFTRC is heard over a greater area within the critical habitat unit, this conclusion must be revisited.

J. INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including, breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering.

Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by DON so that they become binding conditions to the applicant for the exemption in section 7(o)(2) to apply. The DON has a continuing duty to regulate the activity covered by this incidental take statement. If DON (1) fails to assume and implement the terms and conditions or (2) fails to require contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to contract documents, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, DON must report the progress of the action and its impact on the species to the Service as specified in this incidental take statement [50 CFR 402.14(i)(3)].

Amount or Extent of Take Anticipated

Based on our analysis presented in this Biological Opinion, the Service anticipates the following take may occur as a result of the proposed action:

1) The Service anticipates that, over the duration of the proposed action, up to 30 Mariana fruit bats at AAFB and Finegayan could be repeatedly taken in the form of harassment leading to injury from loud aircraft noise, operation of the LFTRC, construction noise, and other human disturbance resulting from the proposed action. We do not anticipate mortality from the proposed action. This take level was determined based on the following factors:

   a. The current population of Mariana fruit bats on Guam is less than 30 individuals, primarily found on AAFB.

   b. Mariana fruit bats can traverse large areas and therefore are likely to come into close vicinity to the proposed action (aircraft noise, operation of the LFTRC, construction, other military training or human disturbance) multiple times during their

life-span.

c. Disturbance from the proposed action could have an adverse effect on fruit bats by increasing energetic demands, disrupting hormonal balances, forcing relocation to lower quality habitat or areas where poaching is more prevalent, disrupting reproductive cycles, and increasing stress levels. These behavioral and physiological responses represent harassment that is reasonably likely to significantly disrupt normal behavior patterns including breeding, feeding or sheltering.

d. Because of the frequency and duration of training events at AAFB and Finegayan we expect that each of the 30 bats may be harassed multiple times over the duration of the proposed action.

Incidental take of the kingfisher, rail, and crow as a result of the proposed action cannot be anticipated at this time. Once these species are reintroduced on Guam, the Service will revise this Incidental Take Statement, as appropriate, to address such take.

Effect of the Take

In the accompanying Biological Opinion, the Service determined that this level of anticipated take is not likely result in jeopardy to the Mariana fruit bat or result in the destruction or adverse modification of Guam Micronesian kingfisher critical habitat, Mariana crow critical habitat, or Mariana fruit bat critical habitat.

K. REASONABLE AND PRUDENT MEASURES

Reasonable and prudent measures serve to minimize impacts on individuals or habitats affected by the action. The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impacts of incidental take on the Mariana fruit bat:

1) The DON shall implement the Conservation Measures set forth in the Project Description in this Biological Opinion.

2) The DON shall minimize the level of incidental take of the Mariana fruit bat occurring as a result of construction and operation of the Proposed Action.

3) The DON shall monitor the level of incidental take of Mariana fruit bat.

4) The DON shall compensate for removal of the ungulate fence required by the Incidental Take Statement in the Service's Biological Opinion addressing the ISR Strike Action.

5) The DON shall report on the progress of project implementation related to take of the Mariana fruit bat.

L. TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, DON must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and specify reporting requirements. These terms and conditions are non-discretionary.

In order to implement the reasonable and prudent measure above, the following terms and conditions apply:

1) DON shall implement the Conservation Measures in the Project Description of this Biological Opinion. We reiterate this requirement here for convenience and clarity.

2) To minimize the level of incidental take of Mariana fruit bat the DON shall:

    a. Halt construction if a fruit bat is present within 492 ft (150 m) of a construction site, at any point during the construction cycle, until the fruit bat leaves the area of its own accord. Information regarding the presence of fruit bats at a construction site shall be provided to the Service on an annual basis.

    b. Use hooded lighting within 482 ft (150 m) of all potential fruit bat roost habitat.

    c. Provide educational materials regarding Mariana fruit bat appearance, behavior, and biology to all personnel using the LFTRC so that they can correctly identify any fruit bats near or within the LFTRC during operation. If a fruit bat is sighted down range during operation of the LFTRC, all use of the range will cease until the fruit bat has left the area of its own accord.

    d. Search for Mariana fruit bat maternity colonies, on a semi-annual basis, in all areas of AAFB that could be affected by the proposed action including 1) all fruit bat habitat within the 65 dB noise contour from the LFTRC shown on Figure 17 and 2) all fruit bat habitat that will be subject to increased noise levels from aircraft overflights. Searches will begin one year prior to the operation of the LFTRC and one year prior to the proposed overflight increases. Surveys will proceed on a semi-annual bases for the first five years, then conducted annually for the length of the project. If a fruit bat maternity colony is found the Service should be notified within one week of the finding.

3) To determine the level of take the DON shall:

    a. Monitor all known roost sites, at a minimum once a quarter, from one year prior to and one year after the proposed overflight increases are fully implemented and during all years in which operation of the LFTRC is active. The monitoring methodology should, at a minimum, include direct counts of Mariana fruit bats utilizing a spotting scope at an appropriate distance to avoid disturbance impacts to the bats.

b. Conduct a noise study at the GNWR and at Ritidian Point upon operation of the MPMG range at the LFTRC. The noise study will occur during the first year of operation of the LFTRC. Multiple stations should record noise levels during operation of the MPMG at the GNWR and at Ritidian Point. The monitoring stations will be approved by the Service in coordination with the DON. Noise monitoring should occur during day and night activities over multiple days (minimum of ten days) at least once a quarter to address seasonal and climatic changes. Weather conditions during monitoring should be closely recorded including temperature, humidity, and wind direction. The results of the surveys will be provided to the Service (Ecological Services and Refuges) on a quarterly basis, with a final report due within three months of the conclusion of the study.

c. Submit reports summarizing the methods and results of the above monitoring efforts shall be sent to the Service's Pacific Islands Fish and Wildlife Office (300 Ala Moana Blvd., Room 3-122, Honolulu, Hawaii 96850) every year until the monitoring is completed.

4) The DON shall

a. Finalize an agreement with the Service, prior to any construction of the LFTRC, regarding the future location of the ISR Strike-related ungulate fence. The DON is responsible for reconstructing the fence, removing ungulates within the fenced exclosure, and re-planting any native outplantings that occurred within the current ISR Strike fence at Ritidian Point. The DON will be responsible for maintaining the fence and continuing any forest enhancement as required under the Incidental Take Statement in the Service's Biological Opinion on the ISR Strike action. Construction of the new ungulate fence and ungulate removal within the fenced area shall be completed by December 2022. If an agreement is not reached, and work on the new fenced exclosure has not begun by January 2017, then the DON shall be out of compliance with both the DON and ISR Strike-related Biological Opinions.

5) The DON shall:

a. Submit annual reports detailing the implementation of the above Reasonable and Prudent Measures and Terms and Conditions. The first report shall be due at the end of October 2016. Annual reports due by the end of October shall be submitted as long as the proposed action is still operating.

Term and Condition for Reporting and Salvage Requirements

Where practical, an attempt should be made to salvage specimens of listed species incidentally taken by the proposed action as modified by the above RPA. The DON shall inform the Field Supervisor of the Service's Pacific Islands Fish and Wildlife Office in Honolulu, Hawaii, in writing of any salvaged specimens of any federally listed species within three (3) working days. The depository designated to receive specimens of any threatened or endangered species killed is the B.P. Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii, 96817 (telephone: 808/547-

3511). If the B.P. Bishop Museum does not wish accession to the specimens, the permittee should contact the Service's Division Office of Law Enforcement in Honolulu, Hawaii (telephone: 808/861-8525; fax: 808/861-8515) for instructions on disposition. The Service's Pacific Islands Fish and Wildlife office (telephone: 808/792-9400) shall also be informed within three (3) working days of any injured threatened or endangered species found and the actions taken.

M. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species, to help implement recovery plans, or to develop information. The recommendations provided relate only to the proposed action and do not necessarily represent complete fulfillment of the DON's section 7(a)(1) responsibilities for the species. In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

The Conservation Recommendations below only include actions that the DON is not currently implemented or has not already committed to implement. They are meant to be recommendations and suggestions for future actions.

1) To further support species recovery efforts, the DON will actively participate in recovery committees for endangered or threatened species on Guam. The DON will work with the Service to develop a re-introduction plan and supporting programmatic biological opinion that ensures such re-introduction efforts are consistent with the species recovery plans.

2) To assist with Endangered Species Act (ESA) section 7 consultations and to further support species recovery on Guam and in the Commonwealth of the Northern Mariana Islands (CNMI), the Deputy Assistant Secretary of the Navy (Environment) and the U.S. Fish and Wildlife Service (Service), Pacific Regional Director established a team (Team) to explore establishment of potential conservation area(s) on Guam and in the CNMI as part of a broader consultation solution. As part of that broader solution, the Team is considering the establishment of conservation area(s) and/or the implementation of conservation actions throughout Micronesia to enhance endangered and endemic species protection and recovery in the Mariana archipelago.

3) The DON should replace the proposed project footprint for the LFTRC with an alternative that does not clear the primary limestone forest at Ritidian Point, does not demolish the ungulate fence at Ritidian Point, and does not put a SDZ over the GNWR.

4) The DON should manage Overlay Refuge land on Guam for recovery of listed species including protecting conservation lands in-perpetuity, conducting ungulate control and/or eradication, fencing for ungulates and non-native predators (including brown treesnake),

conducting invasive species control, and outplanting native species. Native forests should be restored to conditions more closely representative of the forest types described by Fosberg (1960).

5) The DON should work with the Government of Guam to identify, protect, and manage listed species habitat throughout Guam.

6) In addition to ensuring project-related fires do not effect habitat for listed species, the DON should incorporate the following measures into fire management operations: (1) establish and maintain cooperative agreements with Government of Guam and local jurisdictions to ensure DON fire suppression resources are able to assist with fire suppression efforts, as necessary, to protect remaining limestone forest and ravine forest from fire; (2) to facilitate fire management planning and implementation of daily fire suppression staffing, immediately establish remote automated weather stations on Guam and maintain weather and fire danger data in the interagency weather information management system; (3) complete landscape-level forest restoration to convert grasslands in the Naval Munitions Site back to limestone forest or ravine forest; (4) restore any areas of forest burned on DON lands, regardless of fire cause; (5) control public access at the Naval Munitions Site to minimize ignition of fires caused by the public.

7) The DON should extend the security fence around Ritidian Point and the LFTRC to connect with clifflines that serve as barriers to ungulates. The DON should remove all ungulates within this perimeter fence to help restore the land for native species.

8) The DON should continue to work with the Service to develop a Marianas-wide strategy for listed species conservation and develop a Programmatic BO to address all future DoD actions on Guam.

9) Once the SDZ from the LFTRC is established, the DON should provide consistent, reliable, and easy access to the GNWR for researchers, managers, and GNWR staff.

10) The DON should work with the Service to develop a re-introduction plan for listed species once threats to the species have been managed or controlled on Guam such that species re-introduction is feasible.

11) The DON should place barriers at strategic places around the LFTRC to reduce sound transmission into listed species habitats.

Brown treesnake/Invasive species:

12) The DON should fully fund and implement actions identified in the RBP to avoid the spread of invasive species to and from Guam, and within Micronesia.

Guam Micronesian kingfisher:

13) The DON should provide funding for establishing a wild back-up Guam Micronesian kingfisher population outside of Guam (recovery action 3.9 in the recovery plan). Such a population could hedge against the risk of the captive population being loss to disease or catastrophe. Furthermore, a successful wild population should minimize the progressive loss of behavior or genetic traits suited to survival in the wild as opposed to a captive environment, and could thus ultimately improve the likelihood of successful reintroduction to Guam.

Mariana crow:

14) The DON should provide funding for recovery actions for the Mariana crow on Rota in order to enhance the population on Rota to provide for future reintroduction to Guam. Recovery actions needing funding include

    a. Predator monitoring and control on Rota;
    b. Captive propagation of the Mariana crow on Rota; and
    c. Identification and management of sources of adult and juvenile mortality.

Mariana fruit bat:

15) Recovery of the fruit bat population on Guam will likely depend on immigration or translocation of fruit bats from Rota. Consistent protection and monitoring of the fruit bat population on Rota is required to ensure its persistence.

    a. The DON should provide financial and technical assistance to support actions of off-island Law Enforcement personnel (Federal or CNMI DFW from Saipan) conducting surveillance, investigations, and poaching deterrence on Rota. Although the fruit bat population on Rota has increased in recent years due to an increase in enforcement of wildlife protection laws, illegal hunting continues to be the primary threat to this population. Fruit bats continue to be a high-demand cultural delicacy on Rota, and social and familial obligations prevent local authorities from effectively enforcing wildlife protection laws because people feel accountable to each other, but not necessarily to outside agencies, laws, or institutions.

    b. The DON should provide financial and technical assistance for conservation and research projects that include training and employment for local CNMI and Guam residents. Direct involvement of local community in conservation and research efforts has been shown world-wide to be one of the most effective ways to change local attitudes about poaching; not only does direct engagement promote appreciation of the species' intrinsic value, but it also provides an alternative economic value to the species or system, and with this a greater probability of sustained success.

c. The DON should provide financial and technical assistance for research on captive Mariana fruit bats. Long-term research examining life history parameters and reproductive cycles of captive Mariana fruit bats is needed to model population growth, predict population trends in light of a species' response to human and environmental stressors (e.g., hunting and natural disasters), and to insure effective management and conservation of critical habitat. We do not have this information for the Mariana fruit bat and have, to date, been extrapolating from other species of flying fox. Without species-specific knowledge of life history and reproduction, effective population analyses, an accurate determination of species recovery and subsequent delisting will not be possible. To avoid negatively affecting the wild fruit bat population while acquiring knowledge needed for their conservation, recovery, and management, efforts examining life history and ecology using rehabilitated wild bats and an existing captive population should be utilized. There are currently over 75 adult and juvenile fruit bats at the Rota Zoo and the owner of the zoo is willing to cooperate with local and federal agencies, or private organizations on research projects using his captive fruit bat colony. The Rota Zoo has the only known captive breeding colony of Mariana fruit bats. With appropriate financial and technical support, and collaboration with the Rota Zoo, there is great potential to acquire valuable, and much needed information on the life history and reproductive potential of the Mariana fruit bat.

d. The DON should provide technical and financial assistance for monitoring the fruit bat population on Rota. The CNMI DFW receives federal assistance to support employment of a wildlife biologist to monitor and conduct research on the Rota fruit bat population. However, this position has not been consistently filled and has been vacant for the last several years. When the position is vacant, the fruit bat population is not monitored and there is no record of population fluctuations, disturbance events, colony movements, etc. Although a resident biologist on Rota is the optimal way to ensure effective monitoring of the fruit bat population, regular and consistent efforts from off-island biologists could provide an acceptable alternative if the CNMI DFW's bat biologist position remains vacant or inconsistently occupied.

Serianthes nelsonii

16) The DON should fund a study to identify any genetic differences between the Guam *Serianthes* tree and the Rota *Serianthes* trees / population.

Proposed species:

17) The DON should conduct full surveys of the proposed action area to identify all proposed species locations and suitable habitat.

N. REINITIATION – CLOSING STATEMENT

This consultation may need to be reinitated if the following situations arise:

- If cargo originating from Guam is implicated in the transport of a brown treesnake to the CNMI, Hawaii, or continental U.S., the Service shall assess the ongoing risk of brown treesnake transport and will determine if additional brown treesnake interdiction measures or other actions are necessary to ensure the effects of the action are minimized.

- If a maternal fruit bat roost colony is located at AAFB.

- If peak noise levels at the LFTRC are higher than the peak noise levels described in the Project Description.

- If listed species are reintroduced to Guam, the Service may need to reinitiate consultation to assess the effects of the proposed action on the listed species in the Action Area.

- If the June 11, 2015 MOA is not implemented.

This concludes formal consultation on this action. As required in 50 CFR §402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is met, any operation causing such take must cease pending reinitiation.

If you have questions regarding this Biological Opinion, please contact me at the letterhead address or by telephone at (808) 792-9400.

Sincerely,

Kristi Young
Acting Field Supervisor

cc:
Celestino Aguon, Guam Department of Agriculture, DAWR
Laura Beauregard, Guam National Wildlife Refuge
Mark Bonsavage, Joint Region Marianas, Guam

O. REFERENCES

Amidon, F. 2012., in litt. Summary output from an evaluation of Mariana crow recovery criteria utilizing stochastic models in Vortex.

Amidon, F. 2014. USFWS. Personal Communication regarding Mariana crow surveys.

Amitai, O. S. Holtze, S. Barkan, E. Amichai, C. Korine, B. Pinshow, and C. C. Voigt. 2010. Fruit bats (Pteropodidae) fuel their metabolism rapidly and directly with exogenous sugars. The Journal of Experimental Biology. 213:2693-2699.

Andersen Air Force Base (AAFB). 2008. Final Mariana Fruit Bat (*Pteropus mariannus mariannus*) Management Plan for Andersen Air Force Base, Guam. Prepared for 36 CES, Environmental Flight, Andersen AFB, Guam and Air Force Center for Engineering and the Environment, Hickam AFB, HI.

Andersen Air Force Base (AAFB). 2015. Annual Report for Recovery Permit Number TE-84876A-0. *Serianthes nelsonii*. 13pp.

Andersen, D. E., O. J. Rongstad, and W. R. Mytton. 1989. Response of nesting red-tailed hawks to helicopter overflights. Condor 91 :296-299.

Armed Forces Pest Management Board. 2008. Armed Forces Pest Management Board Technical Guide No. 31. Retrograde Washdowns: Cleaning and Inspection Procedures. March 2008. Washington D.C. 101 pp.

Aplet, G.H., S.L. Anderson, and C.P. Stone. 1991. Association between feral pig disturbances and the composition of some alien plant assemblages in Hawaii Volcanoes National Park. Vegetation 95:55-62.

Asner, G. and G. Goldstein. 1997. Correlating stem biomechanical properties of Hawaiian canopy trees with hurricane wind damage. Biotropica 29:145-150.

Association of Zoos and Aquariums (AZA), Population Management Center. 2014. Population Analysis and Breeding and Transfer Plan. Guam Rail. 44pp.

Athens, S.J. and J.V. Ward. 2004. Holocene vegetation, savanna origins, and human settlement of Guam. In A Pacific Odyssey: Archaeology and Anthropology in the Western Pacific. Papers in Honour of Jim Specht, eds. Val Attenbrow and Richard Fullagar. Records of the Australian Museum, Supplement 29:15-30.

Australian Bureau of Meteorology and CSIRO. 2011. Climate change in the Pacific: Scientific assessment and new research. Chapter 6: projections based on global climate models. pp. 146-179.

Awbrey, F.T. and D. Hunsaker II. 1997. Effects of fixed-wing military aircraft noise on California gnatcatcher reproduction. Acoustical Society of America 102(5): 3177.

Bahner, B. 2015. Personal communication regarding Guam Micronesian kingfisher behavior. Philadelphia Zoo.

Bahner B., A. Baltz, and E. Diebold. 1998. Micronesian Kingfisher Species Survival Plan Husbandry Manual, First Edition. Zoological Society of Philadelphia, Philadelphia. 54pp.

Baker, R. H. 1951. The avifauna of Micronesia, its origin, evolution, and distribution. University of Kansas Publications, Museum of Natural History. 3:1-359.

Banack, S.A. 1998. Diet selection and resource use by flying foxes (genus Pteropus). Ecology 79: 1949-1967.

Barber, J.R., K.R. Crooks, and K.M. Fristrup. 2010. The costs of chronic noise exposure for terrestrial organisms. Trends in Ecology and Evolution 25(3): 180-189.

Barron, D.G., J.D. Brawn, L.K. Butler, L.M. Romero, and P.J. Weatherhead. 2012. Effects of military activity on breeding birds. Journal of Wildlife Management 76:911-918.

Bayne, E.M., L. Habib, and S. Boutin. 2008. Impacts of chronic anthropogenic noise from energy-sector activity on abundance of songbirds in the boreal forest. Conservation Biology 22(5): 1186-1193.

Beauchamp, A. J. 1987. The social structure of the weka (*Gallirallus australis*) at Double Cove, Marlborough Sounds. Notornis 34:317-325.

Beauprez, G.M. and M.K. Brock. 1996. Development of an experimental population of Guam Rails on Cocos Island or in the Commonwealth of the Northern Mariana Islands. Pp. 123-131 *in* Annual Report, Fiscal year 1996. Pittman-Robertson Federal Aid in Wildlife Restoration Program. Division of Aquatic and Wildlife Resources, Guam.

Beauprez, G.M. and M.K. Brock. 1997. Development of an experimental population of Guam Rails on Cocos Island or in the Commonwealth of the Northern Mariana Islands. Pp. 128-134 *in* Annual Report, Fiscal year 1997. Pittman-Robertson Federal Aid in Wildlife Restoration Program. Division of Aquatic and Wildlife Resources, Guam.

Beauprez, G.M. and M.K. Brock. 1998. Development of an experimental population of Guam Rails on Cocos Island or in the Commonwealth of the Northern Mariana Islands. Pp. 152-159 *in* Annual Report, Fiscal year 1998. Pittman-Robertson Federal Aid in Wildlife Restoration Program. Division of Aquatic and Wildlife Resources, Guam.

Beauprez, G.M. and M.K. Brock. 1999a. Development of an experimental population of Guam Rails on Cocos Island or in the Commonwealth of the Northern Mariana Islands. Pp.

155-163 *in* Annual Report, Fiscal year 1999. Pittman-Robertson Federal Aid in Wildlife Restoration Program. Division of Aquatic and Wildlife Resources, Guam.

Beauprez, G.M. and M.K. Brock. 1999b. Establishment of populations of endangered species in snake-free area. Pp. 163-169 *in* Annual Report, Fiscal year 1999. Pittman-Robertson Federal Aid in Wildlife Restoration Program. Division of Aquatic and Wildlife Resources, Guam.

Beck, R.E. Jr. 1991. Development of an experimental population of Guam Rails on Cocos Island or in the Commonwealth of the Northern Mariana Islands. Pp. 134-138 *in* Annual Report, Fiscal year 1991. Pittman-Robertson Federal Aid in Wildlife Restoration Program. Division of Aquatic and Wildlife Resources, Guam.

Blake, J.G. and J.R. Karr. 1987. Breeding birds of isolated woodlots: area and habitat relationships. Ecology 68:1724-1734.

Boland, J. 2008- 2015. USFWS. Personal Observations regarding fruit bat behavior.

Boland, J. 2015. USFWS. Personal communication via email regarding fruit bat colonies. April, 9, 2015.

Brock, M.K. and R.E. Beck. 1995. Development of an experimental population of Guam Rails in the Commonwealth of the Northern Mariana Islands. Pp. 109-116 *in* Annual Report, Fiscal year 1995. Pittman-Robertson Federal Aid in Wildlife Restoration Program. Division of Aquatic and Wildlife Resources, Guam.

Brokaw, N.V.L. and L.R. Walker. 1991. Summary of the effects of Caribbean hurricanes on vegetation. Biotropica 23: 442-447.

Brooke, Anne. 2007. Personal Communication. Conservation Program Manager, NAVFAC Marianas, Guam.

Brooke, A. 2008. Mariana fruit bat surveys on Navy properties, Guam, 2008. Unpublished report to NAVFAC Marianas. 5 pp.

Brooke, A. 2014. NAVFAC Marianas. Personal Communication regarding the Pati Point Mariana fruit bat colony.

Brown Tree Snake Technical Working Group (BTS TWG). 2015. Draft Brown Treesnake Strategic Plan. Honolulu, Hawaii. 75 pp.

Brown, L. 2000. Overview of Research on the Effects of Noise on Wildlife. Pages 10-14 in Terra Borealis: Effects of Noise on Wildlife Conference Proceedings. August 22-23, 2000.

Burdick D., Brown V, Asher J, Gawel M, Goldman L, et al. (2008) The State of Coral Reef Ecosystems of Guam. Center for Coastal Monitoring and Assessment, Maryland, United States.

Burke, D.M. and E. Nol. 1998. Influence of food abundance, nest-site habitat, and forest fragmentation on breeding ovenbirds. Auk 115: 96- 104.

Cadenasso, M.L., Pickett, S.T.A., 2001. Effect of edge structure on the flux of species into forest interiors. Conservation Biology 15: 91–97.

Caves, E.M., S.B. Jennings, J. HilleRiseLambers, J.J. Tewksbury, H.S. Rodgers. 2013. Natural experiment demonstrates that birds loss leads to cessation of dispersal of native seeds from intact to degraded forests. Plos One 8(5): 1-9.

Central Intelligence Agency. 2015. World fact book. Guam people 2015. http://www.theodora.com/wfbcurrent/guam/guam_people.html

Chen, J., J.F. Franklin, and T.A. Spies. 1995. Growing season microclimatic gradients extending into old-growth Douglas-fir forests from clearcut edges. Ecological Applications 5: 74–86.

CITES. 2015. Convention on International Trade in Endangered Species of Wild Flora and Fauna. http://www.cites.org/eng. Accessed 25 March 2015.

Clements, R., N.S. Sodhi, M. Schilthuizen, and P.K. Ng. 2006. Limestone karsts of Southeast Asia: imperiled arks of biodiversity. Bioscience 56 (9): 733-724.

Cobb, C. 2015. Personal communication regarding fruit bat BMP. March, 2015.

Commonwealth of the Northern Mariana Islands (CNMI) Division of Fish and Wildlife. 2008. Annual report for Pittman and Robertson Wildlife Restoration grant (W-3-R-5) FY 2008. 91 pages.

Commonwealth of the Northern Mariana Islands (CNMI) Division of Fish and Wildlife 2009a. Standard operating procedures for surveys of Mariana fruit bats on Rota, CNMI. 5pages.

Commonwealth of the Northern Mariana Islands (CNMI) Division of Fish and Wildlife. 2009b. Annual report for Pittman and Robertson Wildlife Restoration grant (W- 3-R-5) FY 2009. 70 pages.

Commonwealth of the Northern Mariana Islands (CNMI) Division of Fish and Wildlife. 2010. Annual report for Pittman and Robertson Wildlife Restoration grant (W-3-R-5) FY 2010. 80 pages.

Commonwealth of the Northern Mariana Islands (CNMI) Division of Fish and Wildlife. 2011. Annual report for Pittman and Robertson Wildlife Restoration grant (W-3-R-5) FY 2011. pages.

Conomy, J.T., J.A. Dubovsky, J.A. Collazo, and W.J. Fleming. 1998a. Do black ducks and wood ducks habituate to aircraft disturbance? Journal of Wildlife Management 62(3):1135-1142.

Conomy, J. T., J. A. Collazo, J. A. Dubovsky, and W. J. Fleming. 1998b. Dabbling duck behavior and aircraft activity in coastal North Carolina. Journal of Wildlife Management 62:1127-1134.

Conry, P.J. 1988. Management of feral and exotic game species on Guam. 1988 Transactions of the Western Section of the Wildlife Society. 24:26-30.

Cruce, Jennifer. 2013. Personal Communication. Refuge Biologist, Guam National Wildlife Refuge, U.S. Fish and Wildlife Service.

Cruce, Jennifer. 2015. Personal Communication. Refuge Biologist, Guam National Wildlife Refuge, U.S. Fish and Wildlife Service.

Cuddihy, L.W. and C.P. Stone. 1990. Alteration of native Hawaiian vegetation: effects of humans, their activities and introductions, University of Hawaii, Honolulu. 138 pp.

Czech and P. H. Kester. 2008. Final Wyle Report, WR 08-01 Aircraft Noise Study for Andersen Air Force Base, Guam. August 2008. 226 pp.

Delaney, D.K., L.L. Pater, R.J. Dooling, B. Lohr, B.F. Brittan-Powell, L.L. Swindell, T.A. Beaty, L.D. Carlile, E.W. Spadgenske, B.A. MacAllister, and R.H. Melton. 2002. Assessment of training noise impacts on the red-cockaded woodpecker: 1998-2000. ERDC/CERL TR-02-32. 101 pp.

Delaney, D.K., L.L. Pater, R.J. Dooling, B. Lohr, B.F. Brittan-Powell, L.L. Swindell, T.A. Beaty, L.D. Carlile, E.W. Spadgenske, B.A. MacAllister, and R.H. Melton. 2002. Assessment of training noise impacts on the red-cockaded woodpecker: 1998-2000. ERDC/CERL TR-02-32. 101 pp.

Delaney, D.K., T.G. Grubb, P. Beier, L.L. Pater, M. Hildegard Reiser. 1999. Effects of helicopter noise on Mexican spotted owls. Journal of Wildlife Management 63(1): 60-76.

Demeulenaere, Else. 2015. Personal Communication. Botanist, Guam Plant Extinction Prevention Program and the University of Guam.

Demeulenaere, E., K. Davis, R. Manzano, J. Santos, and J. McConnell. 2014. *Serianthes nelsoni*i Report 2014. Guam Plant Extinction Prevention Program. 8pp.

Department of the Navy (DON). 1991. FAR 52.236-7, Permits and Responsibilities. November 1991. http://www.farmaster.com/farmaster/data/idx/FAR84/5202360007.htm

Department of the Navy (DON). 2005. Marine Corps Order (MCO) 3550.10, Policies and Procedures for Range Training Area Management. July 7, 2005. Washington D.C. 83 pp.

Department of the Navy (DON). 2010a. Comprehensive Construction and Demolition and Solid Waste Management Plan for the Guam Military Relocation DPRI Construction Program. August 2010. 61 pp.

Department of the Navy (DON). 2010b. Final Environmental Impact Statement for the Guam and Tinian Military Relocation, Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force. July 2010.

Department of the Navy (DON). 2010c. Biological Assessment, Potential Effects on Service-Listed Species from Guam and Tinian Military Relocation, Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force. 268 pp. +Appendices.

Department of the Navy (DON). 2011. Naval Facilities Engineering Command (NAVFAC). Final Guam Landscaping Guidelines. June 2011. Honolulu, Hawaii. 26 pp.

Department of the Navy (DON). 2013a. Integrated Solid Waste Management Plan for DoD Bases, Guam. February 20, 2013. 751 pp.

Department of the Navy (DON). 2013b. Naval Facilities Engineering Command (NAVFAC). Report 1 Mariana Fruit Bat And Mariana Swiftlet Survey for Various Locations on Guam in Support of the Guam and Commonwealth of the Northern Mariana Islands Military Relocation (2012 Roadmap Adjustments) Supplemental Environmental Impact Statement. 86 pages.

Department of the Navy (DON). 2013c. Draft Joint Region Marianas Andersen Air Force Base Ungulate Management Plan. 70 pp.

Department of the Navy (DON). 2013d. Naval Facilities Engineering Command (NAVFAC). Mariana fruit bat conservation through research and local capacity building. Final Report for Cooperative Agreement Number: N40192-11-2-8005. Prepared by T. L. Mildenstein and Mills, L.S., Department of Ecosystem and Conservation Sciences, University of Montana, Missoula, MT. 95 pp.

Department of Navy (DON). 2013e. Final Integrated Natural Resources Management Plan for Joint Region Marianas. Prepared for Commander Joint Region Marianas, Guam by HDR, Hagatna, Guam.

Department of the Navy (DON). 2014a. Biological assessment for the re-initiation of consultation regarding the proposed military relocation to Guam. Naval Facilities Engineering Command. 163pp.

Department of the Navy (DON). 2014b. Draft Supplemental Environmental Impact Statement for the Guam and CNMI Military Relocation (2012 Roadmap Adjustments).

Department of the Navy (DON). 2014c. Naval Facilities Engineering Command (NAVFAC). Monitoring Mariana fruit bats on Andersen Air Force Base. Draft first year report for Cooperative Agreement Number: N40192-13-2-8007. Prepared by T. L. Mildenstein and R. Miller, Biology Program, University of Guam, Guam. 70 pp.

Department of Navy (DON). 2015a. Final Draft Ambient Sound Measurements at Northwest Field on Andersen Air Force Base, Guam. 11 pp.

Department of the Navy (DON). 2015b. Addendum to the biological assessment for the reinitiation of consultation regarding the proposed military relocation to Guam. Naval Facilities Engineering Command. 28 pp.

Department of the Navy (DON). 2015c. Regional biosecurity plan for Micronesian and Hawaii.

Department of the Navy (DON). 2015d. Draft EIS for the Commonwealth of the Northern Mariana Islands Training (CJMT). April 2015.

Department of the Navy (DON) Joint Typhoon Warning Center (JTWC). 2010. Personal communication regarding storm occurrence data for Guam. Pearl Harbor, Hawaii.

Didham RK, J.M. Tylianakis, N.J. Gemmell, T.A. Rand, and R.M. Ewers. 2007. Interactive effects of habitat modification and species invasion on native species decline. Trends in Ecology and Evolution 22:489–496.

Diong, C.H. 1982. Population biology and management of the feral pig (Sus scrofa L.) in Kipahulu Valley, Maui. Ph.D. thesis in Zoology, University of Hawaii, Honolulu. 408 pp.

Dooling, R.J. and A.N. Popper. 2007. The effects of highway noise on birds. Prepared for the California Department of Transportation. Sacramento, CA. 74 pp.

Dorr, B.S., C.S. Clark, and A.B. Shiels. 2014. Aerial application of Acetaminophen-treated baits for control of brown treesnakes on Guam. USDA-APHIS Wildlife Services. Unpublished Data.

Downs, C.T., B. Mqokeli, and P. Singh. 2012. Sugar assimilation and digestive efficiency in Wahlberg's epauletted fruit bat (*Epomophorus wahlbergi*). Comparative Biochemistry and Physiology, Part A. 161 (344-348).

Emmanuel, K., R. Sundararajan, and J. Williams. 2008. Hurricanes and global warming: results from downscaling IPCC AR4 simulations. American Meterological Society. BAMS 89-3: 347-367.

Engbring, J. and F. L. Ramsey. 1984. Distribution and abundance of the forest birds of Guam; results of a 1984 survey. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D. C. 54 pages.

Engbring, J., F.L. Ramsey, and V.J. Wildman. 1986. Micronesian forest bird survey, 1982: Saipan, Tinian, Agiguan, and Rota. U.S. Fish and Wildlife Service Special Publication, Honolulu, Hawai`i. 143 pages.

Esselstyn, J.A., A. Amar, and D. Janeke. 2006. Impact of post-typhoon hunting on Mariana fruit bats (*Pteropus mariannus*). Pacific Science 60(4): 531-539.Banack, S. A. (1998). Diet selection and resource use by flying foxes Genus Pteropus. Ecology 79, 1949-1967.

Faegre, S. 2014. Personal Communication regarding Mariana crow reproduction. University of Washington.

Faegre, S. K. *In press*. Age-related differences in diet and foraging behavior of the critically endangered Mariana Crow (*Corvus kubaryi*). A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science, University of Washington, Department of Psychology.

Foppen, R. and R. Reijnen. 1994. The effects of car traffic on breeding bird populations in Woodland. II. Breeding dispersal of male willow warblers (*Phylloscopus trochilus*) in relation to the proximity of a highway. Journal of Applied Ecology 31:95-101.

Fosberg, F.R. 1960. The vegetation of Micronesia. Bulletin of the American Museum of Natural History 119:1-75.

Francis, C.D. 2015. Vocal traits and diet explain avian sensitivities to anthropogenic noise. Global Change Biology. Doi: 10.1111/gcb. 12862. Pages 1-15.

Francis, C.D., C.P. Ortega, and A. Cruz. 2011a. Noise pollution filters bird communities based on vocal frequency. PLoS ONE 6(11): e27052.

Francis, C.D., J. Paritsis, C.P. Ortega, and A. Cruz. 2011b. Landscape patterns of avian habitat use and nest success are affected by chronic gas well compressor noise. Landscape Ecology 26: 1269-1280.

Frid, A. 2003. Dall's sheep responses to overflights by helicopter and fixed-wing aircraft. Biological Conservation 110:387-399.

Gagne, W.H. and L.W. Cuddihy. 1999. Vegetation. Pp. 45-114 in Manual of the Flowering Plants of Hawaii, W.L. Wagner, D.R. Herbst and S.H. Sohmer (eds.), University of Hawaii Press and Bishop Museum Press, Honolulu.

Gawel, A.M. 2014. USFWS. Personal observation regarding *Serianthes nelsonii*.

Gehlhausen, S.M., Schwartz, M.W., Augspurger, C.K., 2000. Vegetation and microclimatic edge effects in two mixed-mesophytic forest fragments. Plant Ecology 147: 21–35.

Glass, P. and E.M. Taisacan. 1988. Marianas fruit bat surveys and research. Pp. 1-22 *in* Five-year Progress Report, Fiscal Year 1982-87. Pittman-Robertson Federal Aid in Wildlife Restoration Program. Division of Fish and Wildlife, Commonwealth of the Northern Mariana Islands.

Government of Guam. 2009. North and central Guam land use plan. Bureau of Statistics and Plans. March 2009. 150 pp.

Greenlee, D. 2010. Southern Guam loss of limestone forest due to fire: 1975-present. Unpublished report. 2 pp.

Groom, M.J. and C.H. Vynne. 2006. Habitat degradation and loss. Pp. 173-212 in Groom, M.J., G.K. Meffe, and C.R. Carroll (eds.), Principles of Conservation Biology, Third Edition. Sinauer Associates, Inc. Sunderland, Massachusetts. 793 pp.

Guam Department of Agriculture, Division of Forestry (prepared by Watershed Professionals Network). 2010. Guam Statewide Forest Resource Assessment and Resource Strategy. Mangilao, Guam. 143 pp.

Guam Division of Aquatic and Wildlife Resources (DAWR). 2006. Guam Comprehensive Wildlife Conservation Strategy. Department of Agriculture, Guam.

Guam National Wildlife Refuge (GNWR). 2005. Ritidian Point, Guam. Unpublished data.

Guam Visitor Bureau (GVB). 2014. Tourism 2020. Accessed on April 9, 2015, at https://www.guamvisitorsbureau.com/research-and-reports/reports/guam-tourism-2020-plan.

Ha, J. C. and R. L. Ha. 2010a. The aga or Mariana Crow's probably history, current status, and recommendations for recovery action: a synthesis. Part 1. 31 pages.

Ha, J.C., A. Butler, and R.R. Ha. 2010b. Reduction in first-year survival threatens the viability of the Mariana crow *Corvus kubaryi* population on Rota, CNMI. Bird Conservation International 20:335-342.

Ha, R.R. 2012. Behavior and conservation: the decline of the Mariana crow. Presentation given to the U.S. Fish and Wildlife Service, 29 September 2012. University of Washington. 71 pp.

Ha, R. 2014. Personal communication regarding Mariana crow survival on Rota. University of Washington.

Ha, R. 2015. Personal communication regarding human disturbance impacts to Mariana crows. University of Washington. Seattle, Washington.

Ha, R. R., J. C. Ha., S. Faegre, P. Hannon, L. Berry, B. Massey, and J. C. Ha. 2010a. Annual Report (August 1, 2009 – August 30, 2010) on the Mariana Crow (*Corvus kubaryi*) and the Rota White-eye (*Zosterops rotensis*) on the Pacific Island of Rota. Report to CNMI DFW. University of Washington, Seattle, Washington. 68 pages.

Ha, R. R., J. C. Ha., S. Faegre, P. Hannon, S. Lantz, and J. C. Ha. 2011a. Annual Report (August 1, 2010 – July 31, 2011) on the Mariana Crow (*Corvus kubaryi*). Report to CNMI DFW. University of Washington, Seattle, Washington. 50 pages.

Ha, R. R., J. M. Morton, J. C. Ha, L. Berry, and S. Plentovich. 2011b. Nest site selection and consequences for reproductive success of the endangered Mariana crow (Corvus kubaryi). Wilson Journal of Ornithology 123:236-242.

Ha, R. R., J. C. Ha., S. Faegre, P. Hannon, B. Leo, and J. C. Ha. 2012. Annual Report (August 1, 2011 – Sept. 30, 2012) on the Mariana Crow (*Corvus kubaryi*). Report to CNMI DFW. University of Washington, Seattle, Washington. 73 pages.

Ha, R. R., J. C. Ha., S. Faegre, P. Hannon, and B. Leo. 2013. Annual report (October 1, 2012 – August 31, 2013) on the Mariana crow (*Corvus kubaryi*). Report to CNMI DFW. University of Washington, Seattle, Washington. 81 pages.

Habib, L., E.M. Bayne, and S. Boutin. 2007. Chronic industrial noise affects pairing success and age structure of ovenbirds *Seiurus aurocapilla*. Journal of Applied Ecology 44: 176-184.

Haig, S.M., and J.D. Ballou. 1995. Genetic Diversity in Two Avian Species Formerly Endemic to Guam. The American Ornithologists Union. 112 (2): 445-455.

Halfwerk, W., L.J.M. Holleman, C.M. Lessells, and H. Slabbekoorn. 2011. Negative impact of traffic noise on avian reproductive success. Journal of Applied Ecology 48:210-219.

Hannon, P. 2014. Progress report for the release of two Mariana crows. Report to USFWS. University of Washington, Seattle, Washington. 3 pages.

Harrington, R.A., J.H. Fownes, P.G. Scowcroft, and C.S. Vann. 1997. Impact of hurricane Iniki on native Hawaiian *Acacia koa* forests: damage and two-year recovery. Journal of Tropical Ecology 13(4):539-558.

Heideman, P. 2000. Environmental regulation of reproduction. *In*: Crichton E. and P. Krutzsch (eds) Reproductive biology of bats. Academic, New York, pp 469–499.

Hijmans, R.J. 2014. Raster: Geographic data analysis and modeling. R package version 2.2-31. http://CRAN.R-project.org/package=raster

Hodgkinson, R., S.T. Balding, A. Zubaid, and T.H. Kunz. 2003. Fruit bats (Chiroptera: Pteropodidae) as seed dispersers and pollinators in a lowland Malaysian rain forest. Biotropica 35: 491-502.

Holway DA. 2005. Edge effects of an invasive species across a natural ecological boundary. Biological Conservation 121:561-567.

Hulme, P.E., S. Bacher, M. Kenis, S. Klotz, I. Kuhn, D. Minchin, W. Nentwig, S. Olenin, V. Panov, J. Pergl, P. Pysek, A. Roques, D. Sol, W. Solarz, and M. Vila. 2008. Grasping at the routes of biological invasions: a framework for integrating pathways into policy. Journal of Applied Ecology 45:403-414.

Hunsaker II, D. and J. Rice. 2006. The effects of helicopter noise on the coastal California gnatcatcher at Marine Corps Air Station Miramar. Prepared for Marine Corps Air Bases West Area, San Diego, CA. 172 pp.

Hunter-Anderson, R.L. 2009. Savanna anthropogenesis in the Mariana Islands, Micronesia: re-interpreting the palaeoenvironmental data. Archaeology in Oceania. October 1, 2009. Oceania Publication. The Gale Group, Farmington Hills, Michigan. http://www.highbeam.com/doc/1G1-210917480.html

Janeke, D. S. 2006. Nocturnal movements and habitat use by the Mariana flying fox, *Pteropus mariannus mariannus*, on Guam. University of Guam, Guam. 103 pp.

Jenkins, J.M. 1979. Natural history of the Guam Rail. Condor 81: 404-408.

Jenkins, J.M. 1983. The native forest birds of Guam. Ornithological Monographs 31. 61 pp.

Kesler, D.C., R.J. Laws, A.S. Cox, A. Gouni, and J.D. Stafford. 2012. Survival and population persistence in the critically endangered Tuamotu kingfisher. The Journal of Wildlife Management 76: 1001-1010.

Kesler, D.C. and S.M. Haig. 2007a. Territoriality, prospecting, and dispersal in cooperatively breeding Micronesian kingfishers (*Todiramphus cinnamominus reichenbachii*). Auk 124:381-395.

Kesler, D.C. and S.M. Haig. 2007b. Multiscale habitat use and selection in cooperatively breeding Micronesian kingfishers. Journal of Wildlife Management 71:765-772.

Kesler, D.C. and S.M. Haig. 2007c. Conservation biology for suites of species: demographic modeling for Pacific island kingfishers. Biological Conservation 136: 520-530.

Klose, S. M., C. L. Smith, A. J. Denzel, E.K.V. Kalko. 2006. Reproduction elevates the corticosterone stress response in common fruit bats. Journal of Comparative Physiology A 192: 341–350.

Knight, R.L., D.J. Grout, and S.A. Temple. 1987. Nest-defense behavior of the American crow in urban and rural areas. Condor 89: 175-177.

Knutson, K. and S. Vogt. 2002. U.S. Air Force, Andersen Air Force Base, Guam and U.S. Navy, Pearl Harbor, Hawaii. Unpublished Manuscript.

Komenda-Zehnder, S., M. Cevallos, and B. Bruderer. 2003. Effects of disturbance by aircraft overflight on waterbirds an experimental approach. International Bird Strike Committee, Warsaw 5-9 May 2003.

Krausman, P. R., M. C. Wallace, C. L. Hayes, and D. W. DeYoung. 1998. Effects of jet aircraft on mountain sheep. Journal of Wildlife Management 62:1246-1254.

Krausman, P. R., L. K. Harris, C. L. Blasch, K. K. G. Koenen, and J. Francine. 2004. Effects of military operations on behavior and hearing of endangered Sonoran pronghorn. Wildlife Monographs No. 157. 41 pp.

Kroner, A. 2014. Mariana crow pair estimate report, 2013-2014. Report to USFWS. University of Washington, Seattle, Washington. 13 pages.

Kroner, A. and S. Faegre. 2014. Personal Communication regarding Mariana crow life history. University of Washington.

Landon, D. M., P. R. Krausman, K. K. G. Koenen, and L. K. Harris. 2003. Pronghorn use of areas with varying sound pressure levels. The Southwestern Naturalist 48:725-728.

Larkin, R.P. 1996. Effects of military noise on wildlife: a literature review. USACERL Technical Report 96/21. 87 pp.

Laurance, W.F., 2000. Do edge effects occur over large spatial scales? Trends in Ecology and Evolution 15 134–135.

Laurance, W.F., S.G. Laurance, L. Ferreira, J. Rankin-De Merona, C. Gascon, and T.E. Lovejoy. 1997. Biomass collapse in Amazonian forest fragments. Science 278: 1117-1118.

Laurance, W.F., Lovejoy, T.E., Vasconcelos, H.L., Bruna, E.M., Didham, R.K., Stouffer, P.C., Gascon, C., Bierregaard, R.O., Laurance, S.G., Sampaio, E., 2002. Ecosystem decay of Amazonian forest fragments: a 22-year investigation. Conservation Biology 16: 605–618.

Lawler, J. P., A. J. Magoun, C. T. Seaton, C. L. Gardner, R. D. Boertje, J. M. Ver Hoef, and P.A. Del Vecchio. 2005. Short-term impacts of military overflights on caribou during calving season. Journal of Wildlife Management 69:1133-1146.

Lemke, T. O. 1992. History of fruit bat use, research, and, protection in the Northern Mariana Islands. Pages 135-142 *in* Wilson, D. E., and G. L. Graham (eds). Pacific island flying foxes: proceedings of an international conservation conference. U.S. Fish and Wildlife Service Biological Report 90(23).

Leo, B. 2014. Rota Island feral cat removal project, June 2014. Report to USFWS. University of Washington, Seattle, Washington. 4 pages.

Liu, Z. and L. Fischer. 2006a. Guam vegetation mapping using very high spatial resolution imagery – methodology. USDA Forest Service, Pacific Southwest Region, Forest Health Protection.

Liu, Z. and L. Fisher. 2006b. Commonwealth of the Northern Mariana Islands vegetation mapping using very high spatial resolution imagery – methodology. USDA Forest Service, Pacific Southwest Region, Forest Health Protection.

Lujan, D. 2015. Personal Communication via email regarding VCO program on AAFB.

Maben, A.F. 1982. The feeding ecology of the black drongo (*Dicrurus macrocercus*) on Guam. M.S. thesis. California State University, Long Beach; Long Beach, California. 87 pp.

Mahoney, T. 2010. Email to Dawn Greenlee, U.S. Fish and Wildlife Service, regarding U.S. Forest Service funding of salary, technical assistance, and firefighting equipment to the Government of Guam Forestry. U.S. Forest Service, Assistant Director, Office of the Chief (WO), International Programs, Policy.

Maier, J. A. K., S. M. Murphy, R. G. White, and M. D. Smith. 1998. Response of caribou to overflights by low-altitude jet aircraft. Journal of Wildlife Management 62:752-766.

Manci, K.M., D.N.Gladwin, R. Villella, and M.G. Cavendish. 1988. Effects of aircraft noise and sonic booms on domestic animals and wildlife: a literature synthesis. U.S. Fish and Wildlife Service National Ecology Research Center, Ft. Collins, CO. NERC-88/29. 88 pp.

Manglona, James. 2015. Personal Communication. Forester, CNMI Department of Natural and Land Resources, Rota, CNMI.

Marshall, S.D. 1989. Nest sites of the Micronesian Kingfisher on Guam. Wilson Bulletin 101: 47-477.

Marutani, Mari. 2015. Personal Communication. Professor, University of Guam.

Matson, P. 1990. Plant-soil interactions in primary succession at Hawaii Volcanoes National Park. Oecologia (Berlin) 85:241-246.

McConnell, James. 2014. Botanist, Guam Plant Extinction Prevention Program and the University of Guam.

Medeiros, A.C., Jr., L. Loope, R.A. Holt. 1986. Pp. 27-28 in Status of native flowering plant species on the south slope of Haleakala, East Maui, Hawaii. Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu.

Medina, Suzanne. 2013. Personal Communication. Division of Aquatic and Wildlife Resources, Department of Agriculture, Guam

Mehrhoff, Loyal. 2013. Personal Communication. Field Supervisor, USFWS, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. E-mail to Joseph Cecchini, Environmental Director, DON, Joint Guam Program Office, Arlington, Virginia, dated August 20, 2013. Subject: Discussion of DON Consultations on Extirpated Species.

Metevier, M. 2014. in litt. GIS shapefile of forested areas on Guam based on 2013 satellite imagery. 24 March 2014.

McIlwee, A. P. and L. Martin. 2002. On the intrinsic capacity of increase of Australian flying-foxes (*Pteropus spp.*, Megachiroptera). Australian Zoologist 32:76-100.

Michael, G. 1987. Notes on the breeding biology and ecology of the Mariana or Guam Crow. Avicultural Magazine 93:73-82.

Mildenstein, T., and J. Boland. 2010. Development of Mariana fruit bat survey protocols for Mariana Island surveys, final report prepared for USFWS---Rota Island pilot surveys. 21pages.

Moore, Aubrey. 2014. Entomologist/Extension Biologist, University of Guam.

Mortensen, H.S., Y.L. Dupont, and J.M. Olesen. 2008. A snake in paradise: disturbance of plant reproduction following extirpation of bird flower-visitors on Guam. Biological Conservation 141:2146-2154.

Morton, J. 1996. The effects of aircraft overflights on endangered Mariana crows and Mariana fruit bats at Andersen Air Force Base, Guam. Pearl Harbor: Department of the Navy, Pacific Division, Naval Facilities Engineering Command. 81pp.

Morton, J.M., S. Plentovich, and T. Sharp. 1999. Reproduction and juvenile dispersal of Mariana Crows (*Corvus kubaryi*) on Rota 1996 – 1999. U.S. Fish and Wildlife Service, Honolulu, HI.

Morton, J. M., F.A. Amidon, L.R. Quinata. 2000. Structure of a Limestone Forest on Northern Guam. Micronesica. 32(2): 229-244.

Morton, J.M. and G.J. Wiles. 2002. Observations of Mariana fruit bats (*Pteropus mariannus*) in the upper Talofofo watershed on southern Guam. Micronesica 34:155-163.

Mueller-Dombois, D. and F.R. Fosberg. 1998. Vegetation of the tropical pacific islands. Ecological Studies, Volume 132. Springer, New York, New York.

Murcia, C. 1995. Edge effects in fragmented forests: implications for conservation. Trends in Ecology and Evolution 10: 58-62.

Nascimento, H.E.M., Laurance, W.F., 2004. Biomass dynamics in Amazonian forest fragments. Ecological Applications 14: S127– S138.

National Park Service. 1994. Report to Congress: report on the effects of aircraft overflights on the National Park system, September 12, 1994. Accessed on April 9, 2015, at: http://www.nonoise.org/library/npreport/intro.htm.

National Research Council (NRC). 1997. The Scientific Bases for Preservation of the Mariana Crow. National Academy Press. 91 pp.

Nelson, D.K. 2009. COMNAVMARIANAS wildland fire management plan for Navy lands, Guam (Final, January 2009), prepared under U.S. Forest Service Contract #43-91S8-4-3039.

Noss, R., B. Csuti, and M.J. Groom. 2006. Habitat fragmentation. Pp. 213-251 in Groom, M.J., G.K. Meffe, and C.R. Carroll (eds.), Principles of Conservation Biology, Third Edition. Sinauer Associates, Inc. Sunderland, Massachusetts. 793 pp.

O'Grady, J.J., B.W. Brook, D.H. Reed, J.D. Ballou, D.W. Tonkyn, and R. Frankham. 2006. Realistic levels of inbreeding depression strongly affect extinction risk in wild populations. Biological Conservation 133:42-51.

Ortega, C.P. 2012. Effects of noise pollution on birds: a brief review of our knowledge. Ornithological Monographs 74(1): 6-22.

Palmer, A. G., D. L. Nordmeyer, and D. D. Roby. 2003. Effects of jet aircraft overflights on parental care of peregrine falcons. Wildlife Society Bulletin 31: 499-509.

Pater, L.L., T.G. Grubb, and D.K. Delaney. 2009. Recommendations for improved assessment of noise impacts on wildlife. Journal of Wildlife Management 73(5): 788-795.

Peters, K.A. and D.L. Obis. 2006. Wading bird response to recreational boat traffic: does flushing translate into avoidance? Wildlife Society Bulletin 34: 1383-1391.

Pierson, E., and W. Rainey. 1992. The biology of flying foxes of the genus *Pteropus*: A Review. Pages 1-17 *in* Wilson, D. E., and G. L. Graham (eds). Pacific island flying foxes: proceedings of an international conservation conference. U.S. Fish and Wildlife Service Biological Report 90(23).

Plumpton, D. 2006. Review of studies related to aircraft noise disturbance of waterfowl, a technical report in support of the supplemental Environmental Impact Statement for the introduction of F/A-18 E/F (super hornet) aircraft to the East Coast of the United States. Ecology and Environment, Inc., San Francisco, CA prepared for Naval Facilities Engineering Command, Norfolk, VA.

Porneluzi, P.A. and J. Faaborg. 1999. Season-long fecundity, survival, and viability of ovenbirds in fragmented and unfragmented landscapes. Conservation Biology 13:1523-1739.

Pratt, H.D., P.L. Bruner, and D.G. Berrett. 1979. America's unknown avifauna: the birds of the Mariana Islands. American Birds 33(3):227-235.

Pratt, H.D., P.L. Bruner, and D.G. Berrett. 1987. A field guide to birds of Hawaii and the tropical Pacific. Princeton, N.J.: Princeton University Press.

Public Employees for Environmental Responsibility (PEER). 2009. Request for Investigation of Environmental/Natural Resource Violations, Abuses of Authority and Health and Safety Violations at Andersen Air Force Base, Guam. Accessed on March 15, 2015 at http://www.peer.org/assets/docs/dod/03_5_09_DOD_OIG_Mitton_Enviro_Disclosure.pdf

Quitugua, J. 2014. Personal Communication. Guam DAWR.

Quitugua, J. 2015. Personal Communication regarding fruit bat behavior on AAFB. Guam DAWR.

R Core Team. 2014. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.

Raulerson, Lynn, and Agnes Rinehart. 1991. Trees and Shrubs of the Northern Mariana Islands. Saipan, MP: Coastal Resources Management Office.

Reid, J.R.W., and B.M. Hill. 2005. Recent surveys of the Cocos Buff-banded Rail (*Gallirallus phippensis andrewsi*). Report to the Australian Government Department of the Environment and Heritage. Centre for Resource and Environmental Studies, Australian National University Ltd. Canberra. 12pp.

Ripley, S.S. 1977. Rails of the world. Pp. 279-289. Toronto, Canada, M.F. Fehelel Publisher

Rodda, G.H. and J.A. Savidge. 2007. Biology and impacts of Pacific Island invasive species. 2. *Boiga irregularis*, the brown tree snake (Reptilia: Colubridae). Pacific Science 61:307-324.

Rogers, H.S. 2011. The fate of a silent forest: The effects of complete bird loss on the forests of Guam. Dissertation Thesis, University of Washington. 75 pp.

Ross, M.R., S. Medina, and C. Lynch. 2006. Guam rail (*Rallus owstoni*) species survival plan: executive summary and summary recommendations. American Zoos and Aquariums Association, Population Management Center, Lincoln Park Zoo, Chicago, Illinois. 11 pp.

Safford, W.E. 1905. The useful plants of the Island of Guam. Smithsonian Institution, Washington D.C. 416pp.

Savidge, J.A. 1986. The role of disease and predation in the decline of Guam's avifauna. Ph.D. dissertation, University of Illinois, Champaign. 79 pp.

Savidge, J.A. 1987. Extinction of an island forest avifauna by an introduced snake. Ecology 68(3):660-668.

Schwagerl, J. 2015. Personal Communication via email regarding fruit bat detections at GNWR.

Scott, J.M., S. Mountainspring, F.L.Ramsey, and C.B. Kepler. 1986. Forest bird communities of the Hawaiian Islands: their dynamics, ecology, and conservation. In Studies in Avian Biology, R.J. Raitt and J.P. Thompson (eds.), Lawrence, Cooper Ornithological Society 9:1-444.

Sheeline, L. 1991. Cultural significance of Pacific fruit bats (Pteropus spp.) to the Chamorro people of Guam: conservation implications. Report to World Wildlife Fund/TRAFFIC USA. 97pp.

Shilton, L.A., J.D. Altringham, S.G. Compton, and R.J. Whittaker. 1999. Old World fruit bats can be long-distance seed dispersers through extended retention of viable seeds in the gut. Proceedings of the Royal Society, B 266: 219-233.

Siemann, E., J.A. Carrillo, C.A. Gabler, R. Zipp, and W.E. Rogers. 2009. Experimental test of the impacts of feral hogs on forest dynamics and processes in the southeastern US. Forest Ecology and Management 258:546-553.

Slabbekoorn, H. and E.A.P. Ripmeester. 2007. Birdsong and anthropogenic noise: implications and applications for conservation. Molecular Ecology 17:1-12.

Smith, C.W. 1985. Impact of alien plants on Hawaii's native biota. Pp. 180-250 in Hawaii's Terrestrial Ecosystems: Preservation and Management, C.P. Stone and J.M. Scott (eds.), Cooperative National Park Resources Studies Unit, Honolulu.

Stinson, D. W., P. O. Glass, and E. M. Taisacan. 1992. Declines and trade in fruit bats on Saipan, Tinian, Aguijan, and Rota. Pp. 61-67 *in*: Wilson, D. E., and G. L. Graham, eds., "Pacific island flying foxes: proceedings of an international conservation conference." U.S. Fish and Wildlife Service Biological Report 90(23).

Stone, B.C. 1970. The flora of Guam. Micronesica 6:1-659.

Stone, C.P. 1985. Alien animals in Hawaii's native ecosystems: toward controlling the adverse effects of introduced vertebrates. Pp. 251-297 in Hawaii's Terrestrial Ecosystems: Preservation and Management, C.P. Stone and J.M. Scott (eds.), Cooperative National Park Resources Studies Unit, University of Hawaii, Honolulu.

Stubben, C.J. and Milligan, B.G. 2007. Estimating and Analyzing Demographic Models Using the popbio Package in R. Journal of Statistical Software 22:11.

SWCA Environmental Consultants. 2008. The effects of flight operations on endangered Mariana fruit bats and Mariana crows: A monitoring program for Anderson AFB, Guam. Prepared for 36th Civil Engineer Squadron Environmental Flight, Unit 14007 and Air Force Center for Engineering and the Environment, pp. 40.

SWCA Environmental Consultants. 2012. Final summary report: noise study and demographic survey of Mariana fruit bats, Andersen Air Force Base, Guam. Prepared for JRM/ NAVFAC Marianas and Andersen AFB 36th CES/CEV. Hagatna, Guam.

SWCA Environmental Consultants. 2013. Final summary report: noise study and demographic survey of Mariana fruit bats, Andersen Air Force Base, Guam. Prepared for Joint Region Marians, Naval Facilities Engineering Command, Marianas and Andersen Air Force Base 36th CES/CEV. Hagatna, Guam.

Takano, L. 2015. Personal communication regarding observation of Mariana fruit bats at the NMS, Guam.

Tarr, C. L. and R. C. Fleischer. 1999. Population boundaries and genetic diversity in the endangered Mariana crow (*Corvus kubaryi*). Molecular Ecology 8:941-949.

Taylor, B. 1998. Rails: A Guide to the Rails, Crakes, Gallinules and Coots of the World. New Haven and London: Yale University Press.

Tomback, D. F. 1986. Observations on the behavior and ecology of the Mariana crow. Condor 88:398-401.

Tomich, P.Q. 1986. Pig, axis deer, mule deer, domestic goat, roof rat, Polynesian rat, European house mouse. In Mammals in Hawaii: a synopsis and notational bibliography, Bishop Museum Press, Honolulu. Pp. 37-45, 120-126, 130-134, 150-154, 156.

Torres, Victor. 2010. Government of Guam. Personal communication to Dawn Bruns (Service). April 1, 2010.

Traill, L.W., B.W. Brook, R.R. Frankham, and C.J.A. Bradshaw. 2009. Pragmatic population viability targets in a rapidly changing world. Biological Conservation 143:28-34.

Trimper, P. G., N. M. Standen, L. M. Lye, D. Lemon, T. E. Chubbs, and G. W. Humphries. 1998. Effects of low-level jet aircraft noise on the behaviour of nesting osprey. Journal of Applied Ecology 35:122-130.

Trine, C.L. 1998. Wood thrush population sinks and implications for the scale of regional conservation strategies. Conservation Biology 12:576-585.

U.S. Fish and Wildlife Service. (USFWS). 1984. Endangered and threatened wildlife and plants; Determination of endangered species status for seven birds and two bats of Guam and the Northern Mariana Islands. Federal Register 49:33881-33885.

U.S. Fish and Wildlife Service (USFWS). 1987. Endangered and threatened wildlife and plants; determination of endangered status for *Serianthes nelsonii* Merr. (Hayun Lagu or Tronkon Guafi). Federal Register 52(32): 4907-4910. (Including correction of tabular error: Federal Register 52(42): 6651.)

U.S. Fish and Wildlife Service (USFWS). 1989. Experimental Population Status on an Introduced Population of Rails on Rota in the Commonwealth of the Northern Mariana Islands. Federal Register 54(208): 43966-43970

U.S. Fish and Wildlife Service (USFWS). 1990a. Native forest birds of Guam and Rota of the Commonwealth of the Northern Mariana Islands Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon. 86pp.

U.S. Fish and Wildlife Service (USFWS). 1990b. Guam Mariana Fruit Bat and Little Fruit bat recovery plan. Portland, OR. 57 pp.

U.S. Fish and Wildlife Service (USFWS). 1994. Recovery plan for *Serianthes nelsonii*. U.S. Fish and Wildlife Service, Region 1, Portland, Oregon. 60 pages.

U.S. Fish and Wildlife Service (USFWS). 2004. Endangered and threatened wildlife and plants; designation of critical habitat for the Mariana fruit bat and Guam Micronesian kingfisher on Guam and the Mariana crow on Guam and in the Commonwealth of the Northern Mariana Islands; final rule. Federal Register 69(208):62,944-62,990.

U.S. Fish and Wildlife Service (USFWS). 2005a. Draft revised recovery plan for the aga or Mariana crow, *Corvus kubaryi*. Portland, Oregon. x + 147 pp.

U.S. Fish and Wildlife Service (USFWS). 2005b. Endangered and threatened wildlife and plants; Mariana fruit bat (*Pteropus mariannus mariannus*): Reclassification from endangered to threatened in the Territory of Guam and listing as threatened in the Commonwealth of the Northern Mariana Islands. Federal Register 70:1190-1210. January 6, 2005.

U.S. Fish and Wildlife Service (USFWS). 2005c. Study guide for the analytical framework, Section 6: in Advanced Interagency Consultation for Endangered Species, unpublished course notebook, National Conservation Training Center, Shepherdstown.

U.S. Fish and Wildlife Service (USFWS). 2006a. Transmittal of Guidance: Estimating the Effects of Auditory and Visual Disturbance to Northern Spotted Owls and Marbled Murrelets in Northwestern California. Arcata, California. 175 pp.

U.S. Fish and Wildlife Service (USFWS). 2006b. Biological opinion on the establishment and operation of an intelligence, surveillance, reconnaissance, and strike capability project on Andersen Air Force Base, Guam. Service File Number 2006-F-0266. 73 pp.

U.S. Fish and Wildlife Service (USFWS). 2006c. Informal consultation on the Beddown of Training and Support Initiative at the Northwest Field. Honolulu, Hawaii.

U.S. Fish and Wildlife Service (USFWS). 2008a. Revised Recovery Plan for the Sihek or Guam Micronesian Kingfisher (*Halcyon cinnamomina cinnamomina*). Portland, Oregon. 117 pp.

U.S. Fish and Wildlife Service (USFWS). 2008b. Proposed safe harbor agreement for the Guam rail on Cocos Island, Guam, Federal Register 73: 1893-1894.

U.S. Fish and Wildlife Service (USFWS). 2008c. Findings and recommendations regarding issuance of a safe harbor section 10 enhancement of survival permit for the Guam rail to Cocos Island Resort and Guam Department of Agriculture, Cocos Island, Territory of Guam (TE-174228-0).

U.S. Fish and Wildlife Service (USFWS). 2009a. Draft Recommended Survey Guidelines for the Mariana Fruit Bat. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

U.S. Fish and Wildlife Service (USFWS). 2009b. Ko'ko' or Guam Rail (*Gallirallus owstoni*) five-year review summary and evaluation. Pacific Islands Fish and Wildlife Service, Honolulu, Hawaii. 12pp.

U.S. Fish and Wildlife Service (USFWS). 2009c. Terrestrial Resource Surveys of Tinian and Aguiguan, Mariana Islands, 2008. Working Draft dated January 6, 2009.

U.S. Fish and Wildlife Service (USFWS). 2009d. Draft revised recovery plan for the Mariana fruit bat or fanihi (*Pteropus mariannus mariannus*). Portland, Oregon. xiv + 83pp.

U.S. Fish and Wildlife Service (USFWS). 2010a. Formal Section 7 Consultation Regarding the Joint Guam Program Office Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam and Tinian (2010-F-0122). September 8, 2010. Honolulu, Hawaii. 249 pp.

U.S. Fish and Wildlife Service (USFWS). 2010b. Draft revised recovery plan for the Mariana fruit bat or fanihi. Portland, Oregon. 83pp.

U.S. Fish and Wildlife Service. (USFWS). 2011. Rota agricultural homesteads Memorandum of agreement between the Commonwealth of the Northern Mariana Islands and Pacific Islands Fish and Wildlife Office, U.S. Fish and Wildlife Service, Honolulu, Hawaii. 30pages. Unpublished.

U.S. Fish and Wildlife Service. (USFWS). 2012a. The Mariana crow landowner Incentive plan. U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 8 pages.

U.S. Fish and Wildlife Service (USFWS). 2012b. *Serianthes nelsonii* (Hayun lagu) 5-year review. Pacific Islands Fish and Wildlife Service, Honolulu, Hawaii

U.S. Fish and Wildlife Service (USFWS). 2012c. Endangered and Threatened Wildlife and Plants; 5-Year Status Reviews of 46 Species in Idaho, Oregon, Washington, Nevada, Montana, Hawaii, Guam, and the Northern Mariana Islands. Federal Register 77:13248-13251.

U.S. Fish and Wildlife Service (USFWS). 2014a. Guam Micronesian kingfisher 5-year review summary and evaluation. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 6pp.

U.S. Fish and Wildlife Service. (USFWS). 2014b. Aga or Mariana crow (*Corvus kubaryi*) 5-year review summary and evaluation. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 10 pages. Available online, http://ecos.fws.gov/docs/five_year_review/doc4421.pdf.

U.S. Fish and Wildlife Service (USFWS). 2014c. Guam Rail (*Gallirallus owstoni*) five-year review summary and evaluation. Pacific Islands Fish and Wildlife Service, Honolulu, Hawaii. 7pp.

U.S. Fish and Wildlife Service (USFWS). 2014d. Mariana fruit bat (*Pteropus mariannus mariannus*) 5-year review summary and evaluation. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii. 11 pages.

U.S. Fish and Wildlife Service (USFWS). 2014e.
Draft framework for mitigating the impacts of listed species habitat loss on Guam. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii.

U.S. Fish and Wildlife Service (USFWS). 2015a. White paper on peak noise from operation of the LFTRC on AAFB. Unpublished data. Honolulu, Hawaii.

U.S. Fish and Wildlife Service (USFWS). 2015b. Biological Opinion for the Marianas Testing

and Training Program. February 20, 2015. Honolulu, Hawaii. 66 pp.

U.S. Fish and Wildlife Service (USFWS). 2015c. Assessment of Kingfisher Survival and Recovery Habitat, June 10, 2015. Pacific Islands Fish and Wildlife Office, Honolulu, Hawaii

U.S. Fish and Wildlife Service (USFWS). *In Review*. Revised recovery plan for the Mariana fruit bat or fanihi (*Pteropus mariannus mariannus*). Portland, Oregon. xiii + 103pp.

U.S. Forest Service. 2002. Vegetation Map of Guam Digital GIS Data Layer.

U.S. Geological Survey (USGS). 2010. Population Assessment of the Mariana Fruit Bat (*Pteropus mariannus mariannus*) on Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug; 15 June – 10 July 2010. Unpublished report.

USACHPPM 2005 in MCB Hawaii 2014. Environmental assessment and finding of no significant impact for the reconfiguration and construction of small arms ranges at the Ulupau Range Training Facility, Marine Corps Base Hawaii, Kaneohe Bay. Accessed on March 11, 2015 at http://www.mcbhawaii.marines.mil/Portals/114/WebDocuments/Ulupau/Ulupau_RTF_Reconfiguration_FEA_and_FONSI.pdf .

Vanderwerf, E.A. 1993. Scales of habitat selection by foraging 'elepaio in undisturbed and human-altered forests in Hawaii. Condor 95:980-989.

Vanderwerf, E.A. 2000. A study to determine the effects of noise from military training on the endangered Oahu elepaio. Prepared for U.S. Army Engineer District. Honolulu, Hawaii. 220 pp.

Ward, D. H., R. A. Stehn, W. P. Erickson, and D. V. Derksen. 1999. Response of fall-staging brant and Canada geese to aircraft overflights in southwestern Alaska. Journal of Wildlife Management 63:373-381.

Watson, J. W. 1993. Responses of nesting bald eagles to helicopter surveys. Wildlife Society Bulletin 21: 171-178.

Wenninger, Paul. 2008. Personal Communication. Division of Aquatic and Wildlife Resources, Department of Agriculture, Guam.

Whitteman, GJ., and R.E. Beck, Jr. 1990. Development of an experimental population of Guam Rails on Cocos Island or in the Commonwealth of the Northern Mariana Islands. Pp. 172-177 *in* Annual Report, Fiscal year 1990. Pittman-Robertson Federal Aid in Wildlife Restoration Program. Division of Aquatic and Wildlife Resources, Guam.

Wiles, G. J. 1987a. Current research and future management of Mariana fruit bats (Chiroptera: Pteropodidae) on Guam. Australian Mammalogy 10:93-95.

Wiles, G. J. 1987b. The status of fruit bats on Guam. Pacific Science 41:148-157.

Wiles, G. J. 1992. Recent trends in the fruit bat trade on Guam. Pages 52-60 in Wilson, D. E., and G. L. Graham, eds. Pacific island flying foxes: proceedings of an international conservation conference. U.S. Fish and Wildlife Service Biological Report 90(23).

Wiles, G.J. 2005. Decline of a population of wild seeded breadfruit (*Artocarpus mariannensis*) on Guam, Mariana Islands. Pacific Science 59:509-522.

Wiles, G. J., and N. H. Payne. 1986. The trade in fruit bats *Pteropus* spp. on Guam and other Pacific islands. Biological Conservation 38: 143-161.

Wiles, G. J. and P. Glass. 1990. Interisland movements of fruit bats (*Pteropus mariannus*) in the Mariana Islands. Atoll Research Bulletin 343:1-6.

Wiles, G. J., and M. S. Fujita. 1992. Food plants and economic importance of flying foxes on Pacific islands. Pages 24-35 *in* Wilson, D. E., and G. L. Graham, eds. Pacific island flying foxes: proceedings of an international conservation conference. U.S. Fish and Wildlife Service Biological Report 90(23).

Wiles, G.J., C.F. Aguon, G.W. Davis, and D.J. Grout. 1995. The status and distribution of endangered animals and plants in northern Guam. Micronesica 28:31-49.\

Wiles, G.J., I.H. Schreiner, D. Nafus, L.K. Jurgensen, and J.C. Manglona. 1996. The status, biology, and conservation of *Serianthes nelsonii* (Fabaceae), an endangered Micronesian tree. Biological Conservation 76: 229-239.

Wiles, G. J., J. Engbring, and D. Otobed. 1997. Abundance, biology, and human exploitation of bats in the Palau Islands. Journal of Zoology (London) 241: 203-227.

Wiles, G. J., J. Bart, R.E. Beck, Jr., and C.F. Aguon. 2003. Impacts of the brown tree snake: patterns of decline and species persistence in Guam's avifauna. Conservation Biology 17(5):1350-1360.

Wiles, G.J. and N.C. Johnson. 2004. Population size and natural history of Mariana fruit bats on Sarigan, Mariana Islands. Pacific Science 58(4):585-596.

Wiles, G.J. and A.P. Brooke. 2009. Conservation threats to bats in the tropical Pacific Islands and insular Southeast Asia. In: T.H. Fleming and P.A. Racey (eds.), Island bats: evolution, ecology, and conservation, pp. 405-459. University of Chicago Press, Chicago, IL.

Willsey, Tyler. 2014. Personal Communication. Wildlife Biologist, CNMI Division of Fish and Wildlife, Saipan, CNMI.

Wingfield J. C., D. L. Maney, C. W. Breuner, J. D. Jacobs, S. Lynn, M. Ramenofsky, R. D. Richardson. 1998. Ecological bases of hormone-behavior interactions: the ‘‘emergency life history stage’’. American Zoology 38:191–206.

Woodroffe, R. & Ginsberg, J.R. (1998). Edge effects & the extinction of populations inside protected areas. Science 280: 2126–2128.

Worthington, D.J., A.P. Marshall, G.J. Wiles, and C. Kessler. 2001. Abundance and management of Mariana fruit bats and feral ungulates on Anatahan, Mariana Islands. Pacific Conservation Biology 7:134-42.

Zarones, L., A. Sussman, J. M. Morton, S. Plentovich, S. Faegre, C. Aguon, A. Amar, R. R. Ha. 2014. Populations status and nest success of the critically endangered Mariana crow (*Corvus kubaryi*) on Rota, Northern Mariana Islands. Bird Conservation International. Available online at http://journals.cambridge.org/abstract_S0959270914000045.

P. APPENDIX A – INFORMAL CONSULTATION

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2015-I-0291

JUL 3 1 2015

Captain Joseph A. Campbell
Deputy Director, Joint Guam Program Office
Office of the Assistant Secretary of the Navy (EI&E)
Joint Guam Program Office, ASN (EI&E)
201 12th Street South, Suite 700
Arlington, Virginia 22202

Subject: Informal Consultation for the Joint Guam Program Office Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam

Dear Captain Campbell:

The U.S. Fish and Wildlife Service's (Service) received your letter on October 1, 2014, requesting our concurrence that the subject project may affect, but is not likely to adversely affect the federally endangered Mariana swiftlet (*Aerodramus bartschi*), the federally endangered hawksbill sea turtle (*Eretmochelys imbricata*) (hereafter referred to as the hawksbill turtle), and the federally threatened green sea turtle (*Chelonia mydas*) (hereafter referred to as the green turtle). Our analysis and finding in this consultation are based on your letter dated September 30, 2014, your Biological Assessment (BA) (DON 2014a), and other information available to us. This response is in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq.*). A complete administrative record is on file in our office.

Project Description

The Department of Navy (DON) proposes to relocate U.S. Marine Corps (USMC) personnel from Okinawa, Japan to Guam; construct and operate a main cantonment area, including family housing; and construct and operate a live-fire training range complex (LFTRC); and conduct training activities on Guam. Project activities will occur on land administered by the Department of Defense (DoD) and the Government of Guam (for road and bridge work). The proposed action includes the following components:

- Relocation of 5,000 USMC personnel and 1,300 dependents from Japan to Guam
- Construction of the main cantonment within 1,213 acres at Finegayan, Andersen Air Force Base (AAFB)
- Construction of housing within 510 acres at AAFB
- Utilities and site improvement activities within DON-administered lands
- Road and bridge development and/or improvement within DON-administered lands and Government of Guam lands
- Construction and operation the LFTRC at AAFB
- Establishment of a surface danger zone (SDZ) within Northwest Field (NWF), AAFB and the Guam National Wildlife Refuge (GNWR)
- Development and operation of a hand grenade range at Andersen South
- Air craft training activities within the Naval Base Guam's Naval Munitions Site (NMS) and adjacent areas

In addition, per an email correspondence from the DON (DON 2015b), the proposed project also includes surveying the water portion of the SDZ from three locations on the GNWR (Figure 1). The Range Safety Specialist (RSS) would access these locations using an ATV-type vehicle (*e.g*, 2 or 4 passenger Gator vehicle). The portion of the SDZ that cannot be observed by radar would be accessed by an existing dirt road and the RSS would park the vehicle along the road and walk into the locations depicted on Figure 1 to view the radar "blind spots". It is expected that the RSS would not need to walk the beach and would use a pair of binoculars to view the water portion of the SDZ from a static vantage point on the edge of the beach near the road. The RSS would drive out the same dirt road taken to access the locations. The above activity would take no more than 20 minutes.

A detailed project description is included in the BA (DON 2014a), the Draft SEIS (DON 2014b), addendum to the BA (DON 2015a), and the Biological Opinion for the subject project (USFWS 2015), and is hereby incorporated by reference into this informal consultation.

The conservation measures below are a subset of the conservation measures that are proposed in the BA (DON 2014a), addendum to the BA (DON 2015a), and via email correspondence between the DON and the Service. These conservation measures are intended to avoid and minimize effects to the Mariana swiftlet, green turtle, and hawksbill turtle. Any changes to, modifications of, or failure to implement these avoidance and minimization measures may result in a need to reinitiate this consultation.

Conservation Measures to Minimize the Effects of Construction

1. Contractor Education Program. The DON contractor education program ensures that construction contractor personnel are informed of the biological resources in the project area, including invasive species, special-status species, avoidance measures, and reporting requirements. This measure is intended to prevent inadvertent effects to terrestrial biological resources due to lack of awareness of resource presence, sensitivities, and protective measures. This measure will be implemented during pre-construction and construction.

2. Contractor Plans and Specifications. All construction will occur within the limits of construction shown in the plans and specifications. This measure is intended to prevent additional habitat loss. This measure will be implemented during pre-construction and construction.

3. Guam Landscaping Guidelines. Appropriate or non-invasive species will be planted in all new landscapes. This measure is intended to reduce potential effects associated with non-native vegetation, promote habitat for native species, reduce water consumption, and reduce the need for fertilizers. This measure will be implemented during construction.

4. LFTRC Range Berm Controls. LFTRC range berms will contain native or non-invasive herbaceous vegetation, and other engineering controls. This measure will help to manage stormwater runoff and control erosion, and the berm will minimize the number of bullets that may fall outside the range footprint. This measure will be implemented during construction.

5. Lighting Installation. Lighting will be designed to meet minimum safety, sustainability, antiterrorism, and force protection requirements. Hooded-lights will be used to the maximum extent practicable at all new roads and facilities within known sea turtle land habitat and fruit bat roost areas. Either hooded or "night-adapted" lights will be installed at the LFTRC. Illumination of forest, coastline, or beach will be consistent with range safety and security requirements and kept to an absolute minimum including the shielding of lights and directing lighting away from the forest or other wildlife habitat. This measure will be implemented during pre-construction, construction, and during operations.

6. Monitoring. The DON will be responsible for oversight of avoidance, minimization, and conservation measures implementation by the contractors for projects associated with the proposed action. The DON shall ensure that construction remains within the limits of construction and that sensitive resources are avoided, unless otherwise specified in the Project Description. This measure will be implemented during pre-construction, construction, and operations.

Conservation Measures to Minimize the Effects of Invasive Species

Regional Biosecurity Plan. To address invasive species pathways and encourage a more holistic approach to managing invasive species, the DON has funded the development of the Regional Biosecurity Plan (RBP) for Micronesia and Hawaii (formerly referred to as the Micronesia Biosecurity Plan). Individual activities for various species will continue, but the DON and others agree it is more efficient to manage pathways and prescribe corrective measures for a suite of species which will be monitored at discrete control points over time. The RBP will provide stakeholders in Micronesia and Hawaii with a platform for coordination and integration of inter-agency invasive species management efforts such as control, interdiction, eradication, and

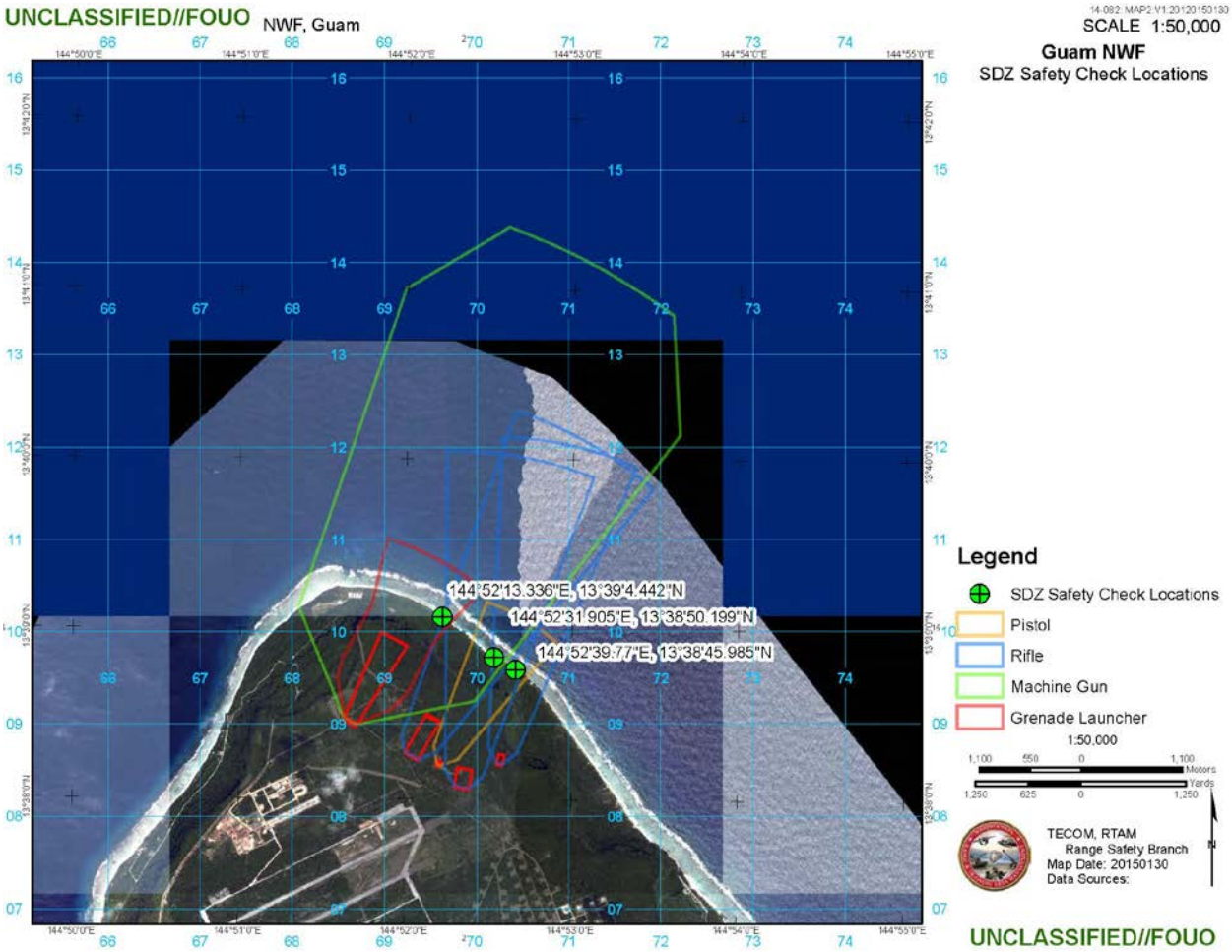


Figure 1. Safety check locations to view the radar "blind spots" of the SDZ, located on the Guam National Wildlife Refuge.

research. The final RBP was completed in 2015 (DON 2015b). Several of the recommendations are incorporated into the Project Description as BMPs:

1. Onsite vegetation waste management procedures. Green waste will be handled by the contractors at designated laydown areas within the limits of construction. Contractors will be required to divert all the green waste. The larger-sized green waste consisting of trees and stumps will be processed into mulch and the smaller sized green waste will be processed into compost. A proposed green waste processing facility at the NBG Landfill may also be used to process green waste generated during construction. The DoD will seek permit authorization from the Guam Environmental Protection Agency for the proposed green waste processing facility.

2. DON's Final Guam Landscaping Guidelines. The DON has developed a manual providing landscaping design guidelines specific to appropriate plant selection and

establishment for all the DON construction activities on Guam (DON 2011). This manual implements required DON policies including, but not limited to:

a. use of native regional plants for landscaping;
b. design, use, and promoting construction practices that minimize adverse effects on natural habitat;
c. pollution prevention by reducing fertilizer and pesticide use, integrated pest management practices, recycling green waste (composting), and minimizing runoff;
d. implementing efficient water practices; and
e. preventing the introduction of invasive species.

The above measure is intended to reduce potential effects associated with non-native vegetation, promote habitat for native species, reduce water consumption, and reduce the need for fertilizers.

3. Biosecurity outreach and education. The DON has initiated and will continue to implement a targeted, comprehensive outreach and education program for DoD and civilian populations for biosecurity focused on prevention. As a starting point, the DON contracted for the development of biosecurity outreach and education materials. The contractor has designed and produced an activity booklet, a two-sided, tri-fold, educational brochure with an associated poster that differentiates native from introduced species, defines invasive species, describes the known impacts of invasive species on native species and ecosystems, and what can be done to prevent and control invasive species. This effort also included the development of radio public service announcements (PSA) in three languages, and a television PSAs both of which aired for one month in September of 2013 during peak broadcasting times.

   The DON's biosecurity outreach and education program has already begun concurrent with the actions that were initiated under the 2010 Environmental Impact Statement's Record of Decision (DON 2010). The DON will develop additional informational videos, expand the radio PSAs broadcasts, and other print media as well as active public outreach concurrent with the arrival of the first major influx of USMC personnel in 2020 and continue for an additional 5 years.

4. Hazard Analysis Critical Control Point (HACCP) planning. HACCP planning is a pathway management tool that provides a comprehensive method to identify risks and focus procedures to prevent spread of species through pathways. Construction work could unintentionally spread non-target (potentially invasive) species. These non-targets could hitchhike on construction equipment or be included in shipments of materials and supplies from locations outside of Guam. The pathways used by invasive species to move into new locations are not always obvious. Many problematic species, diseases, and parasites have been transferred to new locations as undetected (and unplanned) hitchhikers. HACCP planning is a management tool that provides a structured method to identify risks and focus procedures. Understanding pathways and developing plans to reduce non-target species and prevent biological contamination is necessary to avoid unintended spread of species.

a. All construction contracts will contain a requirement to develop a HACCP Plan which will identify risks and potential pathways for non-native species and will outline procedures for controlling and removing risks identified. Construction contractors are required to provide documentation that supports prevention, worker awareness training, and control of non-native invasive and pest species in the project area and efforts to prevent the movement of non-native invasive species to areas outside the project area, whether in a purposeful or inadvertent manner. The contractor is responsible for ensuring that employees receive applicable environmental and occupational health and safety training and keep up to date on regulatory requirements for specific training for the type of work to be conducted onsite.

b. Construction contracts also will contain a requirement for inspections and proper re-use or disposal of vegetation to avoid contributing to the further spread of the coconut rhinoceros beetle (*Oryctes rhinoceros*). The construction contractors are to identify and implement control measures to prevent the inadvertent movement of non-native, invasive species to Guam and to and from the project site to other locations. The contractor is required to establish appropriate facilities that comply with all environmental laws and regulations, provide training for proper vehicle hygiene, and promptly take corrective and preventative actions for noncompliance. This includes vehicle washdown and inspection for soil and other materials and appropriate control measures are implemented to prevent the inadvertent movement of non-native invasive species from the project site to other locations.

c. All HACCP planning and implementation related to the proposed action will be the responsibility of the awarded project contractor(s) to ensure that proper control measures are used throughout the construction activities to prevent the inadvertent movement of invasive species from one location to the project site, and/or from the project site to other locations. It will be the responsibility of DON to review and concur with the development phase of the HACCP planning process to ensure proper compliance by these contractors.

d. HACCP plans will be approved and inspected by the DON.

5. Monitoring to evaluate effectiveness of HACCP

a. The DON shall provide training, review, and technical guidance on HACCP plan development, implementation, and revision during the construction phase of the buildup on Guam. The HACCP planning covers Guam-related rapid response actions. The DON contracted a baseline ecosystem monitoring study for projects on AAFB in 2011. Transects were focused on areas where newly introduced species were most likely to occur. The intent of the project was to establish a baseline of both native and non native plants present prior to the beginning of planned construction activities. This baseline will serve as a reference for

subsequent monitoring efforts conducted concurrently with construction in order to aid in evaluating the success of implemented HACCP plans. The baseline will also provide a basis of comparison for relative abundances of invasive species during construction, as well as whether any species detected during long-term monitoring are newly introduced or were present prior to the beginning of construction. The AAFB project was completed in December 2012.

b. The DON will develop an early detection and rapid response component for when an incipient invasive species is discovered in the proposed action area.

6. Brown treesnake interdiction

a. JRM has established a comprehensive brown treesnake (*Boiga irregularis*) interdiction program to ensure that military activities, including the transport of civilian and military personnel and equipment to and from Guam, do not contribute to the spread of brown treesnake to other islands or regions. Brown treesnake interdiction requirements are specified in DoD instructions (i.e., 36 Wing Instruction 32-7004, Brown Tree Snake Control Plan and COMNAVMAR Instruction 5090.10A, Brown Tree Snake Control and Interdiction Plan). The proposed project will continue to comply with these established procedures.

b. The DON will fund any increase of current federally-funded brown treesnake interdiction measures (in Guam, CNMI, and Hawaii) where the increase is related to direct, indirect and induced growth caused by the USMC relocation to Guam. The fiscal year 2010 level of funding for the Federal interagency brown treesnake interdiction effort on Guam, CNMI, and Hawaii and 2010 transportation levels associated with outbound cargo from Guam for the U.S. or U.S. territories will be used as the baseline. Any increase in funding will continue and become part of the DON's brown treesnake interdiction funding under authority of the Brown Tree Snake Control and Eradication Act (7 USC § 8501 note) (USFWS 2010a). The Department of Interior agrees that it is not DON's responsibility to fund increased interdiction measures *that are identified* more than one year after the end of the fiscal year both USMC relocation construction has ended and the permanent non-transient USMC military units have relocated to Guam. For the purposes of this consultation, interdiction is defined as: "to hinder, prohibit, or prevent the brown treesnake from becoming established in new locations by conducting inspection and suppression processes."

c. Rapid Response – Brown treesnake management, research, and coordination efforts have been refined and progressed to the point where U.S. Department of Agriculture-Animal and Plant Health Inspection Service, Wildlife Services inspection rates for cargo and flights departing Guam are almost 100 percent (BTS TWG 2015).

d. Coordination with the U.S Geological Survey (USGS) regarding the Brown Treesnake Research Closed Population Facility at NWF (located adjacent to the

LFTRC and SDZ) – The DON will ensure through briefings or information packages that the personnel using the LFTRC know the importance of the facility and maintaining the integrity of the fence. An SOP will be developed as part of the Range Management Plan for the LFTRC to ensure the above and that USGS will be immediately notified in the event that the fence is accidentally damaged so the fence can be quickly repaired.

Conservation Measures to Minimize the Effects of Training to Mariana Swiftlets

1. Aviation Training in NMS. All aviation training will be conducted so that flights will approach the southern portion of the NMS over the Talofofo River watershed and Fena Reservoir at heights of 1,000 ft (305 m) or greater above ground level. Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at Highway 4 and then flights may conduct low level terrain flights. Low-level training flights will be restricted to the southernmost portion of the NMS where Mariana swiftlets are not commonly present. This measure is intended to avoid and minimize effects to swiftlets, and will be implemented during operations.

2. Ground Training in NMS. The DON will maintain 328-ft (100-m) no training buffers around the known Mariana swiftlet nesting caves (*e.g.*, Mahlac Cave, Fachi Cave, Maemong Cave) in NMS. This measure is intended to avoid and minimize effects to Mariana swiftlets, and will be implemented during operations.

Conservation Measures to Minimize the Effects of Increased Human Presence at Nesting Sea Turtle Beaches

1. Sea Turtle Public Outreach and Coordination. The DON, in cooperation with the Guam Department of Aquatic and Wildlife Resources (DAWR), has undertaken an educational program to inform military and civilian personnel about sea turtle nesting and the potential impacts to the species from nest disturbance, direct harassment of sea turtles, beach disturbance, and other threats. The DON has developed and distributed sea turtle conservation posters, tri-fold brochures and activity booklets for elementary school children. These educational materials have been distributed to local dive shops on Guam, and will continue to be used and refined throughout the construction period of the proposed USMC relocation. As part of the Range Safety Specialist (RSS) training package, personnel would be directed to not interact with sea turtles and report all sightings to the Service and coordinate with the GNWR on nesting surveys at the Refuge.

Action Area

The term "action area" is defined in the implementing regulations for section 7 at 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action."

The action area for this consultation is the island of Guam (Figure 2). The specific areas likely to be affected, directly or indirectly, by the proposed action are discussed in detail in the BA. In addition to what is detailed in the BA, the following effects from the action may be Guam-wide: 1) effects from introduction of invasive species by the proposed action could spread throughout the whole island of Guam and 2) the population increase resulting from the proposed action will cause additional human disturbance throughout the island, including at recreation sites, hunting areas, traffic along roads, etc.

Status of the Species

<u>*Mariana swiftlet*</u>

Listing status - The Mariana swiftlet was federally listed as endangered on August 27, 1984 (USFWS 1984). A five-year status review was completed in 2010 (USFWS 2010b) and a recovery plan for the Mariana swiftlet was completed in 1991 (USFWS 1991). No critical habitat rules have been published for this species.

Species description - The Mariana swiftlet (*Aerodramus bartschi*) was formerly considered a subspecies of the widespread Vanikoro swiftlet (*A. vanikorensis*), but genetic studies support that it is a distinct species (Thomassen et al. 2005, p. 274). It is a small swift with dark, gray-brown plumage on the upper parts, a slightly paler rump, and paler underparts, and the plumage of both sexes is alike. Weights of 21 birds averaged 7.4 grams (range = 6.4 to 9.0 grams). Other measurements include: wing, average of 107.6 mm and 108 mm; tail, average of 52.3 mm; exposed culmen, average of 4.0 mm; tarsus, average of 10.4 mm, and wingspan, maximum of 233 mm (USFWS 1991, p. 1; https://ecos.fws.gov, *accessed* 9 April 2015). It is the only resident swift in the Mariana Islands, and could potentially be confused with migratory swallows, or the fork-tailed swift (*Apus pacificus*), a rare vagrant (USFWS 1991, p. 1).

Life history - Mariana swiftlets are aerial insectivores that nest in limestone caves and can echolocate (USFWS 1991, p. 2; Reichel et al. 2007, p. 686 and references therein; Valdez et al. 2011, p. 301). They forage over a wide variety of habitats, including cleared and forested areas, but favor ridge crests and open grassy savannas (USFWS 1991, p. 6). Large flocks have been reported to form in the evening, with birds feeding close to the ground until it is dark (Chantler and Driessens 1995, p. 130).

Mariana swiftlets produce a single egg which is incubated for approximately 23 days (range 17-30 days), and chicks fledge after approximately 47 days (range 40-55 days; Reichel et al. 2007, p. 686). Eggs are laid in cup-shaped nests made of moss and saliva attached to cave walls or ceilings. Assessment of guano on Saipan indicate Hymenoptera, especially flying ants (*Formicidae*), were the most common insect prey followed by Coleoptera (Kershner et al. n.d.).

Analysis of guano from swiftlets on Aguiguan showed that their diet consisted primarily of Hymenoptera, with a small percentage of Hemiptera (Valdez et al. 2011, p. 301).

Status and distribution - The Mariana swiftlet is endemic to Guam, Rota, Aguiguan, Tinian, and Saipan, but has declined on all islands and is extirpated from Rota and Tinian (Cruz et al. 2008, p. 233; Valdez et al. 2011, p. 301 and references therein; USFWS 1991, p. 7-14). Based on the most recent data available in our files, the current range-wide population estimate for Mariana swiftlets is approximately 1,493 swiftlets on Guam (DON 2014a, p. 8), over 6,100 swiftlets on Saipan (CNMI DFW 2011, p. 36), and approximately 400 swiftlets on Aguiguan (Cruz et al. 2008, p. 240) for a total of approximately 7,993 swiftlets. In addition, a small population was introduced and currently persists on Oahu, Hawaii (Wiles and Woodside 1999, p. 57, as noted in Valdez et al. 2011, p. 301).

Threats - The causes for the decline of Mariana swiftlets are mostly unknown, but human disturbance, predation, pesticides, and disease have been hypothesized as having a role (USFWS 1991, p. 18-22). Swiftlets have been documented to flush, or fail to enter their caves when humans are near or within their caves (Wiles and Woodside 1999, pp. 57, 61). Swiftlet sensitivity to human presence has resulted in injuries to chicks and adults, and could result in damage to eggs (Wiles and Woodside 1999, p. 61). Sources of human disturbance have included Japanese soldiers during World War II, guano mining, hunters, hikers, and vandalism.

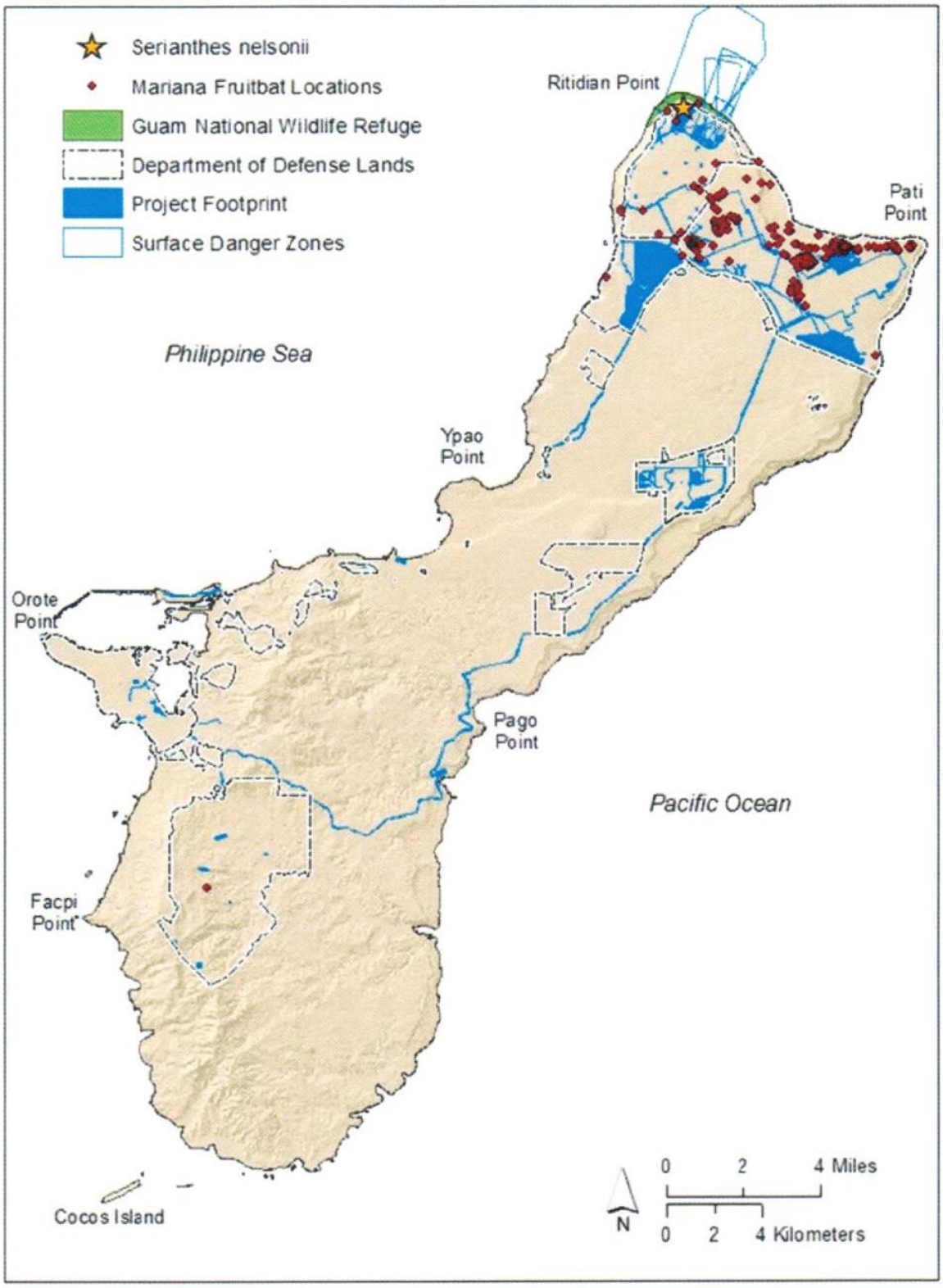


Figure 2. Action Area.

Brown treesnake predation on swiftlets is considered to be a regular event, and there are recent observations of brown treesnake predation on swiftlets in Mahlac cave on Guam (DON 2012). The use of pesticides such as DDT has been suspected of causing the decline of swiftlet populations on Guam (Diamond 1984, p. 452), but the concentrations of pesticide residues found in swiftlet guano have not supported this hypothesis (Grue 1985, p. 301). On Saipan, non-native cockroaches are known to destroy swiftlet nests by consuming the saliva that holds the nests to the walls or ceilings (Cruz et al. 2008, p. 242). Savidge et al. (1992, p. 206) investigated the role of disease in the decline of birds on Guam and determined that there is no evidence that it has played a significant role. The typhoons that frequently occur in the area may cause periodic declines in swiftlet populations, but are not expected to threaten the species as a whole since the species has survived numerous such events during its evolutionary history (USFWS 1991, p. 22).

Green sea turtle

Listing status - The green turtle is listed as endangered in Florida and on the Pacific coast of Mexico, and as threatened throughout the rest of its range (NMFS and USFWS 1978). The National Marines Fisheries Service (NMFS) and Service have recently proposed to relist the green turtle based on 11 different distinct population segments (DPS's). The new proposal, if finalized, will uplist their status, along with the rest of the Central West Pacific DPS, to endangered. This DPS includes the Mariana Islands, southern Japanese Islands, the Marshall Islands, the islands of Belau, and parts of Melanesia (NMFS and USFWS 2015, p. 15311). The entire DPS is estimated to have approximately 6,500 nesting females (NMFS and USFWS 2015, p. 15311). Persistent threats to this DPS include continued poaching and development of nesting beaches in addition to ongoing detrimental changes to marine habitats both from in-water and upland sources (NMFS and USFWS 2015, p. 15313). These threats continue to hinder their recovery when compared to other DPS's analyzed in the listing proposal, and therefore, is one of the three DPS's – of 11 proposed worldwide – that is proposed for uplisting to endangered. There is no critical habitat within coastal water or on nesting beaches in the Mariana Islands, although critical habitat for the green turtle occurs within coastal waters in portions of its range (NMFS 1998).

Species description - The green turtle grows to a maximum size of 4 ft (1.2 m) in carapace (upper shell) length and 440 lbs (200 kg) in body mass (https://ecos.fws.gov, *accessed* 5 June 2015). It has a heart-shaped shell, small head, and single-clawed flippers (NMFS and USFWS 1998a, p. 7). Hatchlings generally have a black carapace, white plastron, and white margins on the shell and limbs. The adult carapace is smooth, keelless, and light to dark brown with dark mottling; the plastron is whitish to light yellow. Adult heads are light brown with yellow markings. Identifying characteristics include four pairs of costal scutes, none of which borders the nuchal scute, and only one pair of prefrontal scales between the eyes (NMFS and USFWS 1998a, p. 8; https://ecos.fws.gov, *accessed* 5 June 2015).

Life history - Most green turtles spend the majority of their lives in coastal foraging grounds, and rely on marine algae and seagrass for their diet. Green turtles use nesting beaches that are characterized by intact dune structures, native vegetation, little to no artificial lighting, and beach temperatures between 26 and 35 degrees Celsius (NMFS and USFWS 2015, p. 15275, and references within). All species of sea turtles have high site fidelity to their hatching (natal)

beaches, returning close to their own hatching site to lay their nests, usually nesting multiple times over a nesting season.

The green turtle nesting season varies with locality. A female can lay multiple clutches within a nesting season at about 10 to 15-day intervals. Clutch size varies but can consist of about 100 eggs each. Hatchlings generally emerge at night and dig upward in a communal effort and take 2 to 3 days before reaching the surface. Newly emerged hatchlings are strongly photopositive and can be disoriented away from their path to the sea by artificial lighting (NMFS and USFWS 1998a, p. 18).

Status and distribution - Green turtles have a circumglobal distribution, occurring throughout tropical, subtropical, and to a lesser extent, temperate waters. Their movements within the marine habitat are not fully understood, but they are known to inhabit coastal waters of over 140 countries, and nest at 468 known sites worldwide (NMFS and USFWS 2015, p. 15275).

The NMFS and Service completed a five-year status review in 2007 (NMFS and USFWS 2007). An estimated 108,761 to 150,521 females nest each year among sampled nesting sites throughout its range. Among 23 sides for which data enables an assessment of the threatened population, 10 nesting populations are increasing, 9 are stable, and 4 are decreasing. Long-term continuous data sets (greater than 20 years) are available for 9 sites, all of which are either increasing or stable (NMFS and USFWS 2007, p. 14).

Threats - The causes for the decline of green turtle numbers are similar to the hawksbill turtles (refer to *Threats to Sea Turtles - Nesting Environment* below)

Hawksbill sea turtle

Listing status - The hawksbill turtle was federally listed as endangered throughout its range. Critical habitat was designated in nesting beach areas and marine areas in 1982 and 1998, respectively (USFWS 1992, NMFS 1998). Recovery plans for populations of the hawksbill turtle were completed in 1993 and 1998 (NMFS and USFWS 1993, 1998b).

Species description - The hawksbill turtle is one of seven species of sea turtles found throughout the world. One of the smaller sea turtles, it has overlapping scutes (plates) that are thicker than those of other sea turtles. This protects them from being battered against sharp coral and rocks during storm events. Adults range in size from 30 to 36 inches (0.8-1.0 m) carapace length, and weigh 100 to 200 lbs (45-90 kg). Its carapace (upper shell) is dark brown with faint yellow streaks and blotches and a yellow plastron (under shell). The name "hawksbill" refers to the turtle's prominent hooked beak (website https://ecos.fws.gov, *accessed* 15 June 2015).

Life history - Hawksbill turtle movement within the marine environment is not fully understood. Adult hawksbill turtles were once considered to be relatively non-migratory, but are now thought to use a mixed migration strategy. Studies have revealed that some turtles remain close to their rockery and others are highly mobile, traveling hundreds to thousands of kilometers between nesting and foraging areas (NMFS and USFWS 2013, p. 11 and references therein).

Hawksbill turtles typically feed in the vicinity of rock or reef habitat in shallow tropical waters with little turbidity (Witzell 1983). Throughout their range, hawksbill turtles feed on sponges but their primary diet differs depending on the region occupied. For example, in the northeastern Australia Great Barrier Reef, the primary food item was algae (72.2 percent) followed by sponges, soft corals, invertebrate species (total 23 percent), and inorganic material (5.4 percent) (Bell 2012).

Female hawksbill turtles exhibit strong fidelity of their choice of nesting sites and can lay multiple clutches at approximately two-week intervals within one nesting season (Witzell 1983). Female hawksbill turtles usually select a nest site within the cover of woody vegetation, although some will use grass or open sand if the preferred cover is not accessible (NMFS and USFWS 1998b, p. 17). There is much variation in clutch size from site to site (Witzell 1983). Maragos (1991) estimated 130 eggs per clutch for Palauan hawksbill turtles, and in eastern Caribean clutch size is closer to 150 eggs per clutch (Corliss et al. 1989).

Status and distribution - Hawksbill turtles are circumtropical in distribution, generally occurring from 30 degrees north to 30 degrees south latitude within the Atlantic, Pacific, and Indian Oceans and associated bodies of water (NMFS and USFWS 1998b). They prefer nearshore areas where they can forage on their preferred diet of marine sponges. Like green turtles, they rely on nesting beaches that have little to no artificial lighting. Hawksbill turtles usually select a nest site within the cover of woody vegetation, although they will nest occasionally in grass or open sand (NMFS and USFWS 1998b, p. 17).

The NMFS and Service completed a five-year status review in 2013 (NMFS and USFWS 2013). An estimated 22,004 to 29,035 hawksbill turtles nest each year among 88 sites within nesting beach in the Atlantic, Indian, and Pacific regions. Among the 63 sites for which historic trends could be assessed, all 63 (100 percent) showed a decline during the long-term period of greater than 20 to 100 years. Among the 41 sites for which recent trend data are available, NMFS and Service determined that 10 (24 percent) were increasing, 3 (7 percent) stable, and 28 (68 percent) were decreasing (NMFS and USFWS 2013, p. 24).

Threats to Sea Turtles – Nesting Environment

Green and hawksbill turtles, both historically common in tropical nearshore waters, have been significantly reduced over the past few centuries due to a variety of factors. The significant reduction in numbers of green turtles due to development of coastal areas for industry and tourism, meat and egg harvest in different parts of the world, and accidental catch in other fishery industries led to the listing of this species (NMFS and USFWS 1978, 32803-32807). While hawksbill turtles share many of the same threats, their numbers also declined because their shells were widely used for ornamental and practical uses (NMFS and Service 1998b, p. 4). Today, harvest continues to be a major threat in the Pacific islands, but development of historical nesting beaches also has drastically reduced populations of both sea turtles in the Pacific (NMFS and USFWS 2015, p. 15311). Threats to the green turtles on nesting grounds, as outlined in their recovery plan (NMFS and Service 1998a), are representative of those also faced by hawksbill turtles (NMFS and Service 1998b). Storm events, including typhoons, may destroy nests because of flooding or piling of eroded sand on the nest site. Beach erosion due to wave action

may decrease the availability of suitable nesting habitats and result in a decline in the nesting rate. A number of non-native and native predators dig into nests and prey upon incubating eggs, while some predators, including birds, may take hatchlings just prior to or during their emergence from nests.

Human crowding of nesting beaches can disturb nesting females and prevent laying of eggs. Flashlight use, beach fires, and artificial lighting on human structures may deter females from coming up onto a beach or may disorient hatchlings as they emerge from nests and try to find the sea (Witherington and Martin 1996, pp. 4-5). Emerging hatchlings may respond to the effects of artificial lighting by causing hatchlings to move in the wrong direction (*misorientation*) and/or interfere with their overall ability to orient (*disorientation*), which causes hatchlings to move in circles attempting to orient in the correct direction. Both behaviors can result in hatchling mortality through exhaustion, dehydration, predation, and other causes (Mann 1977, p. 54; Witherington and Martin 1996, pp. 4-5).

Human presence on nesting beaches also may lead to an increase in the presence of domestic pets (which can depredate nests) and litter (which may attract wild predators). Humans may inadvertently trample nests through recreational beach activities and increase sand compaction, which may damage nests or hatchlings. Bonfires also may damage strand vegetation and alter behavior by nesting females who are sensitive to smells such as smoke. Humans may introduce exotic vegetation in conjunction with beach development that can overrun nesting habitat or make the substrate unsuitable for digging nest cavities. Construction on or in the vicinity of sea turtle nesting beaches can result in sand compaction, beach erosion, and increase in direct and ambient light pollution. The rate of habitat loss because of erosion and escarpment may be increased when humans attempt to stabilize the shoreline, either through re-nourishment or through placement of hard structures, such as sea walls or pilings. Off-road vehicle traffic also contributes to habitat loss through erosion, especially during high tides or on narrow beaches where driving is often concentrated on the high beach and fore dune.

One of the most substantial threats to nesting sea turtles in the Pacific islands remains the illegal poaching of adults and eggs (NMFS and Service 1998a, NMFS and Service 2015, p. 15313). The direct harvest of adult nesting females can increase the rate of local extinction. Harvesting of eggs reduces the chance that recruitment will replace the reduced breeding population.

Environmental Baseline

Status of the species within the action area-Mariana swiftlet
A nest/roost cave on Ritidian Point was previously used by Mariana swiftlets, but this cave was abandoned by the late 1970s (USFWS 1991, p. 9). The reason for the abandonment is unknown, but is likely related to human disturbance or predation, since negative effects from pesticides and disease are not supported by available data (USFWS 1991, p. 18-22; Grue 1985, p. 301; Savidge 1986, p. 9). The Mariana swiftlet currently occurs in three known caves on Guam within the Naval Munitions Site (Mahlac, Maemong, and Fachi; DON 2012, p. 8) (Figure 3). Monthly counts at the three caves fluctuate, but approximately 90 percent of the swiftlet population on Guam is thought to nest/roost within the Mahlac cave (DON 2012, p. 8). In 2014, the average number of swiftlets was 1203 ± 120 at Mahlac, 226 ± 38 at Maemong, and 64 ± 61 at Fachi

(DON 2014, p. 1). The estimate of the Guam population was 1,150 birds in 2008 (Grimm 2008, p. 1), and by 2014 the estimate was 1493 ± 171 (DON 2014, p. 8).

In 2012 surveys for Mariana swiftlets were conducted in an area within the Naval Munitions Site (NMS) and a Private Lands Site (PLS) as part of the biological inventory for the Guam SEIS (DON 2013). The NMS study area is located in the northwestern portion of the NMS in the Santa Rita municipality of Guam. The PLS is located southeast of the NMS in the Talofofo municipality of Guam. No swiftlets were observed during surveys at the NMS, despite the survey stations being 1.3-2.8 mi (2.1- 4.5 km) from three known occupied swiftlet nesting caves (DON 2013, p. 17). Numerous detections of foraging swiftlets were documented during surveys within the PLS. Swiftlet observations within the PLS were 1.6- 3.1 mi (2.6- 5 km) from the three known occupied caves in the northeastern portion of the NMS (DON 2013, p. 12-15).

Status of the species within the action area-green sea turtle

Green turtles are regularly recorded in the waters around Guam (NMFS and USFWS 1998a, p. 12; Eldredge 2003, p. 653). No published estimates exist for the number of sea turtles that inhabit Guam. However, approximately 1,000 to 2,000 green turtles inhabit island reef areas in the southern island of the CNMI (Kolinski et al. 2004, pp. 98, 111). Aerial counts of all sea turtles are regularly performed twice monthly by DAWR by circumnavigating Guam's shoreline. The highest single-day count from the last two years of available data (2010-2011) was 92 turtles (DAWR, unpublished data), and DAWR staff estimate that the highest one-day counts are close to the total population of resident sea turtles (both green and hawksbill) in Guam's nearshore waters (B. Tibbatts, DAWR, pers. comm. 2015).

Although many historical nesting beaches in Guam are no longer suitable for sea turtle nesting due to onshore development and other persistent threats, green turtles continue to nest on multiple Guam beaches. A higher numbers of nests have been recorded in Guam between the months of February and July, but this correlates strongly to the number of surveys performed each month (Bonham 2014, p. 13). Therefore, green turtles can potentially nest during any month on Guam's beaches, and a peak nesting season is yet to be defined. Based on green turtle nesting data collected between 1975-2013 on Guam, about 92 total eggs were present in excavated nests that were analyzed (Bonham 2014, p. 16). Hatchling success was 87 percent and emergence success was 86 percent (Bonham 2014, p. 16). Since more frequent systematic monitoring began on the GNWR beaches in 2013, 17 green turtle nests were recorded during 2013, 4 in 2014, and 18 in 2015, as of May (GNWR 2014a, pp. 1-3; GNWR 2014b, p. 4; J. Cruce, USFWS, pers. comm. 2015). The approximately 5-km stretch of beaches at GNWR, most of which falls within the proposed SDZ, is one of the most active sea turtle nesting sites in Guam. Several crawls were recorded at Haputo Beach in 2008, and this beach has historical records of nesting (NBG 2012, p. 3).

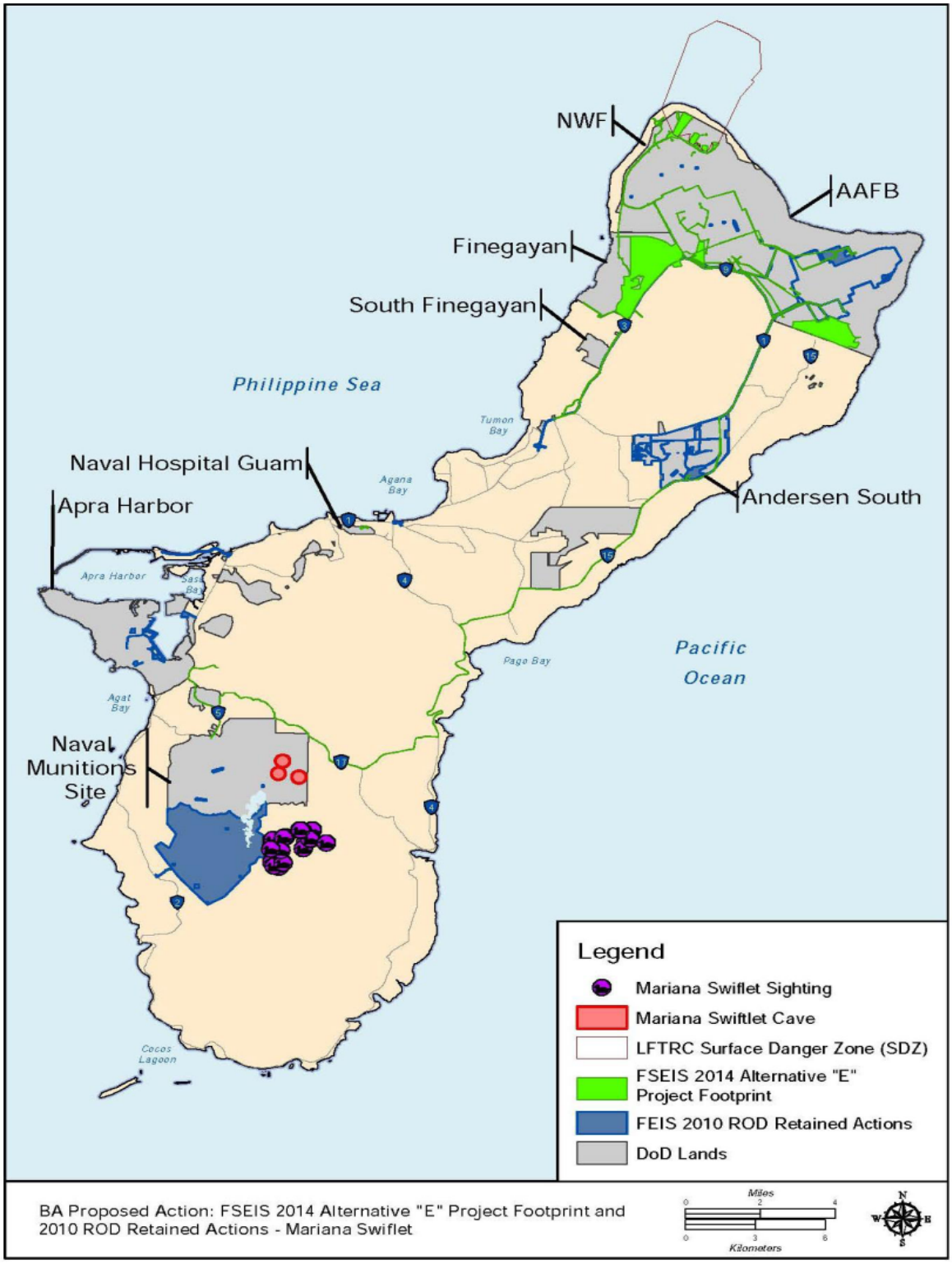


Figure 3. Mariana swiftlet locations and project footprint (DON 2014b).

Status of the species within the action area-hawksbill turtles

Hawksbill turtles are frequently sighted in the near-shore waters surrounding Guam (Grimm and Farley 2008, p. 1), although not as frequently as green turtles. Nesting data compiled by DAWR since 1975 included 15 recorded hawksbill nests in Guam. Between 1991 and 1994, hawksbill turtles nested in Sumay Marina, Guam, during varying months including October, December, February, and March (S. Wusstig, DAWR, pers. comm. 2009). The most recent documented hawksbill turtle nest was in 2009 (Bonham 2014, p. 15). Although not documented in recent years, it is possible that hawksbill sea turtles could nest at Ritidian or other historical nesting beaches on DoD property, Haputo, Double Reef, Tarague, Spanish Steps, or Dadi, if favorable nesting conditions are maintained there.

Effects of the Action

Mariana swiftlet

On Guam, all three of the caves currently occupied by Mariana swiftlets are located within the Naval Base Guam's NMS, and none of the project's ground activities will occur within or near the swiftlet caves located at the NMS. However, new aviation training flight paths are proposed over the Talofofo River watershed, the primary foraging area for swiftlets on Guam, and over the NMS area. Flights may also occur over the Ugum River watershed that supports swiftlet foraging near the mouth of the river. Foraging by most members of the swift family is likely limited to 328 ft (100 m) above the tree canopy because of the reduction in insect prey above that level (Chantler and Driessens 1995, p. 20). Tree canopy height plus 328 ft (100 m) is expected to be well below 1,000 ft (305 m) above ground level, thereby reducing risk of bird/wildlife aircraft strike hazard, but noise generated by the aircraft may still affect swiftlet foraging behavior, as has been documented in other species (refer to General Effects section of the Biological Opinion, USFWS 2015).

Mariana swiftlets on Guam are known to forage within 3.1 miles (5 km) of their nest/roost caves (DON 2013, p. 12), but it is not known if they will forage further away from nest/roost caves as this has not been examined for this species. The proposed LFTRC is over 20 miles (32 km) away from the known occupied swiftlet caves. However, there is a cave on Ritidian Point that was previously used by swiftlets and abandoned in the 1970's (USFWS 1991, p. 9). In addition, suitable foraging habitat is also present at Ritidian Point and seasonal insect blooms could attract swiftlets to Ritidian Point. Live fire within the LFTRC could preclude reoccupation of the Ritidian cave by swiftlets due to noise disturbance; however, we do not currently have enough information on swiftlet behavior to know if this would occur.

As stated above, conservation measures included in the project description that will avoid and minimize effects to Mariana swiftlets include:

1. The DoD will maintain 328-ft (100-m) no training buffers around the known Mariana swiftlet nesting caves (e.g., Mahlac Cave, Fachi Cave, Maemong Cave) in the Naval Munitions Site.
2. To avoid noise impacts and bird/wildlife aircraft strike hazard risks, all aviation training will be conducted such that flights approach the southern portion of the Naval Munitions

Site over the Talofofo River watershed and Fena Reservoir at heights of 1,000 ft (305 m) or greater above ground level. Flights may go up the Ugum River at altitudes of 1,000 ft (305 m) or greater above ground level until they reach 9,843 ft (3,000 m) from the mouth of the river at Highway 4 and then low-level terrain flights may begin. Otherwise, low-level training flights (DON 2010, p. 54) will be restricted to the southernmost portion of the Naval Munitions Site (DON 2010, p. 35) where swiftlets are not commonly present.

Adverse effects to Mariana swiftlets that nest and shelter in the caves are not expected. If construction noise, noise from aircraft overflights, or noise from the LFTRC disturbs foraging swiftlets, they would likely avoid the disturbance and forage elsewhere. There have been no reports of aircraft striking Mariana swiftlets on Guam. Conservation measures included in the project description, such as invasive species control and habitat restoration, may benefit the Mariana swiftlet. Overall, effects from the proposed action to the Mariana swiftlet are expected to be discountable.

Green and hawksbill sea turtles

The proposed action would result in the increase of recreational use at nesting beaches, increase in light pollution at nesting beaches, create noise disturbance from the operation of the LFTRC, and potentially hinder data collection by biologists on nesting beaches because of limited access to nesting beaches at the GNWR. To minimize impacts to sea turtles from recreational beach users, DON proposes to continue an education and outreach program about sea turtles and to use hooded lights to the maximum extent practicable. Educational outreach described in the proposed action is comprised of creating posters, brochures, and elementary school booklets that are distributed to local dive shops. Tarague Beach on AAFB and the Spanish Steps beach on NBG continue to have multiple sea turtle nests recorded annually, and nesting is possible at a number of other beaches on DOD property. These nesting beaches are open to personnel with access and are expected to experience an increase in recreational activities as a result of personnel moving to Guam through the proposed action. Educating beach users can minimize harmful activities associated with increased recreation like artificial lights or fires at night or bringing pets to nesting beaches. As mentioned above, darkness is important on nesting beaches as artificial lights can interfere with the ability of hatchlings to orient themselves. The use of hooded lights to the maximum extent practicable will help minimize artificial lighting and maintain conditions suitable for nesting on beaches. DON is also proposing to implement biosecurity measures and the development of a HACCP as best practice measures, which will minimize the likelihood of spreading invasive species that can harm nests and hatchlings such as biting ants and plants that are can root quickly and penetrate nests.

Although the SDZ will be monitored from observation towers, ground patrols would also be conducted on the nesting beach prior to the operations of the LFTRC, which will operate daily up to 39 weeks per year. As part of the RSS training package, personnel would be directed to not interact with sea turtles and report all sightings to the Service and coordinate with the GNWR on surveys at the Refuge (see Conservation Measures). The limited amount of time spent on beach edge closest to the road for the survey of the water portion of the SDZ, combined with implementing RSS training for sea turtles and coordination with the GNWR on presence of

nesting sea turtles at Refuge will minimize the likelihood of disturbance to nesting sea turtles and hatchlings by RSS personnel.

Currently, GNWR staff survey beaches at least weekly. Monitoring needs to be at least this frequent to facilitate nest excavations and to track important biological information on nesting sea turtles. Frequent monitoring is also important because evidence of crawls and nests weather away as time passes. Therefore, it is crucial that regular monitoring is coordinated between RSS and GNWR staff. As mentioned above, a "nesting season" is still largely speculative on Guam, and continued frequent monitoring can help researchers and managers determine these temporal patterns with more certainty. Further, this information will enable conservation and management by being able to accurately track the status of nesting females in the region, be able to detect declines, and respond with appropriate management actions. The operation of the LFTRC may limit regular access to beaches within the SDZ for up to 39 weeks a year. However, because GNWR will be coordinating scheduling of nesting surveys with the RSS, monitoring should be able to still occur with some regularity.

Nesting sea turtles may be exposed to noise disturbance from the operation of the LFTRC. The beach areas at GNWR may receive peak noise levels from the LFTRC of up to about 100 dB and average day-night level values between 65-74 dB (USFWS 2015). It is difficult to predict how this noise would affect nesting behavior. Sea turtles have ears that are well adapted to perceiving in-water noise, but they are poor receptors of aerial sounds (Hetherington 2008, p. 197). For aerial sounds, green turtles can only detect a limited frequency range (200-700 Hz), with best sensitivity at the low tone region of about 300-400 Hz (Ridgeway et al. 1969, p. 888). Large-caliber guns, like the ones proposed for use in the LFTRC tend to give off low-frequency sounds (16-100Hz) while small-caliber weapons can range between 150-2,500 Hz (Ylikoski et al. 1995, p. 3). Several studies have investigated behavioral responses of sea turtles when exposed to underwater noises such as airguns. In one study, green and loggerhead turtles (*Caretta caretta*) grew agitated when exposed to seismic airgun noise exceeding 166 dB at 1m (McCauley et al. 2000, p. 699), and sea turtles observed in the wild near airguns behaved in a startled way, usually by rapidly diving (DeRuiter and Doukara 2010, p. 1726). Based on the available literature, there are no data that indicates that proposed noise levels and frequency range of the weapons at LFTRC would have adverse effects on nesting sea turtles. Although turtles would be exposed to noise disturbance from the LFTRC, it is unlikely that sea turtles will be deterred from nesting on the beaches at the GNWR.

Because of the conservation measures detailed in the project description, including the use of hooded lights, an educational outreach program, and frequent monitoring, adverse effects to green and hawksbill sea turtles that nest on the beaches in the action area are not expected. Therefore, the effects from the proposed action to green and hawksbill turtles are expected to be discountable.

Conclusion

Based on the above information, including the proposed conservation measures, and our analysis, we concur with your determination that the proposed project may affect, but is not likely to adversely affect the Mariana swiftlet, green turtle, and hawksbill turtle. Unless the project description changes or new information reveals that the effects of the proposed action may affect listed species in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed action, no further action pursuant to section 7 of the ESA is necessary.

Although conservation recommendations are not typically included in informal consultations, we ask that you consider the following measures to further prevent disturbance to nesting females, their nests, and emerging hatchlings on beaches.

Conservation Recommendations

- Avoid the use of artificial lighting at or near nesting turtle beaches. However, if lighting is used, use of hooded lights near or on nesting turtle beaches should be a requirement.
- Personnel should refrain from smoking while on nesting beaches to prevent deterring nesting females, as they can be sensitive to scent (J. Cruce, USFWS, pers. comm. 2015).
- If personnel encounter a nesting sea turtle or hatchlings, every possible measure will be taken to leave them alone. Personnel should keep at least a 5-meter distance from any individual turtle onshore, and any lights should be directed away and turned off.
- Personnel should keep beaches free from litter and debri, which can tangle nesting females and impede hatchlings.

We appreciate your efforts to protect listed species. If you have questions regarding this consultation or questions concerning the Mariana swiftlet, please contact Fish and Wildlife Biologist, Leilani Takano (phone: 671-989-6745). If you have questions regarding nesting sea turtles, please contact Ann Marie Gawel, Fish and Wildlife Biologist (phone: 671-989-6746).

Sincerely,

Kristi Young
Acting Field Supervisor

cc:
Celestino Aguon, Guam Department of Agriculture, DAWR
Laura Beauregard, Guam National Wildlife Refuge
Mark Bonsavage, Joint Region Marianas, Guam

Literature Cited

Bell, I. 2012. Algivory in hawksbill turtles: *Eretmochelys imbricata* food selection within a foraging area on the Northern Great Barrier Reef. Marine Ecology 34(1): 43-55.

Bonham, K. 2014. Draft Guam Sea Turtle Recovery Program: Sea turtle nest monitoring and stranding reports from 1975 to 2013. Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. 28 pp.

Brindock, K. M. 2012. Brown treesnake activity at a swiftlet occupied cave on Naval Base Guam. U.S. Navy, NAVFAC Marianas Environmental, Guam. 8 pp.

Brown Tree Snake Technical Working Group (BTS TWG). 2015. Draft Brown Treesnake Strategic Plan. Honolulu, Hawaii. 75 pp.

Chantler, P. and G. Driessens. 1995. Swifts: A guide to the swifts and treeswifts of the world. Pica Press, UK.

Commonwealth of the Northern Mariana Islands (CNMI) Division of Fish and Wildlife (DFW). 2011. CNMI Wildlife Restoration Annual Report FY 2010. Division of Fish and Wildlife, Department of Lands and Natural Resources. Saipan, MP. 80 pp.

Corliss, L.A., J.I. Richardson, C. Ryder, and R. Bell. 1989. The hawksbill of Jumby Bay, Antigua, West Indies Pages 33-35 *in* Proc. Ninth Annual Workshop on Sea Turtle Conservation and Biology. NOAA Tech. Memo. NMFS-SEFC-232.

Cruz, J. B., S. R. Kremer, G. Martin, L. L. Williams, and V. A. Camacho. 2008. Relative abundance and distribution of Mariana swiftlets (Aves: Apodidae) in the Northern Mariana Islands. Pacific Science 62: 233-246.

[DOI] Department of Interior. 1970. Conservation of Endangered Species and Other Fish and Wildlife. Federal Register 35: 8491-8498.

Diamond, J. M. 1984. Possible effect of unrestricted pesticide use on tropical birds. Nature 310: 452.

[DON] Department of Navy. 2010. Final Environmental Impact Statement for the Guam and Tinian Military Relocation, Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force. July 2010.

___. 2011. Naval Facilities Engineering Command (NAVFAC). Final Guam Landscaping Guidelines. June 2011. Honolulu, Hawaii. 26 pp.

___. 2012. Mariana swiftlet monitoring, Naval Base Guam, October 2012. 9 pp.

___. 2013. Report 1 Mariana Fruit Bat And Mariana Swiftlet Survey for Various Locations on Guam in Support of the Guam and Commonwealth of the Northern Mariana Islands Military Relocation (2012 Roadmap Adjustments) Supplemental Environmental Impact Statement. 86 pp.

___. 2014a. Biological assessment for the re-initiation of consultation regarding the proposed military relocation to Guam. Naval Facilities Engineering Command. 163pp.

___. 2014b. Draft Supplemental Environmental Impact Statement for the Guam and CNMI Military Relocation (2012 Roadmap Adjustments).

___. 2014c. Mariana swiftlet monitoring, Naval Base Guam, October 2014. 8 pp.

___. 2015a. Addendum to the biological assessment for the reinitiation of consultation regarding the proposed military relocation to Guam. Naval Facilities Engineering Command. 28 pp.

___. 2015b. Regional biosecurity plan for Micronesian and Hawaii.

DeRuiter, S.L. and K.L. Doukara. 2010. Loggerhead turtles dive in response to airgun sound exposure. J. Acoust. Soc. Am. 127(3): 1726.

Eldredge, L.G. 2003. The marine reptiles and mammals of Guam. Micronesica 35-36: 653-660.

Grimm, G. 2008. Mariana swiftlet surveys on Naval Munitions Site, Guam. Naval Facility Marianas, Guam.

Grue, C. E. 1985. Pesticides and the decline of Guam's native birds. Nature 316: 301.

[GNWR] Guam National Wildlife Refuge. 2014a. Marine turtle surveys 2013. Unpublished report. 3 pp.

____. 2014b. 2014 Annual Report U.S. Fish and Wildlife Service Subpermit No. GNWR-7, regional Blanket Permit TE-10673-7. 37 pp.

Grimm, G. and J. Farley. 2008. Draft sea turtle nesting activity on Navy Base Guam, 2007-2008. NAVFAC Marianas Report. 7 pp.

Hetherington, T. 2008. Comparative anatomy and function of hearing in aquatic amphibians, reptiles, and birds, pp. 183-210. In: J.G.M. Thewissen and S. Nummela (eds.), Sensory Evolution on the Threshold: Adaptations in Secondarily Aquatic Vertebrates. UC Press: Berkeley.

Kershner, E. L., R. Kohley, B. Hudgens, and D. K. Garcelon. 2007. Assessment of Mariana Swiftlet (*Aerodramus bartschi*) diet and insect availability on Saipan and Rota, Mariana Islands. Institute for Wildlife Studies, Arcata, CA.

Kolinski, S.P., L. Itbus Ilo, and J.M. Manglona. 2004. Green turtles and their marine habitats at Tinian and Aguijan, with projections on resident turtle demographics in the southern arc of the Commonwealth of the Northern Mariana Islands. Micronesica 37: 97-118.

Mann, T.M. 1977. Impact of developed coastline on nesting and hatchling sea turtles in southeastern Florida. Unpublished Master of Science thesis. Florida Atlantic University, Boca Raton, Florida. 100 pp.

Maragos, J.E. 1991. Assessment and recommendations for the conservation of hawksbill turtles in the Rock Islands of Palau. Report prepared by The Nature Conservancy, Pacific Region, Honolulu, Hawaii. 26 pp.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000. Marine seismic surveys – a study of environmental implications. APPEA Journal 692-708.

[NMFS] National Marine Fisheries Service, National Oceanic and Atmospheric Administration. 1998. Designated Critical Habitat; Green and Hawksbill Sea Turtles. Federal Register 63: 46693-46701.

[NMFS and USFWS] National Marines Fisheries Service and U.S. Fish and Wildlife Service. 1978. Listing and Protecting Loggerhead Sea Turtles and Threatened Species and Populations of Green and Olive Sea Turtles as Threatened Species or Endangered Species. Federal Register 43: 32800-32811.

___. 1993. Recovery Plan for the Hawksbill Turtles in the U.S Caribbean Sea, Atlantic Ocean, and Gulf of Mexico. National Marine Fisheries Service, St. Petersburg, Florida.

___.1998a. Recovery Plan for U.S. Pacific Populations of the Green Turtle (*Chelonia mydas*). National Marine Fisheries Service, Silver Spring, MD. 95 pp.

___. 1998b. Recovery Plan for U.S. Pacific Populations of the Hawksbill Turtle (*Eretmochelys imbricata*). National Marine Fisheries Service, Silver Spring, MD. 95 pp.

___. 2007. Green Sea Turtle (*Chelonia mydas*) 5-Year Review: Summary and Evaluation. National Marines Fisheries Service, Office of Protected Resources, Silver Spring, Maryland and U.S. Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Services Field Office, Jacksonville, Florida. August 2007. 102 pp.

___. 2013. Hawksbill Sea Turtle (*Eretmochelys imbricata*) 5-Year Review: Summary and Evaluation. National Marines Fisheries Service, Office of Protected Resources, Silver Spring, Maryland and U.S. Fish and Wildlife Service, Southeast Region, Jacksonville Ecological Services Field Office, Jacksonville, Florida. June 2013. 89 pp.

___. 2015. Endangered and Threatened Species; Identification and Proposed Listing of Eleven Distinct Population Segments of Green Sea Turtles (*Chelonia mydas*) as Endangered or Threatened and Revision of Current Listings. Federal Register 80: 15271-15337.

Navy Base Guam. 2012. Sea Turtle Monitoring Naval Base Guam. 9 pp.

Reichel, J. D., C. T. Collins, D. W. Stinson, and V. A. Camacho. 2007. Growth and development of the Mariana swiftlet. Wilson Journal of Ornithology 119: 686-692.

Savidge, J. A., L. Sileo, and L. M. Siegfried. 1992. Was disease involved in the decimation of Guam's avifauna? Journal of Wildlife Diseases 28(2): 206-214.

Thomassen, H. A., R. J. den Tex, M. A. G. de Bakker, G. D. E. Povel. 2005. Phylogenetic relationships amongst swifts and swiftlets: A multi locus approach. Molecular Phylogenetics and Evolution. 37: 264-277.

[USFWS] U.S. Fish and Wildlife Service. 1982. Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Hawksbill Sea Turtle in Puerto Rico. Federal Register 47: 27295-27298.

[USFWS] U.S. Fish and Wildlife Service. 1984. Endangered and threatened wildlife and plants; Determination of endangered species status for seven birds and two bats of Guam and the Northern Mariana Islands. Federal Register 49: 33881-33885.

___. 1989. Endangered and threatened wildlife and plants. 50 CFR 17.11 & 17.12. U.S. Fish and Wildlife Service, Department of Interior, Washington, DC. 34 pp.

___. 1991. Recovery Plan for the Mariana Islands Population of the Vanikoro Swiftlet, *Aerodramus vanikorensis bartschi*. U.S. Fish and Wildlife Service, Portland, OR. 49 pp.

___. 2010a. Formal Section 7 Consultation Regarding the Joint Guam Program Office Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam and Tinian (2010-F-0122). September 8, 2010. Honolulu, Hawaii. 249 pp.

___. 2010b. Mariana swiftlet or Chachaguak (*Aerodramus bartschi*) 5-year review summary and evaluation. U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, HI. 12 pp.

___. 2015. Biological Opinon for the Re-initation of the Consultation Regarding the Proposed Military Relocation to Guam. U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, HI.

Valdez, E. W., G. J. Wiles, and T. J. O'Shea. 2011. Diets of the sympatric pacific sheath-tailed bat (*Emballonura semicaudata rotensis*) and Mariana swiftlet (*Aerodramus bartschi*) on Aguiguan, Mariana Islands. Pacific Science 65: 301-309.

Wiles, G. J., and D. H. Woodside. 1999. History and population status of Guam swiftlets on O'ahu, Hawai'i. 'Elepaio 59: 57 – 61.

Witherington, B.E. and R.E. Martin. 1996. Understanding, assessing, and resolving light pollution problems on sea turtle nesting beaches. Florida Marine Research Institute Technical Report TR-2. 73 pp.

Witzell. W.N. 1983. Synopsis of biological data on the hawksbill turtle *Eretmochelys imbricata* (Linnaeus, 1766). FAO Fisheries Synopsis No. 137. 78 pp.

Ylikoski, M., J.O. Pekkarinen, J.P. Starck, R.J. Pāākōnen, and J.S. Ylikoski. 1995. Physical characteristics of gunfire impulse noise and its attenuation by hearing protectors.

Personal Communications

Cruce, Jennifer. 2015. Biologist, Guam National Wildlife Refuge, U.S. Fish and Wildlife Service. In person meetings and phone calls to discuss sea turtles.

Tibbatts, Brent. 2015. Biologist, Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. Electronic mail correspondence April 3, 2015 through 7, 2015 regarding aerial counts of sea turtles.

Wusstig, Shawn. 2009. Biologist, Guam Department of Agriculture, Division of Aquatic and Wildlife Resources. Electronic mail correspondence May 6, 2009 through May 13, 2009, regarding nesting and movement of green sea turtles detected on or near Guam.

Q. APPENDIX B – MEMORANDUM OF AGREEMENT BETWEEN THE DEPARTMENT OF THE NAVY AND THE U.S. FISH AND WILDLIFE SERVICE REGARDING CONSERVATION OF GUAM MICRONESIAN KINGFISHER RECOVERY HABITAT IN NORTHERN GUAM

MEMORANDUM OF AGREEMENT

Between

THE DEPARTMENT OF THE NAVY
And
THE U.S. FISH AND WILDLIFE SERVICE

Regarding

CONSERVATION OF GUAM MICRONESIAN KINGFISHER RECOVERY HABITAT
In
NORTHERN GUAM

I. PARTIES

This Memorandum of Agreement (MOA) is entered into by and between the Department of the Navy (DON) and the U.S. Fish and Wildlife Service (USFWS), hereinafter referred to as "the Parties."

II. PURPOSE AND SCOPE

A. The purpose of this MOA is to ensure that:

1. A sufficient amount of suitable survival and recovery habitat (hereinafter "habitat") is conserved and managed in accordance with federal agency obligations under section 7(a) of the Endangered Species Act, 16 U.S.C. § 1536(a) in northern Guam to support the reintroduction and recovery of the Guam Micronesian kingfisher (hereinafter "kingfisher"); and

2. The DON can meet the purpose and need for the proposed action to relocate U.S. Marines to Guam (hereinafter "Guam Military Relocation") in accordance with its responsibilities under Title 10 of the U.S.C.

B. The provisions of this MOA will inform the Parties' respective present and future mitigation actions and decisions under section 7(a) of the Endangered Species Act (16 U.S.C. § 1531 et seq.), including those mitigation actions and decisions under subsection 7(a)(2) currently pending regarding the DON's proposed relocation of U.S. Marines to Guam as discussed in paragraph.IV.E below.

III. AUTHORITY

A. Section 7(a) of the Endangered Species Act (ESA), 16 U.S.C. § 1536(a)

B. Section 101 of the Sikes Act, 16 U.S.C. § 670a (as amended)

C. Title 10 U.S.C. § 5063

D. This MOA neither modifies existing agency authorities nor reduces, expands, or transfers any of the respective statutory or regulatory authorities and responsibilities of the Parties.

IV. BACKGROUND

A. Private and public development on Guam has reduced the amount of potentially available habitat for the kingfisher to a point where it has created uncertainty regarding whether there will be a sufficient amount habitat preserved for the future reintroduction and ultimate recovery of the kingfisher on Guam which supports the entire native range of the species.

B. The endangered kingfisher is currently extirpated on Guam. The USFWS has depicted "survival and recovery habitat" for the kingfisher on Guam in Figure 1 (hereinafter "kingfisher habitat"). The Parties agree that conservation of habitat of sufficient quality and quantity to support the reintroduction and ultimate recovery of the endangered kingfisher is needed on Guam.

C. The Parties have a responsibility under the ESA to conserve and protect endangered species.

D. The USFWS currently estimates that approximately 11,512 acres of habitat for the kingfisher is needed across all of northern Guam to support its survival and recovery in the wild. The USFWS has identified approximately 14,997 acres of potential kingfisher habitat in northern Guam, of which approximately 10,742 acres are located on lands currently under the custody and control of the Department of Defense (DoD) (Figure 1). The USFWS estimates that 8,178 acres of these 10,742 acres need to be conserved in northern Guam to provide reasonable certainty that sufficient habitat for the species will remain available for reintroduction and recovery of the kingfisher. The Parties further agree that lands in northern Guam not currently under the custody and control of DoD are also required to support the reintroduction and ultimate survival of the kingfisher in the wild.

E. The DON is proposing to relocate approximately 5,000 Marines as part of the Guam Military Relocation. This proposal is central to the U.S. Government's rebalancing of forces in the Pacific. The purpose and need for the proposed action is to ensure that the relocated Marines are organized, trained, and equipped as mandated in section 5063 of Title 10 of the U.S.C., to satisfy individual live-fire training requirements, and to establish an operational U.S. Marine Corps (USMC) presence in Guam in

accordance with April 2012 adjustments to the May 2006 United States-Japan Roadmap for Realignment Implementation.

F. The Guam Military Relocation would result in the clearing of approximately 1,015 acres of kingfisher habitat in northern Guam on lands currently under the custody and control of DoD. In addition, the USFWS estimates that an additional 319 acres will be indirectly impacted by the proposed action thereby resulting in a total impact to kingfisher habitat of approximately 1,334 acres in northern Guam.

V. GENERAL PROVISIONS

A. The USFWS has determined that approximately 8,178 total acres are required on lands currently under the custody and control of DoD in northern Guam to provide sufficient habitat for the reintroduction and eventual recovery of the kingfisher (Figure 2). To facilitate kingfisher conservation goals, the DON agrees to designate approximately 5,234 acres under the custody and control of the DoD in northern Guam as identified on Figure 3, to a status that will provide durable habitat protection needed to support native habitat restoration and land management for the survival and recovery of the kingfisher. These 5,234 acres have been identified by the USFWS as habitat for the kingfisher and needed to offset impacts of the Guam Military Relocation. The Parties recognize that the designation of the 5,234 acres under this paragraph may also provide a conservation benefit to other Federally-listed species with similar habitat requirements (e.g. Mariana crow, Mariana fruit bat).

B. Consistent with the Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP) developed in accordance with section 101 of the Sikes Act, the DON agrees to actively restore native habitat and manage, in collaboration with the USFWS, the 5,234 acres identified in Figure 3 consistent with DoD's obligations under the 7(a) of the ESA and the Sikes Act to benefit the survival and recovery of the kingfisher. The DON will work cooperatively with the USFWS to identify, develop and implement specific management activities and projects on these 5,234 acres to support the following: 1) brown treesnake (BTS) control and suppression to facilitate the larger goal of suppressing snake population levels that will ultimately support kingfisher survival and recovery; 2) support for BTS control and eradication methods development, focusing on tools and techniques needed for landscape level survival and recovery of the kingfisher, 3) ungulate fencing and eradication; 4) control of small mammalian predators; 5) invasive plant control and eradication; 6) native plant restoration; and, 7) localized control of introduced invertebrates that may negatively impact kingfisher nesting/fledging. The DON has funded and initiated a number of projects to support the seven focal activities identified above. The DON agrees to continue these activities with items (2) and (3) prioritized for continued funding.

C. The JRM INRMP will be completed by DON within 365 days of signing of the MOA. This timeline is contingent upon the USFWS providing its specific concerns with the 2013 draft INRMP to the DON within 45 days of the signing of this MOA. Any delay by the USFWS in providing comments to the DON will result in a corresponding

extension of this 365-day time period. In accordance with the Sikes Act, the DON will coordinate with the USFWS on specific INRMP projects and goals. Such coordination will include, but is not limited to, the annual INRMP review.

D. Recognizing the importance of DoD's mission in northern Guam, within 120 days of the signing of the Record of Decision (ROD) for the Guam Military Relocation, the DON may, in collaboration with the USFWS, identify an alternative configuration for the 5,234 acres of habitat identified in Figure 3 as necessary to enable the DoD to meet its national defense requirements. While the DON anticipates that the 5,234 acres identified in Figure 3 will enable DoD to meet its requirements, DoD must conduct a thorough assessment to ensure current and future military requirements are appropriately considered. The revised map (acreage) must total at least 5,234 acres and be derived from areas identified in Figure 2 and provide contiguous landscape and connected forested habitat corridors. If an alternative configuration is not defined within 120 days of the signing of the ROD, the Parties agree to default to the acreage identified in Figure 3.

E. DON will provide durable habitat protection for the 5,234 acres identified in Figure 3 or as modified in subparagraph V.D. However, should an emerging national defense requirement dictate that some of the aforementioned 5,234 acres be cleared or otherwise made unsuitable for kingfisher survival and recovery, in coordination with the USFWS, the DON will identify and substitute habitat of equal or greater quality, as determined by the USFWS, to replace the impacted habitat. If habitat of equal or greater quality cannot be identified, then additional acreage suitable for kingfisher survival and recovery will be placed in durable protection to offset the loss of higher quality habitat. The amount of habitat will be determined based on the kingfisher mitigation framework developed using the best available information at that time. The Parties recognize that any substituted habitat must provide contiguous landscape and connected forest habitat corridors. The DON commits to rigorously exploring other alternatives to support an emerging national defense requirement and will only use lands within the 5,234 acres to meet the requirement if absolutely necessary.

F. For the land identified on Figure 3 (or as amended via the process described in subparagraph V.D of this MOA), the USFWS requires enhanced management activity to ensure this habitat supports reintroduction of the kingfisher. Accordingly, starting in Fiscal Year (FY) 2016, the DON commits to provide an additional $2 million per year of funding above execution year INRMP funding levels (as adjusted for inflation) for the next ten years, subject to Congressional authorization and appropriation. This additional funding will be used to support projects that fall within one of the seven focal activities identified under subparagraph V.B of this MOA, according to priorities established jointly by DON and the USFWS. Upon expiration of this ten-year period (FY 2026), the Parties mutually agree to reassess progress of recovery efforts. If, following this assessment, the USFWS determines that it remains possible to recover the kingfisher on Guam, the DON commits to extend the additional $2 million per year in funding for another five years. Subsequently, the Parties will reassess the progress of recovery efforts every five years. So long as the USFWS determines that it remains

possible to recover the kingfisher on Guam, and until the kingfisher is delisted, every five years the DON and USFWS will identify activities and a schedule of implementation that the USFWS determines are sufficient to conserve and enhance the habitat needed to support the survival and recovery of the kingfisher on these 5,234 acres. The DON will implement these activities, dedicating $2 million annually in accordance with the JRM INRMP. The Parties recognize that the level of funding may vary depending on the activities to be implemented in a given year, but will not exceed $2 million annually. The Parties may also subsequently modify, as necessary, the focal activities identified in subparagraph V.B of this MOA to be implemented on the 5,234 acres.

G. If the provisions of subparagraphs V.A to F of this MOA are not implemented as described herein, barring mutual agreement by the Parties, the Guam Military Relocation section 7 ESA consultation will require re-initiation. In addition, nothing in this MOA is intended to affect the responsibility of the USFWS and DON to re-initiate consultations pursuant to 50 CFR § 402.16, or the re-initiation regulation then applicable.

H. If new scientific information indicates the amount or extent of habitat needed for the survival and recovery of the kingfisher is different than identified herein, as determined by the USFWS, the Parties will revise this MOA in accordance with paragraph VI of this MOA.

I. The DON will maintain management authority on kingfisher habitat on Guam under the custody and control of DoD unless DoD transfers management authority to another military service, in which case the responsibilities under this MOA that apply to DON shall transfer to the military service that assumes land management authority.

J. In accordance with established security procedures to grant access to military facilities, USFWS staff shall be provided reasonable access to kingfisher habitat identified on lands under the custody and control of the DoD. DON commits to working with the USFWS to help streamline the security approval process.

VI. MODIFICATIONS, INTERPRETATIONS, ENFORCEABILITY AND TERMINATION

A. Changes and/or modifications to this MOA may be made at any time upon mutual written consent of the Parties. With regard to both Parties, no oral statement by any person and no written statement by anyone other than the undersigned, or an authorized representative as designated in writing, shall be interpreted as modifying or otherwise affecting the terms of this MOA.

B. This MOA shall be deemed null and void in its entirety if any one of the following events occurs: 1) Both Parties revoke the agreement in writing; 2) the DON does not sign a ROD with the currently identified preferred alternative in the Final Biological Assessment regarding the DON's proposed Guam Military Relocation as discussed in

paragraph IV.E of this MOA; or 3) the USFWS determines that the kingfisher is no longer viable for reintroduction on Guam.

C. The Parties understand and agree that performance by the DON of any of the terms of this MOA is subject to the availability of appropriated funds. Nothing herein shall constitute nor be considered to constitute an obligation or expenditure of funds in advance of or in excess of a proper appropriation by the Congress of the United States or otherwise be in violation of the Anti-Deficiency Act, 31 U.S.C. § 1341 et seq.

D. This MOA shall not be construed to create any private right, privilege, remedy, claim or cause of action against the Parties for or by any person or entity.

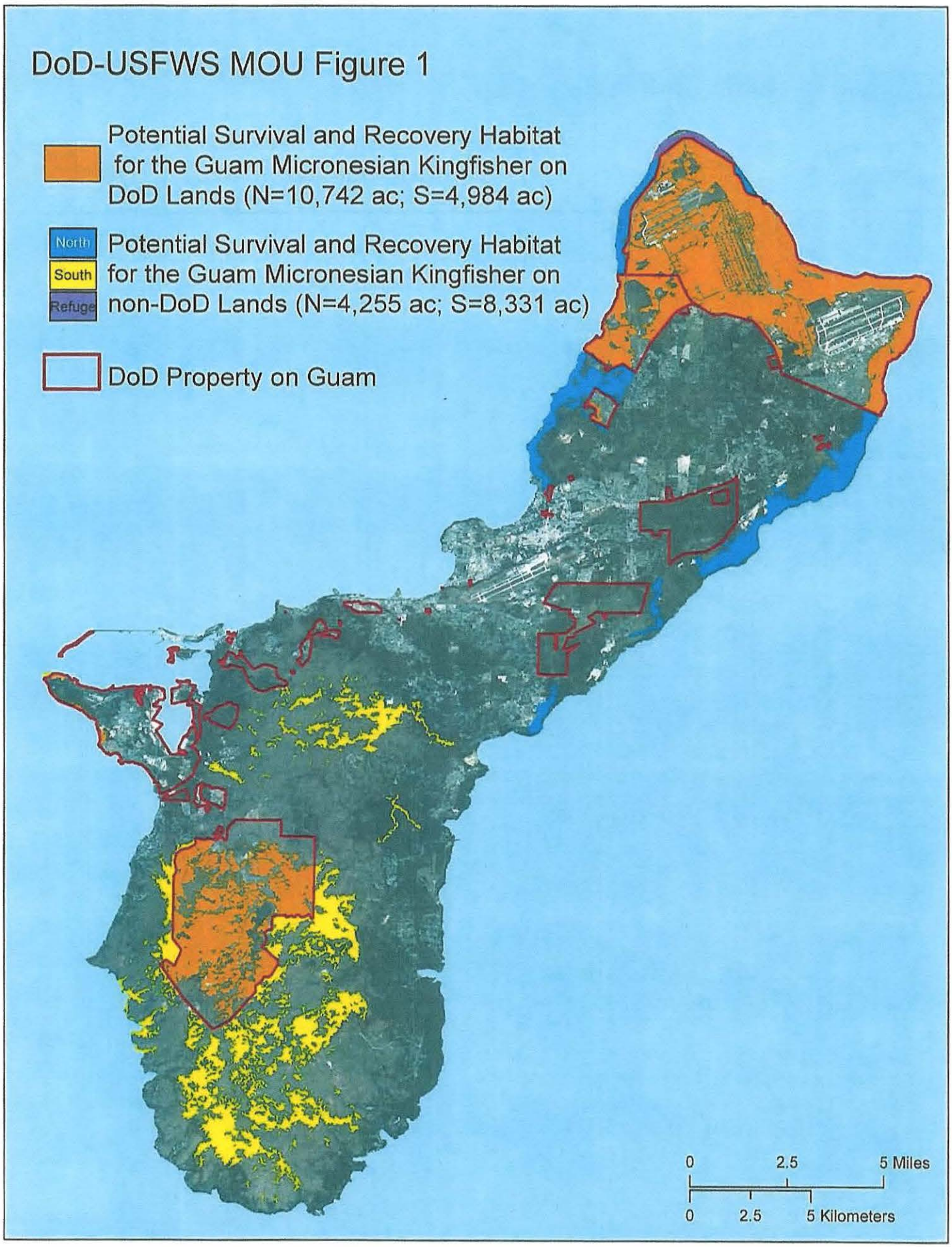
VII. RESOLUTION OF DISAGREEMENTS

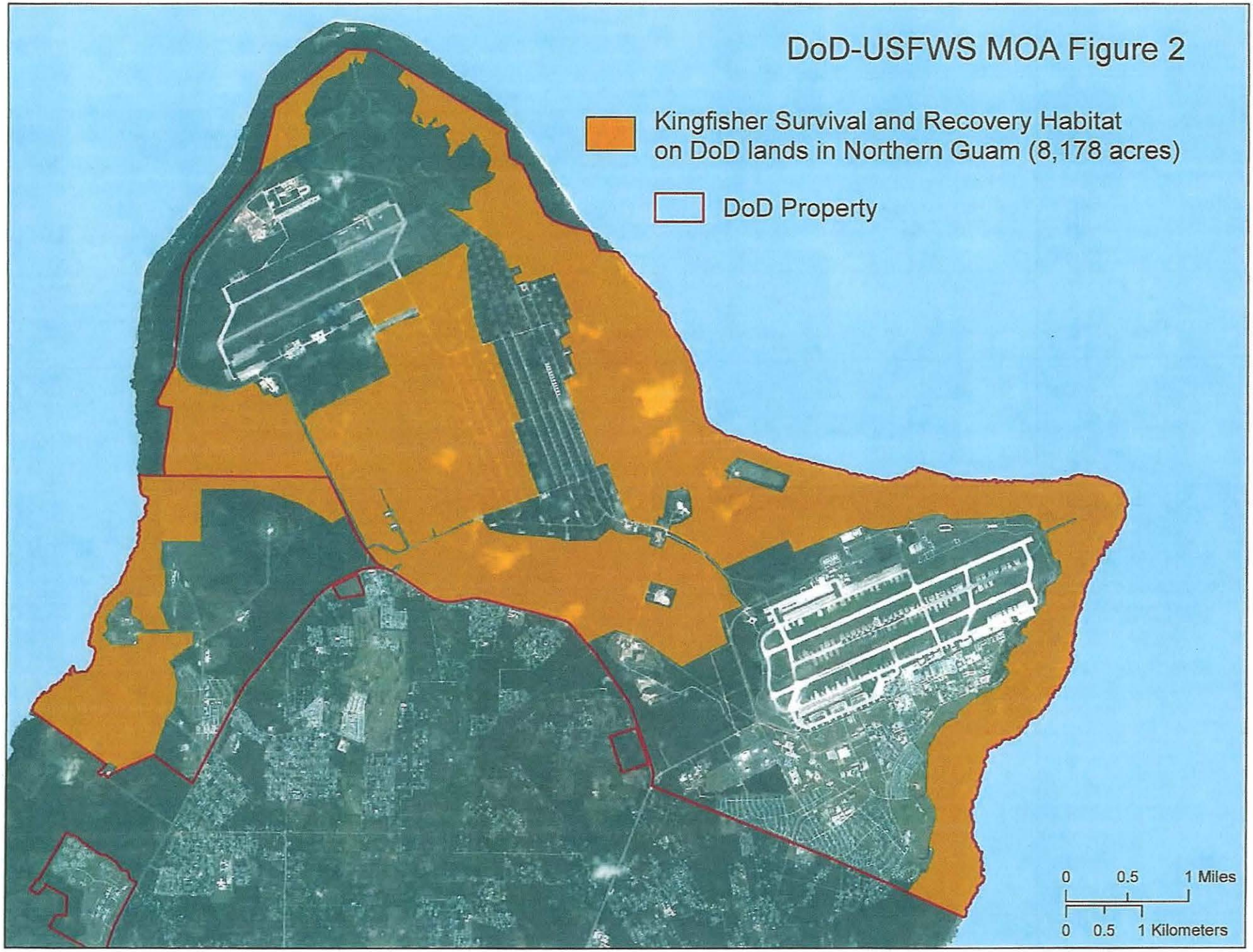
The Parties shall consult with one another to resolve issues at staff levels and elevate disputes through the respective organizational levels only if necessary. Notification of potential areas of disagreement by either agency should be in writing. If there is no resolution at the staff level, either agency may elevate the issue to the appropriate official within each agency or department.

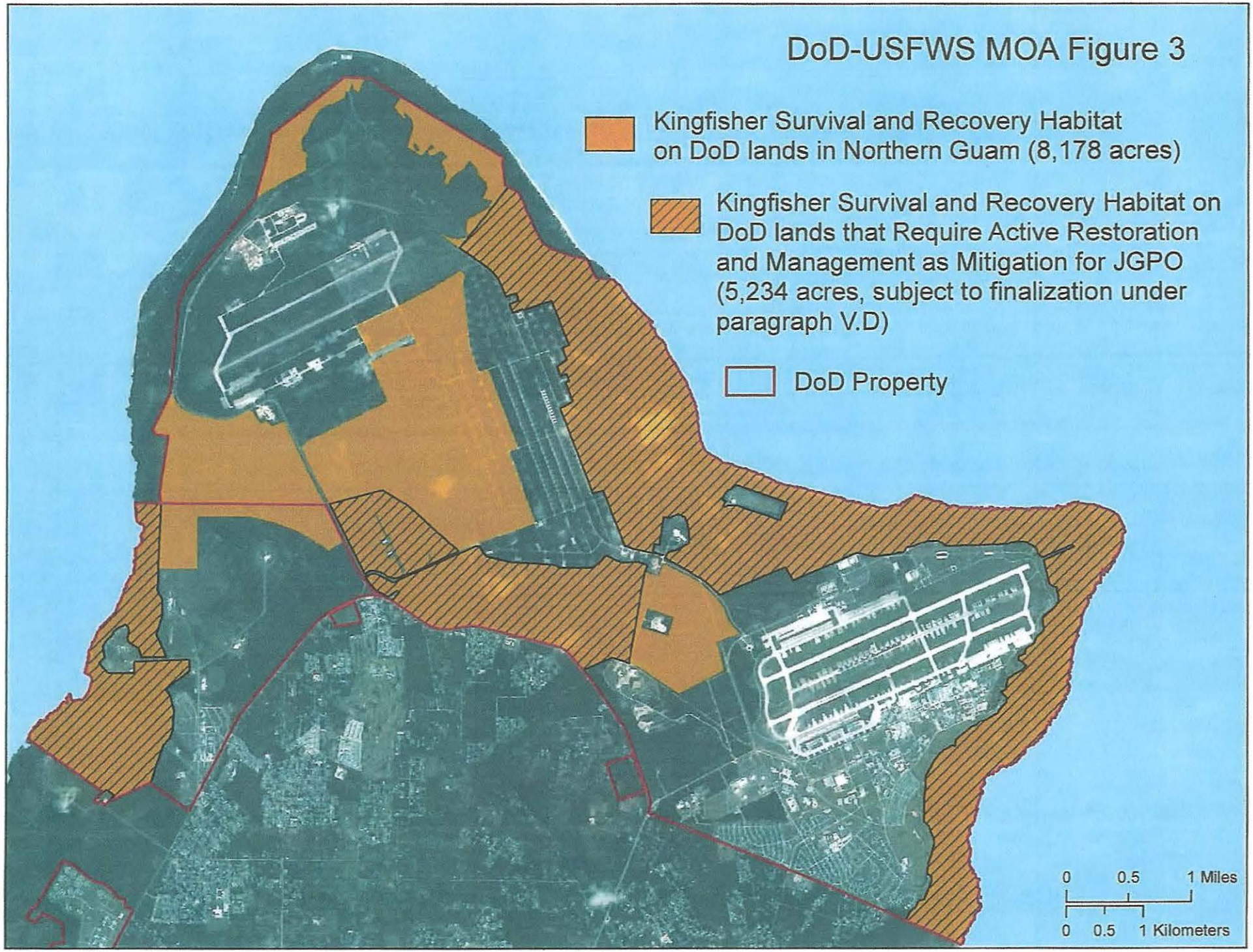
VIII. SIGNATURES

Donald R Schregardus Date: June 11, 2015
Deputy Assistant Secretary of the Navy (Environment)

Dan Ashe Date: June 11, 2015
Director, U.S. Fish and Wildlife Service


DoD-USFWS MOU Figure 1
Potential Survival and Recovery Habitat for the Guam Micronesian Kingfisher on DoD Lands (N=10,742 ac; S=4,984 ac)
North
South
Refuge
Potential Survival and Recovery Habitat for the Guam Micronesian Kingfisher on non-DoD Lands (N=4,255 ac; S=8,331 ac)
DoD Property on Guam
0
2.5
5 Miles
0
2.5
5 Kilometers


DoD-USFWS MOA Figure 2
Kingfisher Survival and Recovery Habitat on DoD lands in Northern Guam (8,178 acres)
DoD Property
0 0.5 1 Miles
0 0.5 1 Kilometers


DoD-USFWS MOA Figure 3
Kingfisher Survival and Recovery Habitat on DoD lands in Northern Guam (8,178 acres)
Kingfisher Survival and Recovery Habitat on DoD lands that Require Active Restoration and Management as Mitigation for JGPO (5,234 acres, subject to finalization under paragraph V.D)
DoD Property
0 0.5 1 Miles
0 0.5 1 Kilometers

R. APPENDIX C – FIGURES

FIGURES

Figure 1. Surface danger zone (SDZ) within the Northwest Field and Guam National Wildlife Refuge.

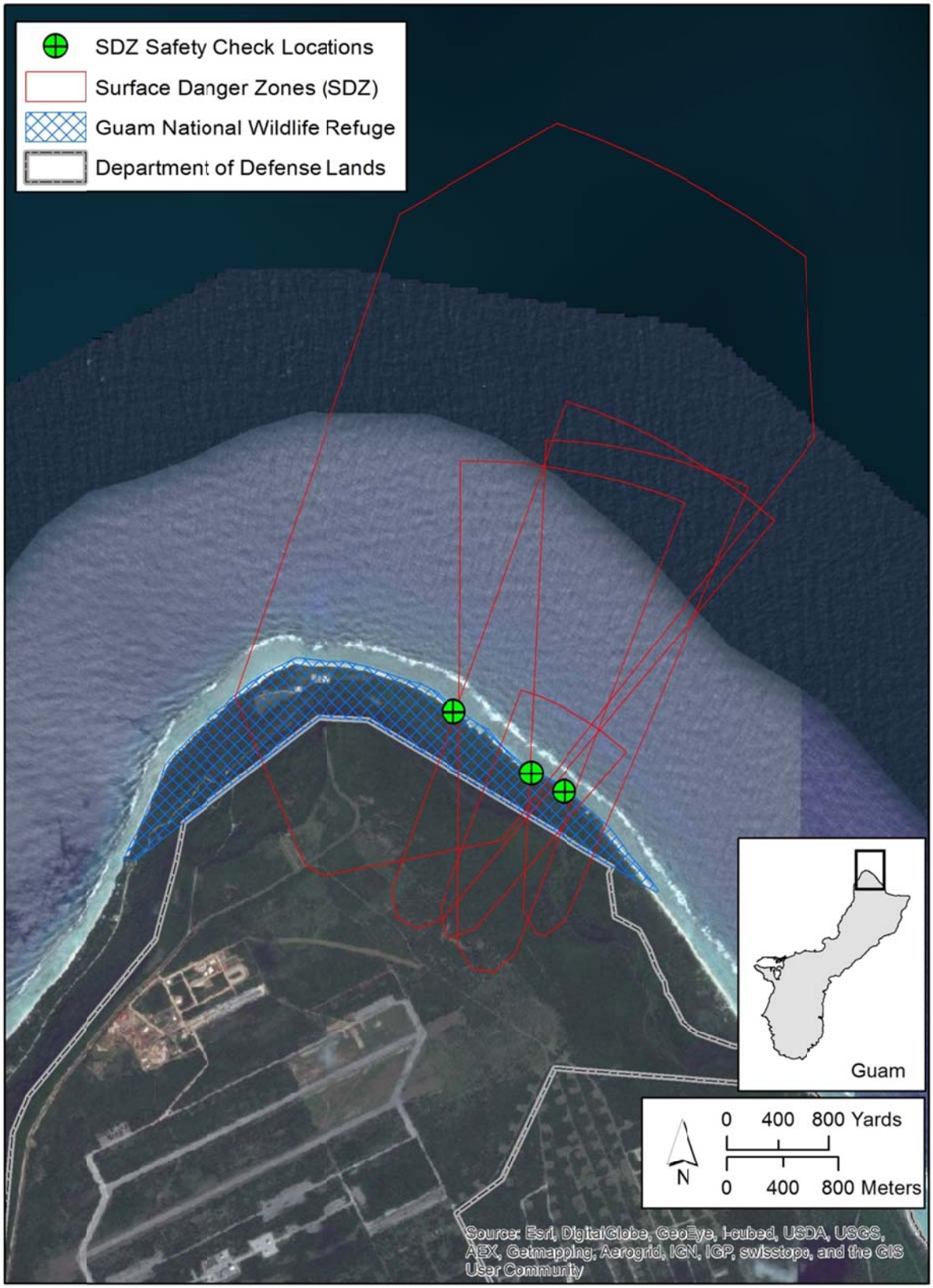


Figure 2. Well field construction sites.

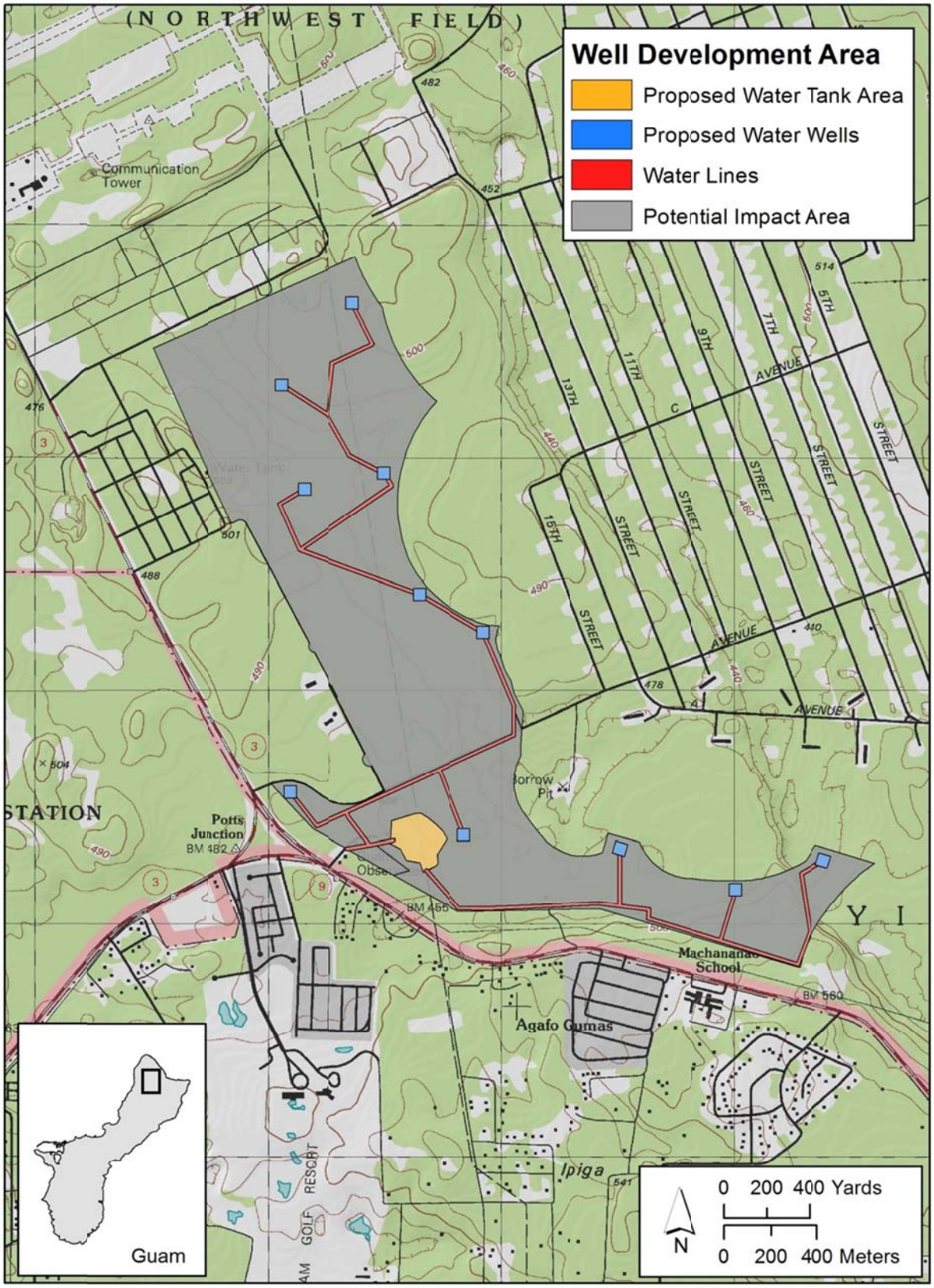


Figure 3. Forest enhancement project site and brown treesnake exclosure sites

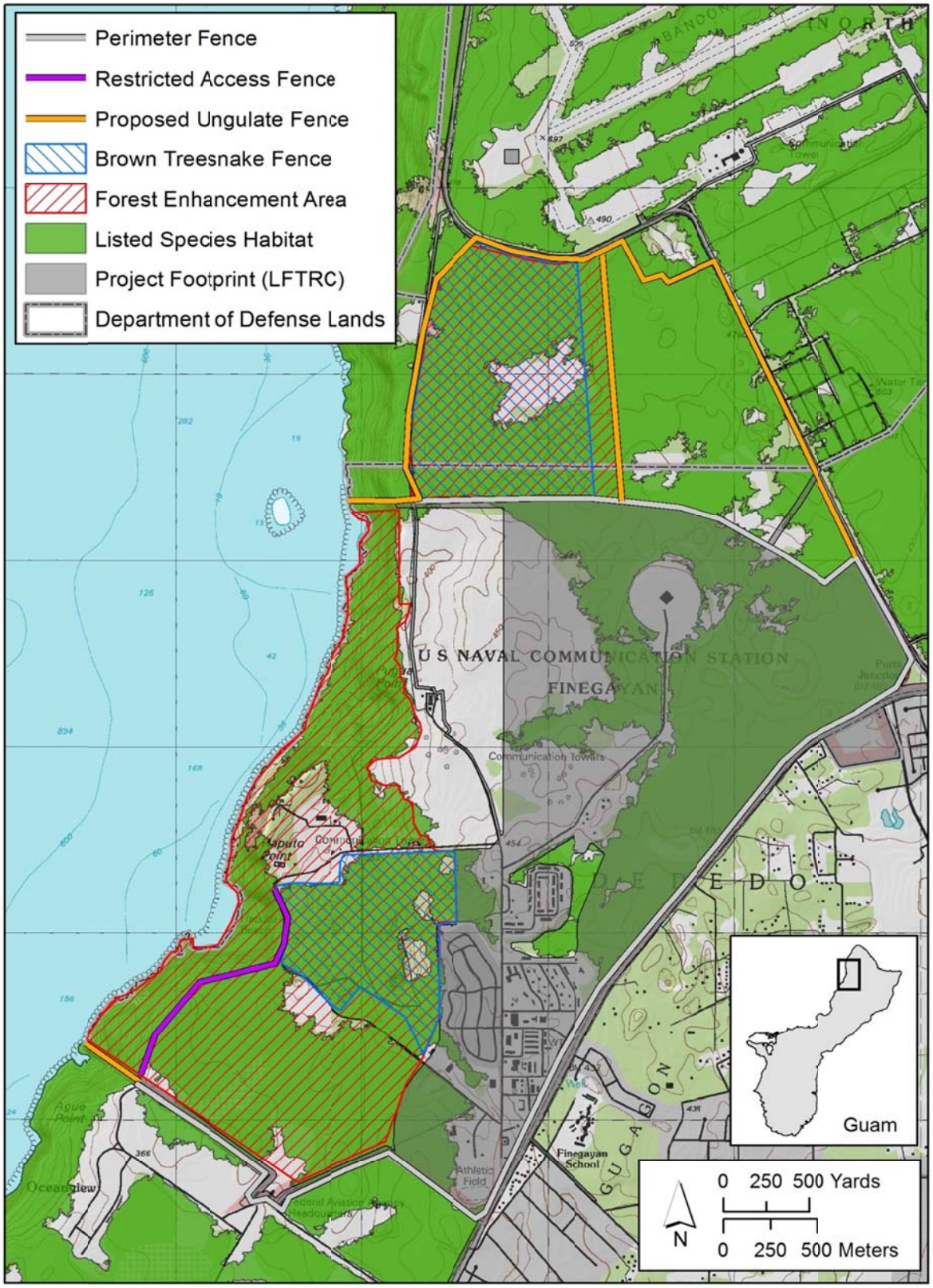


Figure 4. Action Area

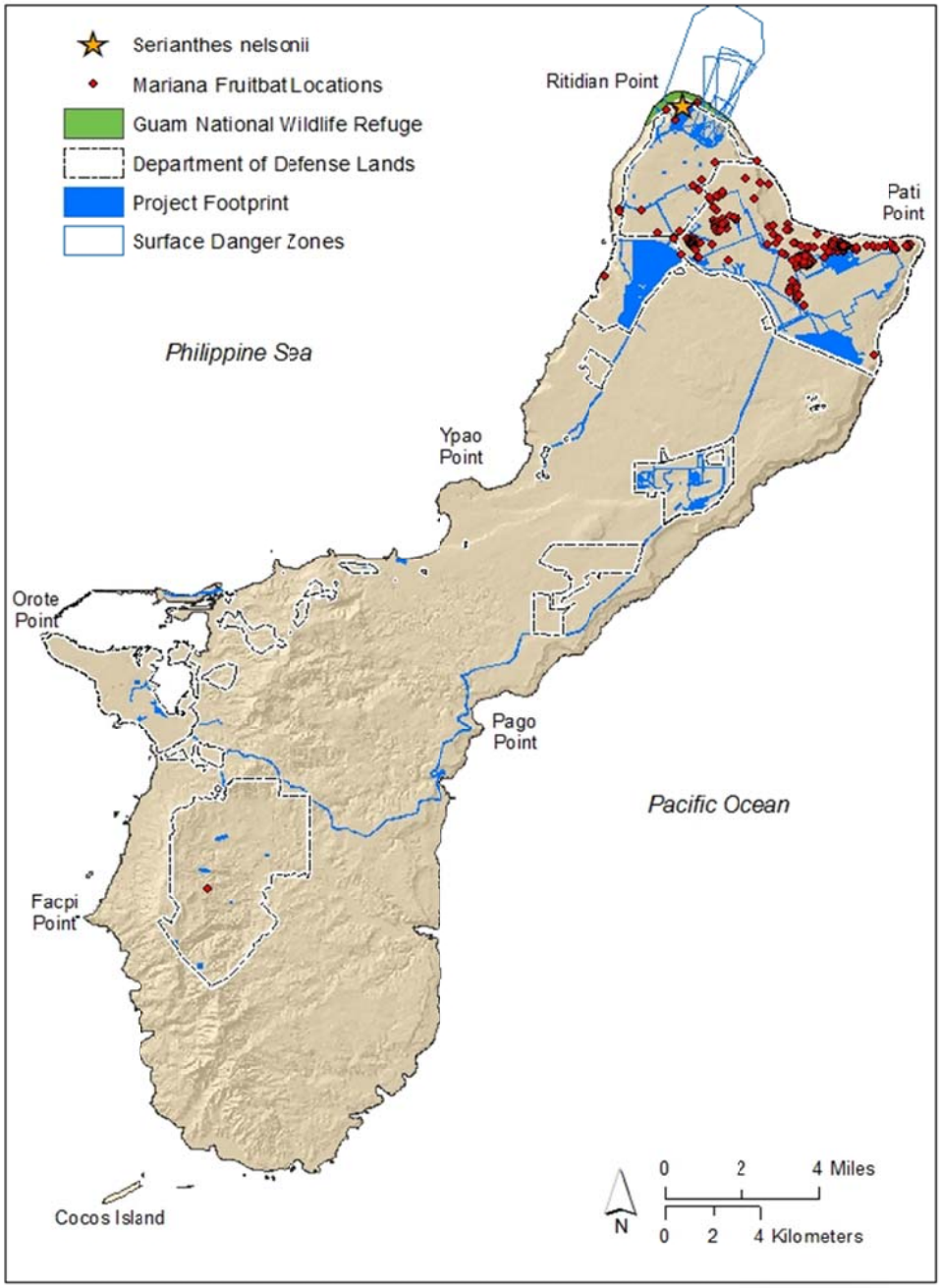


Figure 5. Direct counts of fruit bats at the historical fruit bat maternity colony at Pati Point on Andersen Air Force Base from 1984-2011 (A. Brooke, pers. comm. 2014, data compiled from survey efforts of the DON and Guam Department of Aquatic and Wildlife Resources).

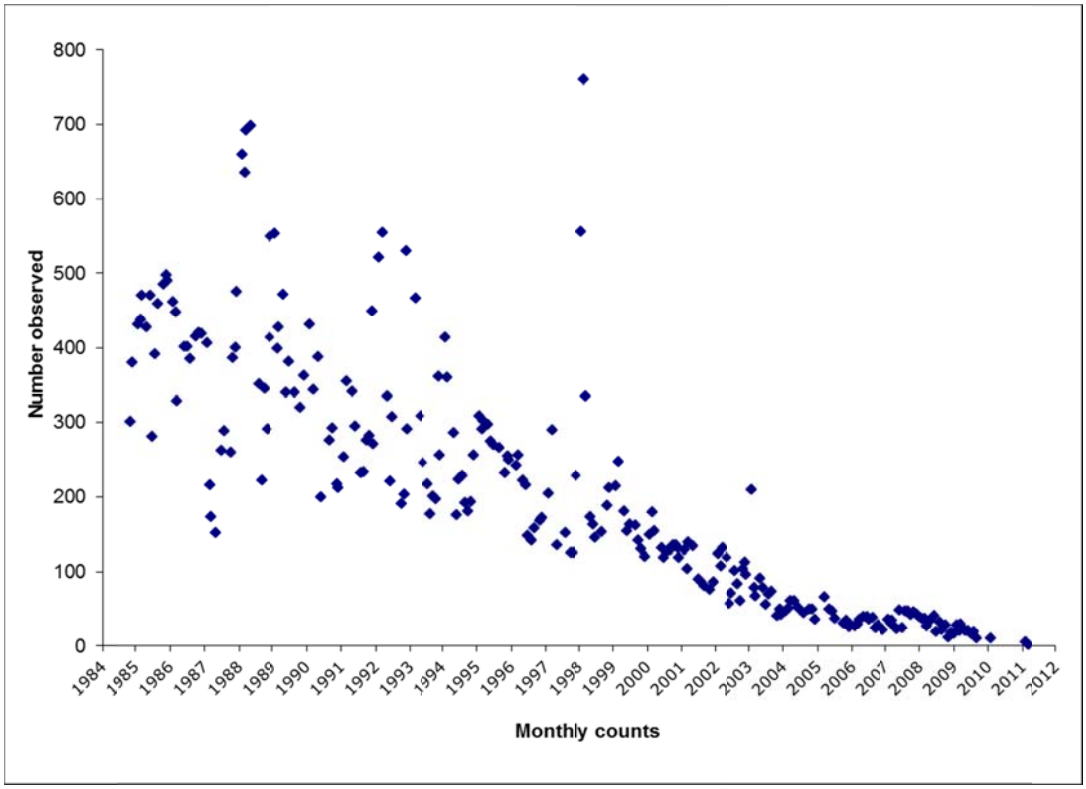


Figure 6. Guam Micronesian kingfisher habitat on Guam

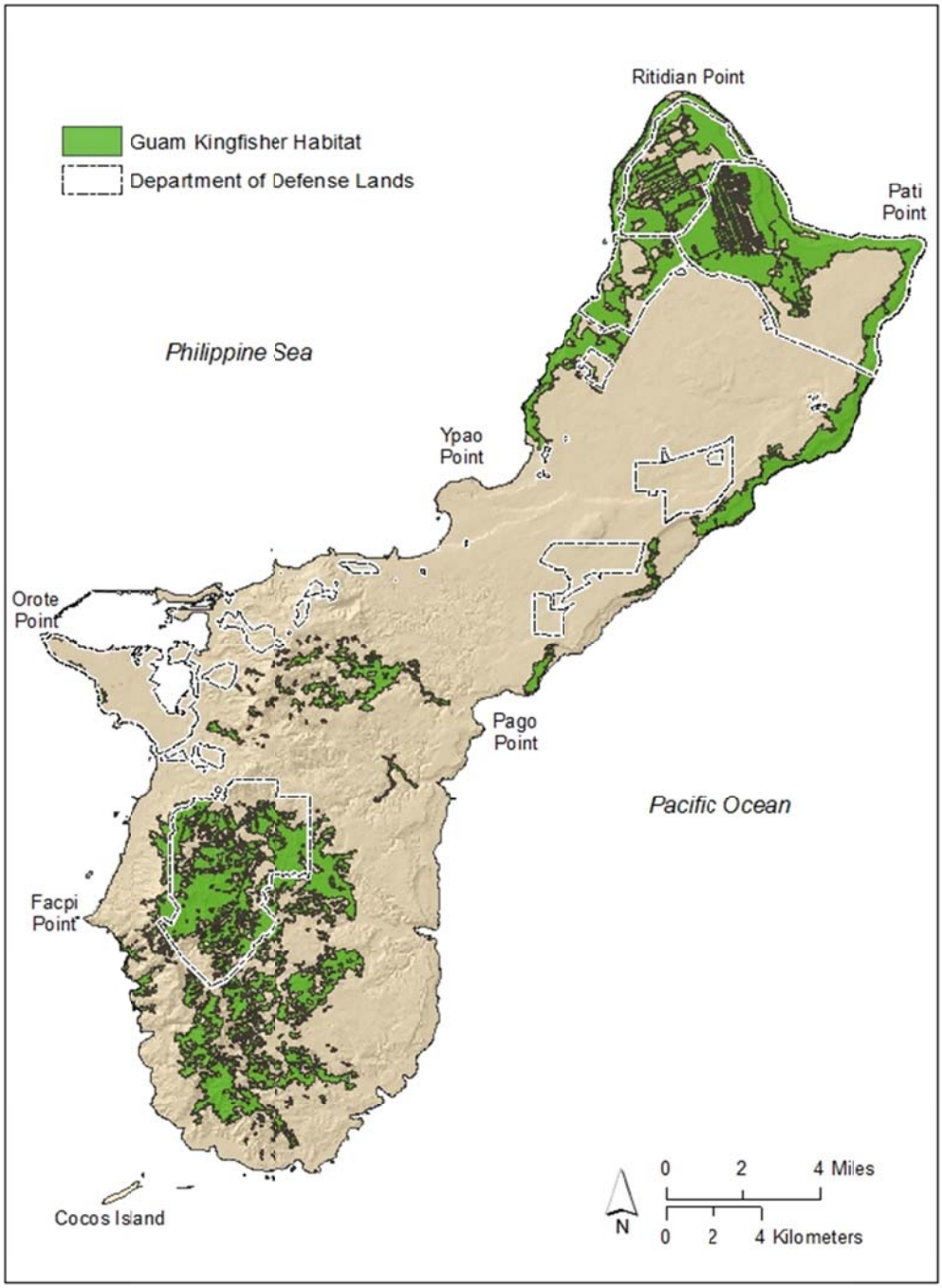


Figure 7. Mariana crow habitat on Guam.

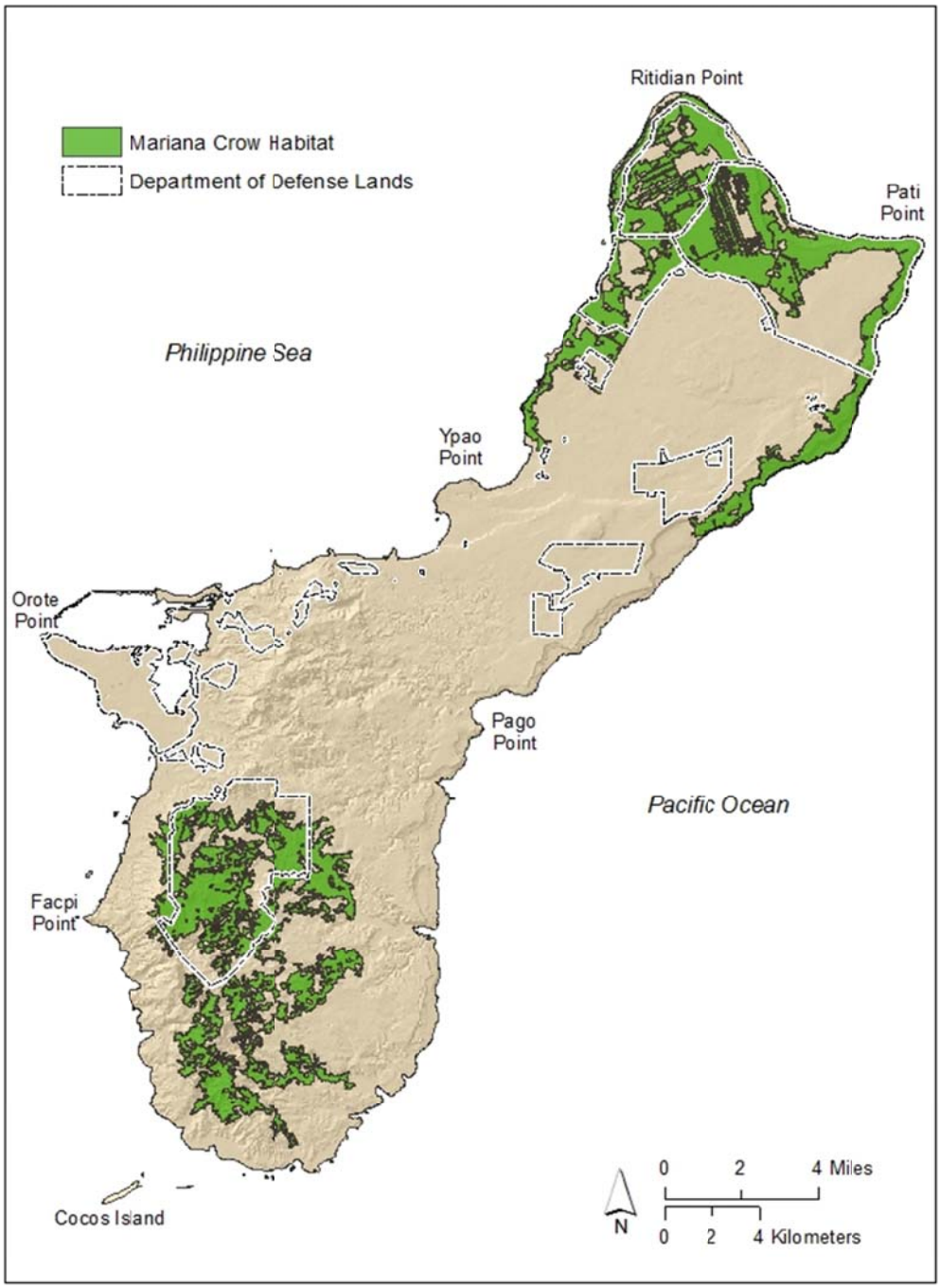


Figure 8. Guam rail habitat on Guam.

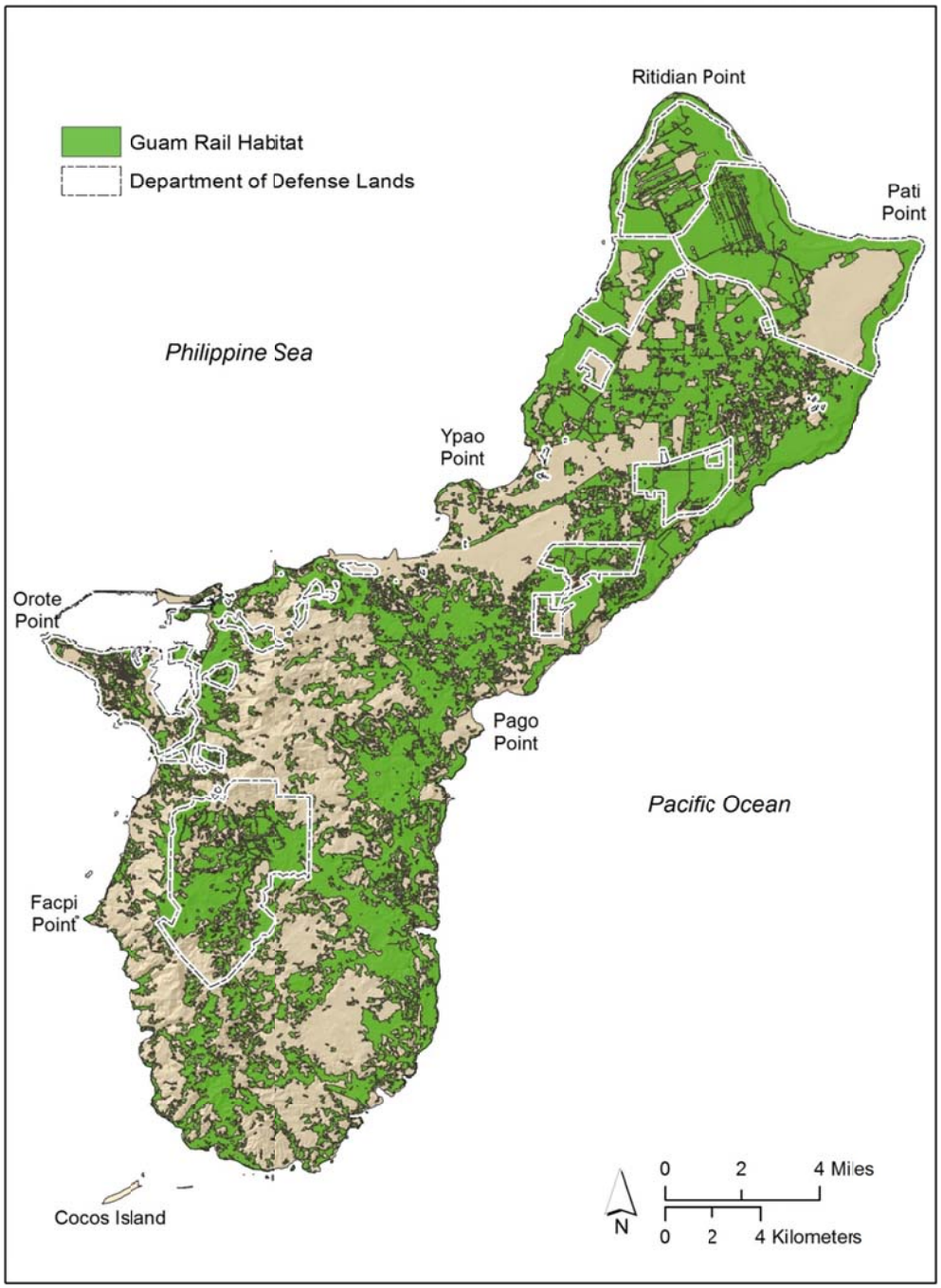


Figure 9. Mariana fruit bat detections and habitat on Guam.

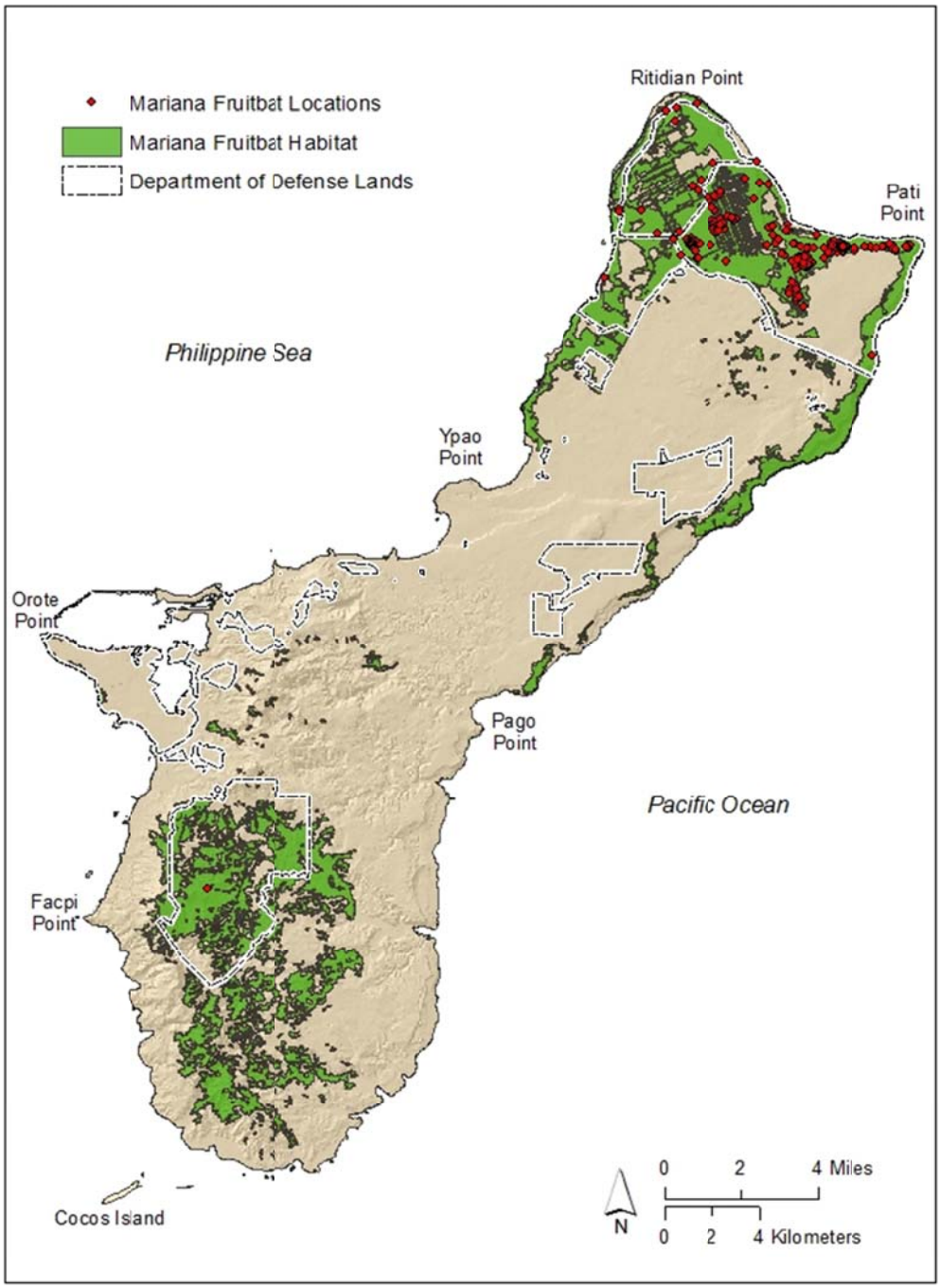


Figure 10. *Serianthes nelsonii* location and habitat on Guam.

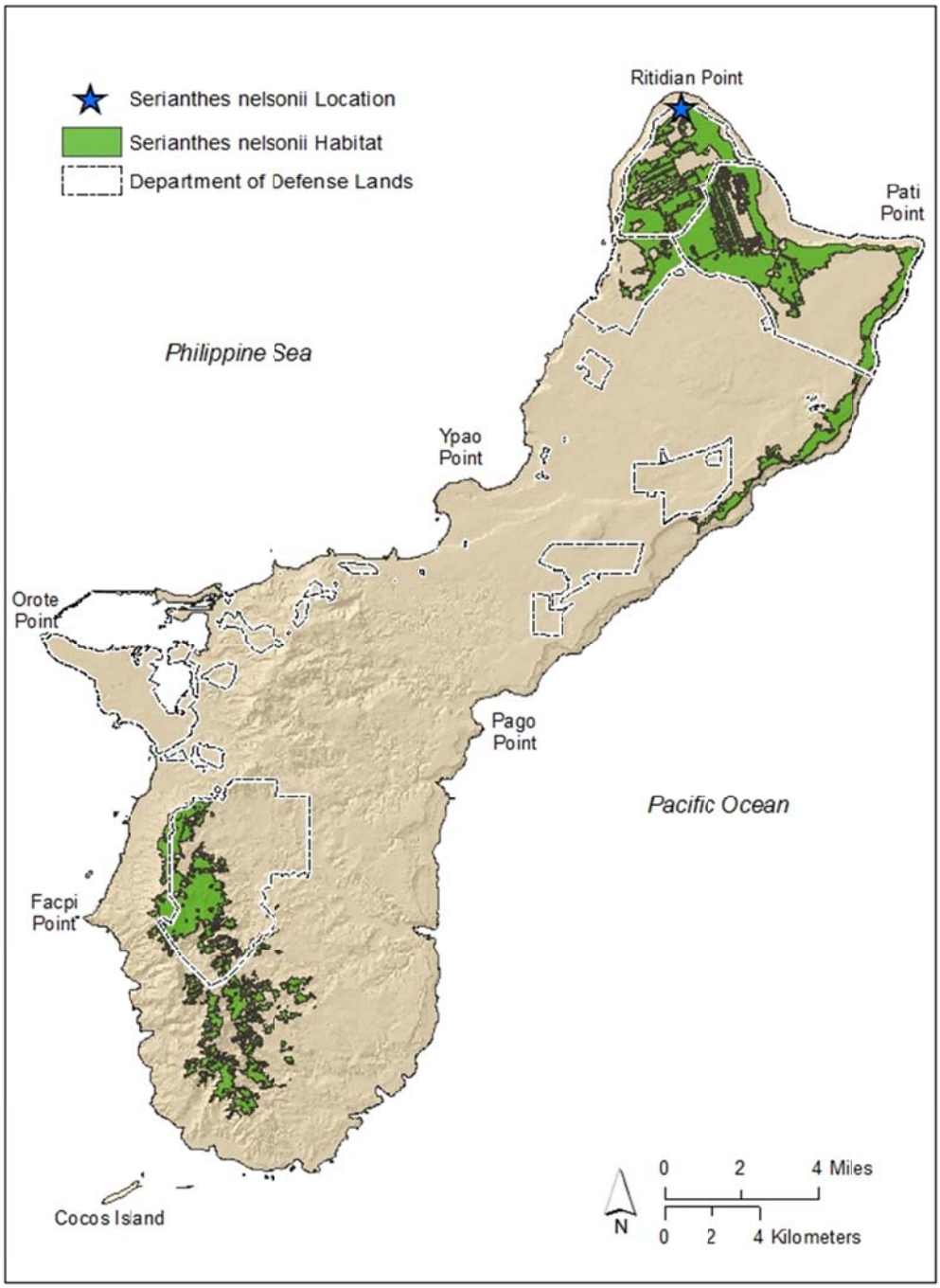


Figure 11. Primary and secondary limestone forests, Guam National Wildlife Refuge, and the project footprint at Ritidian Point, AAFB.

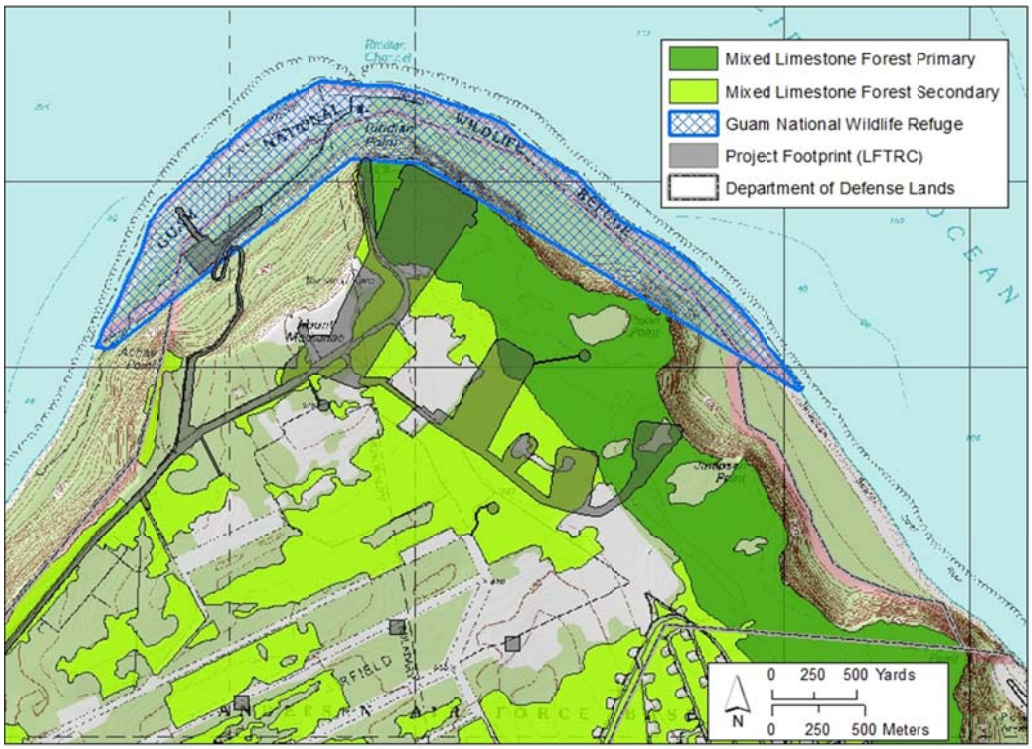


Figure 12. Listed species habitat, designated critical habitat, and the project footprint at Ritidian Point, AAFB.

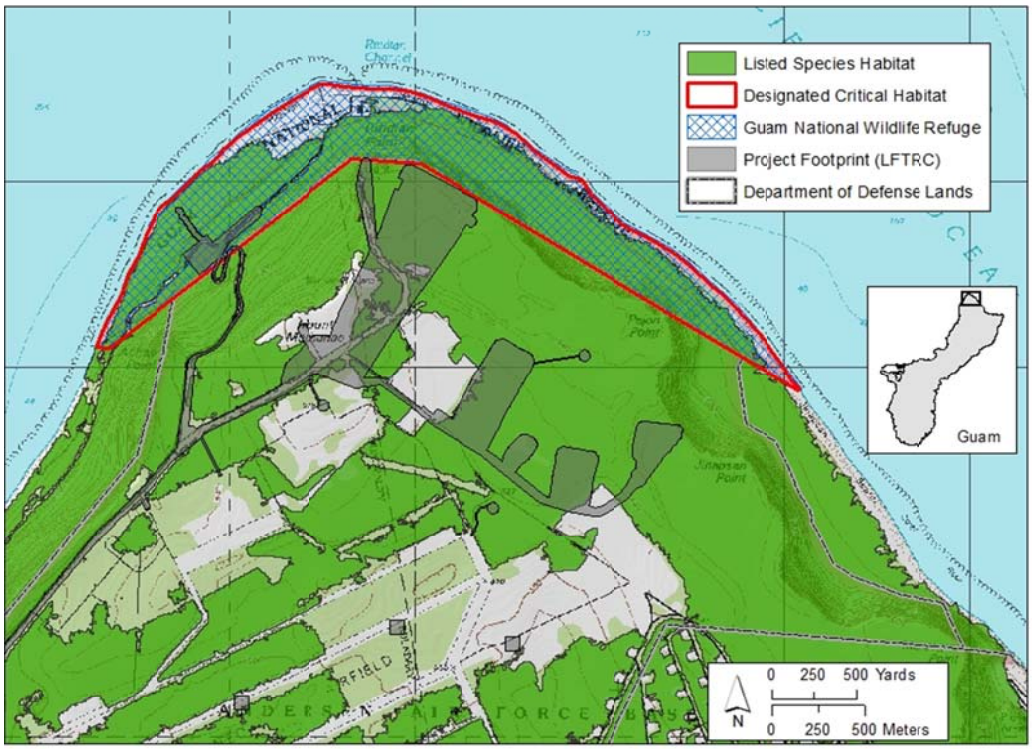


Figure 13. Results from noise modeling (80 dB contour) from operation of the LFTRC on Guam Micronesian kingfisher habitat

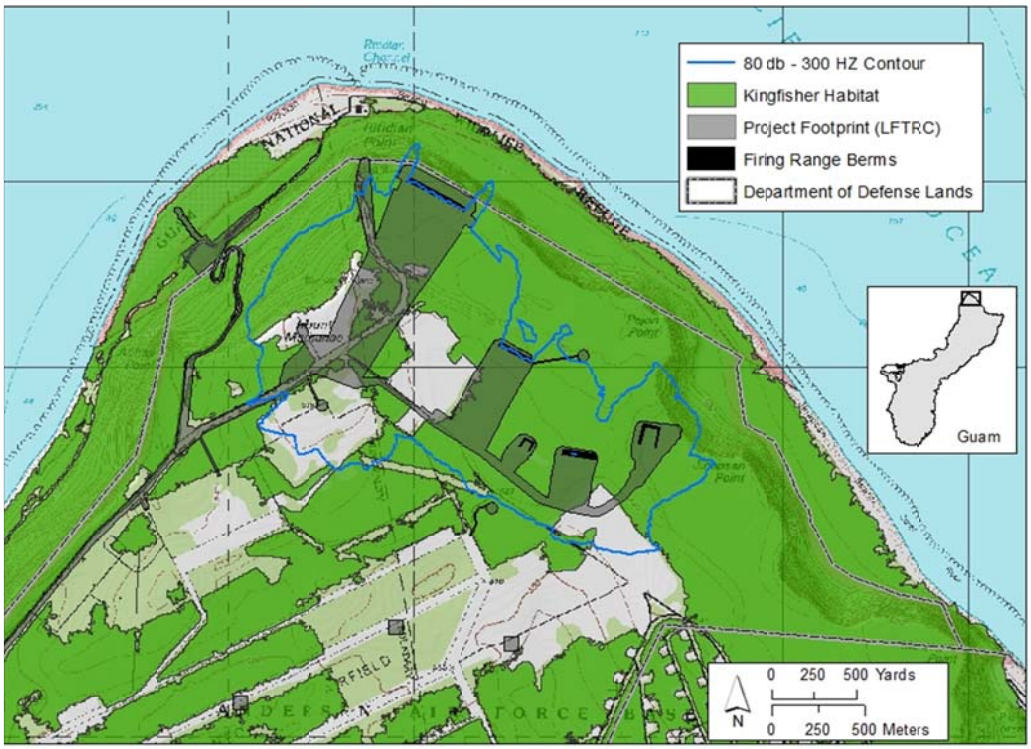


Figure 14. Results from noise modeling (80 dB contour) from operation of the LFTRC on Mariana crow habitat.

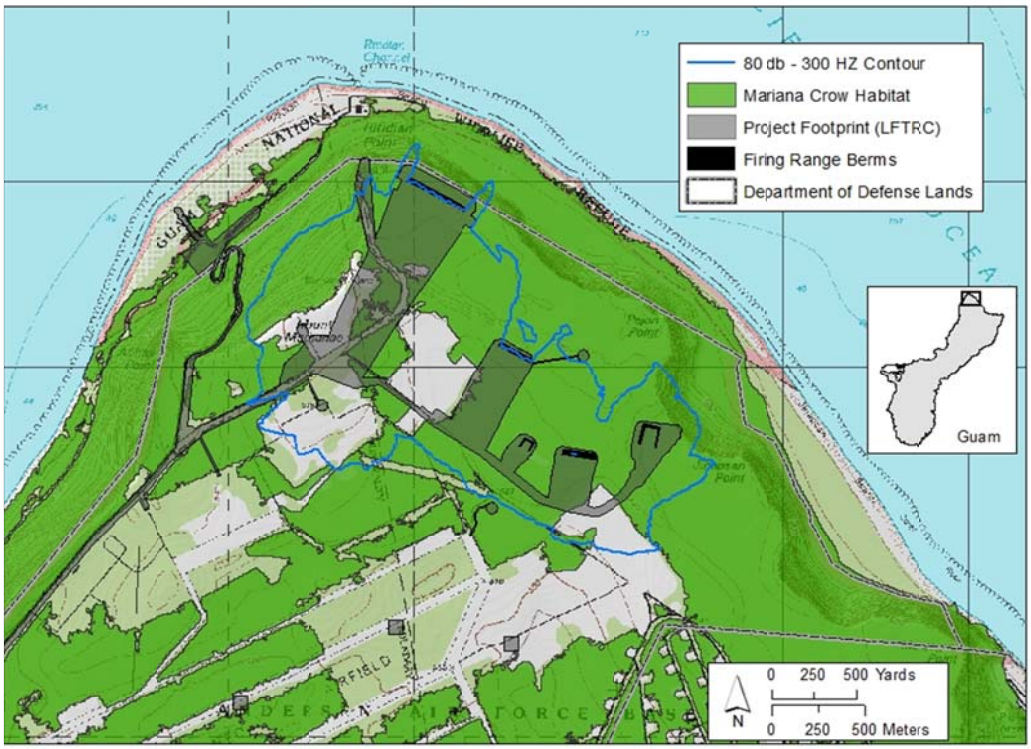


Figure 15. Haputo ERA, Mariana crow habitat, and the project footprint.

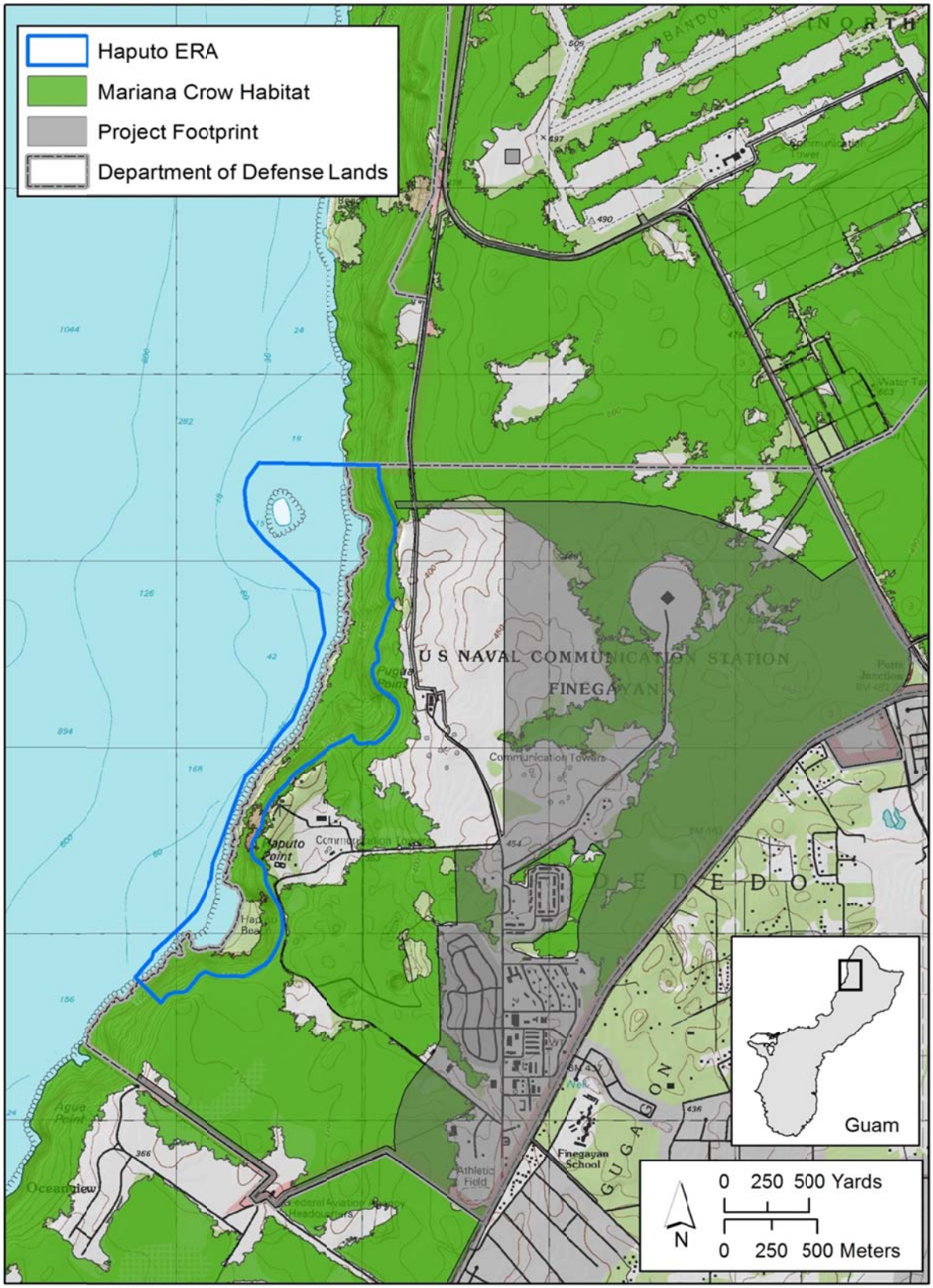


Figure 16. Guam rail habitat loss as part of the proposed action.

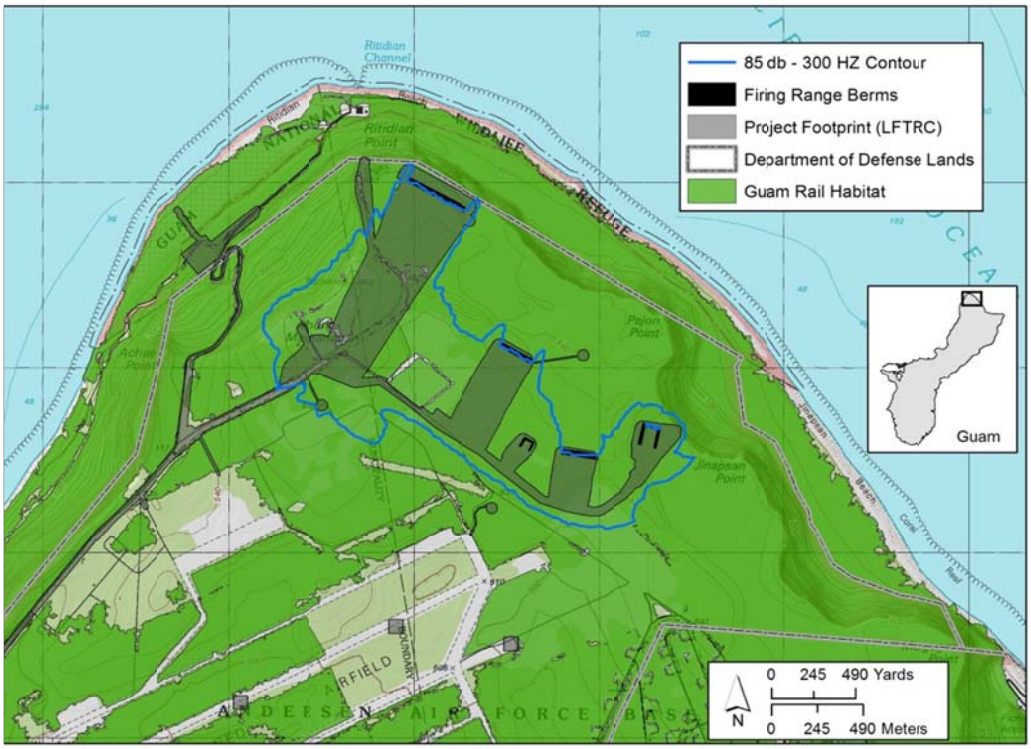


Figure 17. Results from noise modeling (65 dB contour) from operation of the LFTRC on Mariana fruit bats and habitat.