National Park Service
US Department of the Interior

Haleakalā National Park
Hawaiʻi

FINDING OF NO SIGNIFICANT IMPACT
Haleakalā National Park

Suppression of Invasive Mosquito Populations to Reduce Transmission of Avian Malaria to Threatened and Endangered Forest Birds on East Maui Environmental Assessment

Recommended:

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FINDING OF NO SIGNIFICANT IMPACT

1.1 INTRODUCTION

In compliance with the National Environmental Policy Act (NEPA), the National Park Service (NPS) and State of Hawaiʻi Department of Land and Natural Resources (DLNR) prepared an Environmental Assessment (EA) to examine alternative actions and environmental impacts associated with suppressing invasive mosquito populations to reduce transmission of avian malaria to threatened and endangered forest birds on East Maui. The purpose of the project is to substantially suppress or eliminate invasive southern house mosquitoes (*Culex quinquefasciatus*) and, thus avian malaria, in threatened and endangered forest bird populations on East Maui, thereby reducing extinction risks and contributing to the recovery of these species. To prevent the extinction of threatened and endangered forest birds on East Maui, timely management action needs to be taken to control avian malaria.

The statements and conclusions reached in this Finding of No Significant Impact (FONSI) are based on documentation and analysis provided in the EA and associated decision file. Relevant sections of the EA are summarized and incorporated by reference below. The EA is available on the NPS Planning, Environment and Public Comment (PEPC) project site at https://parkplanning.nps.gov/HALE-mosquito.

The public was provided two opportunities to comment on the planning process. The NPS and DLNR held a 45-day public scoping period from December 6, 2021, to January 20, 2022, which initiated the joint NEPA and Hawaii Environmental Policy Act (HEPA) planning process. Virtual public scoping meetings were held on December 14, 2021, and January 6, 2022. In total, 51 people attended the virtual public scoping meetings, including 34 on December 14, 2021, and 17 on January 6, 2022. The project team received 72 pieces of correspondence during the 45-day scoping period. The comments received were reviewed by the NPS and DLNR and considered in developing the EA. A public scoping report documenting the process is available on the NPS PEPC project site at https://parkplanning.nps.gov/HALE-mosquito.

The NPS and DLNR also requested public input on the EA during a 45-day EA public review period from December 6, 2022 to January 23, 2023. In total, the NPS and DLNR received 853 independent pieces of correspondence, several with substantive comments. A summary of substantive public comments received and responses from the NPS and DLNR is provided in Attachment A of this document. Minor modifications to the text of the EA are provided in Attachment B.

Although the EA was a cooperative federal and state compliance document satisfying both NEPA and HEPA regulations, this FONSI analyzes only the impacts that would occur on NPS lands. The Hawaiʻi DLNR will sign its own FONSI.

1.2 SELECTED ALTERNATIVE AND RATIONALE FOR DECISION

1.2.1 Selected Alternative

The NPS and DLNR analyzed two alternatives in detail in the EA. Based on this analysis, the NPS selected the Proposed Action as the alternative for implementation because it best meets the purpose of, and need for, action, without causing significant impacts on park resources. The selected alternative is described in detail in Chapter 2 of the EA.

Under the selected alternative, the NPS and DLNR propose to reduce threatened and endangered forest bird mortality from avian malaria by suppressing mosquito populations on East Maui. The selected alternative consists of repeatedly releasing incompatible male mosquitoes to reduce the reproductive potential of mosquitoes in the project area. This approach employs an incompatible insect technique (IIT), which uses a naturally occurring bacteria termed *Wolbachia* that is present in the eggs and sperm of many insect species, including the southern house mosquito (Hilgenboecker et al. 2008, Bennett et al. 2012). When male mosquitoes with an incompatible strain of *Wolbachia* are introduced to a population of female mosquitoes, mating is unproductive, thereby substantially suppressing mosquito populations (Atyame et al. 2015). Releases under the selected alternative must be conducted repeatedly over time to achieve and maintain significant suppression of the mosquito population. Monitoring mosquito populations will guide the frequency, number, and location of the proposed releases, and will need to continue for as long as the selected alternative is implemented. The park will oversee implementation on federal lands and DLNR on state and private conservation lands or those managed by The Nature Conservancy (TNC).

The selected alternative will begin with small-scale on-the-ground or aerial releases of incompatible mosquitoes within the project area, where field teams will be able to monitor effectiveness of IIT implementation. The majority of the project area is inaccessible by ground, and thus will require uncrewed aircraft systems (i.e., UAS/drones) to implement large-scale mosquito releases throughout the project area. Releases via helicopter may be required as a short-term (up to two months per year), temporary release method if drones are not available. Releases will be expected to continue until invasive mosquito populations are significantly reduced and the status of threatened and endangered forest birds stabilizes, or until new mosquito population suppression techniques are developed. Release efforts may be concentrated within smaller management areas if there are limitations in the availability of drones, personnel, or incompatible mosquitoes, and then scaled up throughout the project area once additional resources are available. The details of the selected alternative are described below.

Frequency and Timing of Release

Incompatible mosquito releases could occur throughout the project area during all seasons. However, releases will likely occur across the largest portion of the project area during the summer and fall months when mosquito populations in Hawaiʻi peak (LaPointe 2000, Warren et al. 2020). These are months when temperatures are suitable for avian malaria transmission within the broadest elevational range, including areas above 4,300 feet in elevation (where most threatened and endangered birds currently live and breed). Incompatible mosquito releases may be reduced during the cooler spring and winter months when the abundance of mosquitoes at high elevations is thought to decrease. Concurrent monitoring will help identify seasonal fluctuations in mosquito populations and help guide the release strategy.

To achieve the greatest possible reduction in the mosquito population, incompatible mosquitoes will be released at a maximum of twice per week per release location and potentially less frequently as invasive mosquito population suppression is achieved over time. Release frequency will be determined by initial trials to determine longevity and dispersal of the incompatible males. The release locations, each spaced approximately 1,300 feet apart, have distinct temperature and precipitation characteristics because of elevation, topography, and aspect. Low-elevation areas will require releases throughout the year, while high-elevation areas may require less frequent releases with most occurring during the summer months. The frequency and number of incompatible mosquitoes released could decrease over time depending on the project's success in suppressing the mosquito population.

Release Methods

Mosquito releases will be primarily conducted via drones. If there are obstacles to using drones for aerial releases, NPS and DLNR will release incompatible mosquitoes from helicopters over the short term (up to two months), either from a release device attached to the belly of a helicopter or from a long cable affixed with a device that could allow release of mosquitoes closer to the forest canopy or floor (described below). It is expected that limited pedestrian releases and monitoring will be conducted simultaneously on a quarterly basis.

Drone Release

Drones will allow for efficient incompatible mosquito releases throughout the core area and are considerably safer, less expensive, more efficient, and quieter than helicopters. Drones will operate somewhat automatically (monitored by an operator), flying a prescribed route and releasing incompatible mosquitoes at pre-determined release locations in the core area. It is estimated that drones will fly approximately 50–100 feet above the tree canopy during mosquito releases but no higher than 500 feet above ground level (AGL) when ferrying between release locations and the operator. Larger areas will require multiple days to conduct releases (e.g., Koʻolau Forest Reserve), while smaller areas (e.g., Kīpahulu Forest Reserve) may only require a few hours for each aerial release. The drone operator will ensure that the drone and release mechanism are operating correctly and safely during each flight. Incompatible mosquitoes will likely be released in small biodegradable packages designed to open upon contact with the canopy or forest floor.

Proposed release locations will be spaced approximately 1,300 feet apart, so a drone flying at 22 mph will be able to release incompatible mosquitoes at 24 release locations over a 15-minute period. The drone will likely spend 15 seconds or less hovering over each mosquito release location; it may be possible that drones will be able to release without pausing. A "treatment" is defined as releasing incompatible mosquitoes at all release locations within the entire core area. At least two drones will need to be working simultaneously each week to achieve two complete treatments per week in the core area.

Helicopter Longline Release

Given the noise and visual impacts, logistics, and financial requirements of helicopters, the use of helicopters for releasing incompatible mosquitoes is proposed as a short-term (up to two months per year), temporary release method if drone releases are unavailable. In this event, helicopters could release incompatible mosquitoes for up to two months in management units where population suppression can be sustained. The helicopter, operated by a pilot and carrying one spotter, will be equipped with an approximately 50–100-foot longline attached to the belly hook of the helicopter. Longlines are heavy-duty steel cables that can be attached to the underside of a helicopter. This type of cable allows the helicopter to place loads in areas where the helicopter could not safely land or distribute a load while hovering above the surface.

During a typical operation, it is expected that the helicopter will fly at a speed of 69 miles per hour and approximately 500–2000 feet above ground level (AGL) from the main heliport (Kahului Airport, OGG) to a designated temporary helibase where the longline and release mechanism will be attached by ground teams. The helicopter will then fly at a slower speed with the longline to the core area (approximately 22 miles per hour) for releases. The helicopter will likely spend 15 seconds or less hovering over each mosquito release location. Here we assume repeat visits to any given area will not likely occur more than twice per week, based on logistic constraints, but will be refined over time based on monitoring of mosquito populations.

Pedestrian Mosquito Release

Pedestrian release is not expected to be a substantial release method as it is much less efficient than aerial release methods and it is only possible in limited areas within the project area where trails exist. Consistent pedestrian release is only possible in portions of Makawao Forest Reserve and Waikamoi Preserve. Under this method, pedestrian teams will receive helicopter deliveries and then distribute mosquitoes to the release locations and conduct concurrent mosquito monitoring. Pedestrian releases will involve field teams walking the terrain on foot, using existing management trails and fence lines, as well as camping at established remote camps or helicopter landing zones (LZs) if necessary.

Pedestrian mosquito release, especially at remote sites, will likely primarily be for necessary field trials because it can be implemented immediately and will allow for simultaneous monitoring. Although pedestrian releases could occur throughout the year in Makawao Forest Reserve and Waikamoi Preserve, pedestrian releases may only be possible within Haleakalā National Park, Hanawī Natural Area Reserve, and other remote sites on a quarterly basis simultaneous with ground-based mosquito monitoring. A helicopter will be required to transport crews into the field to reach LZs near monitoring and release locations in Haleakalā National Park and Hanawī Natural Area Reserve, and the frequency and duration of these helicopter flights is described in the following section, "Mosquito Monitoring."

Mosquito Monitoring

Field teams will conduct a variety of monitoring activities to measure the effectiveness of the selected alternative. Field teams will trap mosquitoes in release areas to determine relative abundance of the mosquito population, dispersal distance of incompatible mosquitoes, and estimated hatch success. Field teams will place traps along existing trails and fence lines, collect mosquitoes from traps, and preserve the captured mosquitoes for additional testing, e.g., for absence or presence of avian malaria. As a result of monitoring, the NPS and DLNR will be able to prioritize future releases, optimize the number and location of incompatible mosquitoes, improve mosquito release methods, and minimize costs for project implementation. Sustained and regular mosquito trapping will be necessary to understand the selected alternative's effectiveness and track seasonal fluctuations in population densities.

Monitoring will likely occur quarterly (four times per year). Monitoring will be more frequent at the start of the project and will vary depending on the availability of incompatible mosquitoes and personnel. It is assumed that four locations will be selected on state lands (e.g., two within Hanawī Natural Area Reserve and two within Forest Reserves), two locations within the park (within the Kīpahulu Valley Biological Reserve), and two locations within TNC's Waikamoi Preserve. Field teams at the five remote monitoring locations will need to use portable generators to charge the batteries in the mosquito traps.

Mosquito monitoring will involve field teams camping at established remote shelters or helicopter LZs for overnight stays for approximately one week at a time. Where needed, a helicopter will deliver field teams to established LZs within Haleakalā National Park, TNC's Waikamoi Preserve, Hanawī Natural Area Reserve, or other state reserves.

Vehicle Support

Where access roads exist, motorized vehicles (trucks or SUVs) will be used to transport field teams and equipment for ground-based monitoring and pedestrian releases. Vehicles will be used in the project area on a quarterly basis to support monitoring and likely more frequently to support pedestrian mosquito releases. Vehicles will be used on existing roads that are currently used and maintained by their respective landowners for maintenance, management, and public recreation. During monitoring, vehicles will drive along the Flume Road for up to 4 hours per day for 7 consecutive days on a quarterly basis to reach three monitoring locations in Makawao Forest Reserve and TNC's Waikamoi Preserve. Vehicles will drive along the same road once or twice weekly for up to 2 hours per day when or if pedestrian mosquito releases are occurring (for perhaps 50–100 locations in Makawao Forest Reserve and TNC's Waikamoi Preserve). This road crosses Makawao Forest Reserve and private conservation lands but provides pedestrian access to TNC's Waikamoi Preserve.

Additional details of the selected alternative and other alternatives considered are described in Chapter 2 and Appendix B of the EA. In keeping with the NPS *Management Policies 2006*, a Determination of No Impairment for the selected alternative was also prepared and is attached to this document (Attachment C).

1.2.2 Rationale

The selected alternative best meets the purpose and need because it provides the most effective and feasible solution to suppress invasive mosquito populations to reduce transmission of avian malaria to threatened and endangered forest birds on East Maui. The selected alternative also best meets Section 4.4.2.3 of NPS *Management Policies 2006* which requires the NPS to "…protect and strive to recover all species native to national park system units that are listed under the Endangered Species Act".

Numerous other potential alternatives were considered but dismissed from further analysis as described in "Appendix B: Issues, Impact Topics, and Alternatives Dismissed from Detailed Analysis" of the EA.

1.2.3 Changes to the Selected Alternative

The NPS added clarifications to some elements of the selected alternative but made no substantive changes. Minor edits and clarifications are included in Attachment B, Errata.

1.3 MITIGATION MEASURES

The NPS places strong emphasis on avoiding, minimizing, and mitigating potentially adverse environmental impacts. Therefore, the NPS will implement multiple mitigation measures and best management practices to protect wildlife, plants, special status species, cultural/historic/ethnographic resources, acoustic environment, wilderness resources, human health and safety, and visitor use and experience. These measures and practices are described in detail in Tables 6 and 7 and Appendix D of the EA and are hereby incorporated by reference. As stated in the EA, these mitigation measures and best management practices are included as integral parts of the selected alternative. The NPS has the authority to implement the mitigation measures under the Organic Act, The Wilderness Act, The National Historic Preservation Act, NPS *Management Policies 2006*, and other federal and state applicable requirements.

1.4 SIGNIFICANCE CRITERIA REVIEW

1.4.1 Potentially Affected Environment

The project area includes approximately 64,666 acres, including NPS land (12,042 acres); DLNR lands in forest reserves and natural area reserves (37,989 acres); adjacent lands privately managed in a conservation easement by TNC (8,606 acres); and East Maui Irrigation Company, LLC (4,409 acres) Haleakala Ranch (393 acres), and Mahi Pono (1,227 acres) lands managed for conservation. This FONSI only applies to impacts on lands within Haleakalā National Park. Within the project area, releases will be initially focused within a 48,164-acre core area, including approximately 7,099 acres within the park. Approximately 9,118 acres (35%) of the park's 24,719 acres of wilderness are within the project area.

To evaluate the potential for significant impacts, agencies must consider the setting, or potentially affected environment, in which impacts may occur. In this case, the selected alternative may beneficially or adversely impact the acoustic environment, wilderness, threatened and endangered wildlife species, state wildlife species of concern, threatened and endangered plant species, state plant species at risk, and visitor use and experience. Wilderness and threatened and endangered species are resources that are afforded different levels of protection through the Wilderness Act and the Endangered Species Act. Therefore, they are briefly discussed in this section as well as in more detail under section 1.4.2.

Drone and helicopter use under the selected alternative has the potential to result in adverse effects to the opportunity for solitude in wilderness. However, because the wilderness in the project area is inaccessible to the public, impacts to solitude would be barely perceptible. Some impacts to the untrammeled quality of wilderness would occur under the selected alternative due to the intentional actions to manipulate the environment by suppressing the mosquito population. However, the selected alternative would provide a long-term benefit to the natural quality of wilderness due to the reduction in the spread of avian malaria and expected recovery of threatened and endangered forest bird species. A more detailed description of the short-and-long term impacts to wilderness can be found in section 1.4.2 below. In summary, the selected alternative will not result in significant impacts to wilderness because most impacts would be short-term and intermittent and with respect to solitude, barely perceptible. Also, most of the park's wilderness is outside of the project area and will be largely unaffected by activities under the selected alternative. Over the long term, there would be a substantial beneficial effect to the natural quality of wilderness.

Although there could be intermittent disturbance to some listed species from drone and helicopter use, the selected alternative will result in long-term beneficial impacts to threatened and endangered bird species. The project will substantially suppress or eliminate invasive southern house mosquitoes (*Culex quinquefasciatus*) and, thus avian malaria, in threatened and endangered forest bird populations on East Maui, thereby reducing extinction risks and contributing to the recovery of these species. The selected alternative therefore will primarily benefit federally listed species and will not result in significant adverse effects.

Please refer to section 1.4.2 for a more detailed description of the potential effects of the selected alternative on each of the resources discussed in the affected environment.

1.4.2 Degree of Effects of the Action

The NPS considered the following actual or potential project effects in evaluating the degree of effects (40 CFR 1501.3(b)(2)) for the selected alternative.

Beneficial and Adverse, and Short-term and Long-term Effects of the Selected alternative
No significant impacts to resources were identified that would require analysis in an Environmental Impact Statement (EIS). Whether taken individually or as a whole, the impacts of the selected alternative, including direct, indirect and cumulative effects, do not reach the level of a significant effect because most adverse impacts associated with implementation will be minimal or temporary, lasting only as long as actions are being executed. The selected alternative will result in substantial long-term beneficial impacts to threatened and endangered bird species and the natural quality of wilderness. Best management practices and mitigation measures as mentioned above (and described in detail in Tables 6 and 7 and Appendix D of the EA) will further minimize any potential adverse impacts. It is expected that the frequency of actions and any associated adverse impacts will decline as invasive mosquito population suppression is achieved

over time.

Acoustic Environment

As discussed in Chapter 3 of the EA, activities associated with the selected alternative will result in noise that could impact the acoustic environment, visitor experience, sensitive wildlife, and wilderness character. Noise impacts will be mitigated through careful planning of flight paths, timing of mosquito releases, and the use of drones.

Noise from drones (the primary method for mosquito releases) could occur on 7,099 acres of NPS lands within the entire core area for 6–11 hours per week. Noise levels from drones could reach 47–59 dBA at 100–200 feet AGL (the altitude where most releases will occur) for less than 15 seconds as the drone passes over any given location in the core area one to two times per week. At the upper limit of the estimated decibel levels, drone noise could possibly be loud enough to disrupt conversations, but this disruption would be brief, due to the minimal time that a drone would be overhead in one location.

Helicopter noise will only occur if a short-term (up to two months per year), temporary release method is needed for releases and when monitoring needs to occur in the backcountry (on a quarterly basis). Helicopter noise impacts will occur primarily at LZs, helibases, and along selected flight paths. To reach the two helicopter-only accessible monitoring sites in the park on a quarterly basis, helicopter flights could occur on two days per site every three months and operations would range from 2–4 hours per day for potentially 4–8 hours per quarter for both sites, totaling 16–32 hours/year. For short-term temporary helicopter longline releases, it is anticipated that up to 6 hours per day, 1–2 days per month for up to two months could occur and result in a total of up to 7–12 hours of flight time per year. Noise levels could reach a maximum 82 dBA at 150 AGL for up to 15 seconds while the helicopter hovers over release locations within targeted portions of the core area. While noise levels immediately beneath flight paths would exceed levels that would be expected to disrupt human communication and potentially cause annoyance to wildlife, these noise levels would not be sustained at that level for more than 15 seconds at any given point. Actual distances and sound levels would likely be far lower than the modeled results provided in Table 11 of the EA due to the rugged terrain and extensive tree canopy cover in the project area, which would block and absorb some of the helicopter noise.

Noise from generators (maximum of 52–58 dBA at 23 lateral feet) will be highly variable and will be limited to the two helicopter-only accessible monitoring areas and camps for up 3 hours per day for up to 7 consecutive days on a quarterly basis during monitoring trips.

In summary, noise from the drone and helicopter longline release methods and monitoring will be the most intense acoustic impacts to result from this project. However, the adverse impacts from the drone and helicopter longline release methods and monitoring will be confined largely to backcountry areas and will largely go unnoticed by humans and will only briefly disturb wildlife. Humans and animals will experience slight perceptible increases in sound/noise in certain areas at certain times resulting in fleeting disruption or annoyance. The selected alternative will contribute a measurable but largely unnoticeable adverse impact to the acoustic environment during mosquito release and monitoring activities. Impacts to the acoustic environment will not be significant because impacts from mosquito releases and monitoring would be intermittent and would occur during daylight hours on weekdays only, primarily in areas of the park not heavily visited by the public. And because drones would be the primary mosquito release method rather than helicopters, noise impacts from aerial releases would be minimized.

Wilderness

As discussed in chapter 3 of the EA, all three mosquito release deployment methods under the selected alternative will have the same impact on the untrammeled quality of wilderness. The broad intervention of wildlife through the release of mosquitoes using any of the three methods will result in an adverse impact on the untrammeled quality of wilderness for the life of the plan, likely at least 20 years, as the methods described in the selected alternative are used to suppress invasive mosquito populations to reduce avian malaria mortality in native forest birds.

The use of motorized equipment, such as drones, helicopters, and generators (during monitoring only) will result in intermittent, direct, adverse impacts on the undeveloped quality of wilderness character due to its presence in and around wilderness. Pedestrian releases may occur within designated wilderness but only on a quarterly basis simultaneous with ground-based mosquito monitoring. Helicopters will land briefly in wilderness during each incompatible mosquito monitoring and release operation, to pick up and drop off teams and supplies. Generators will likely be used during the monitoring trips. The presence of helicopters and generators within wilderness will briefly adversely impact the undeveloped quality given the presence of this technologically motorized equipment in a wilderness setting. Incompatible mosquitoes may be released in small biodegradable packages which will result in an impact to the undeveloped quality of wilderness for as long as they remain in the environment (until they biodegrade).

Minimal clearing of vegetation at LZs, trails, and fence lines will be required at the onset of the project to accommodate mosquito monitoring, but impacts will be limited to areas that have already been cleared for administrative use and mechanized equipment will not be used. Noise from drone flights once or twice per week, short-term (up to two months per year), temporary helicopter longline releases, and quarterly pedestrian monitoring and release efforts will result in adverse impacts on the natural quality of wilderness during mosquito release and monitoring activities. The reduction in the mosquito population under the selected alternative, and the subsequent reduction in native forest bird mortality from the transmission of avian malaria, will result in substantial beneficial impacts to the natural quality of wilderness character because of the resultant stabilization or increase in native forest bird populations over time. Over the long term, the selected alternative will substantially benefit the natural quality of wilderness.

Direct adverse impacts on the primitive wilderness experience will result from the selected alternative, though these will be rarely and intermittently perceptible to visitors in accessible wilderness areas. Project noise created within Haleakalā Wilderness will be mostly confined to the project area and those wilderness areas are closed to public access. However, drone and helicopter noise created by the selected alternative may travel to some wilderness locations beyond the project area that are accessible to the public, but those instances will be rare and discontinuous. Although helicopter and drone noise would adversely impact the ability of wilderness users to enjoy a sense of solitude or primitive recreation, it would be short lived and, in most cases, imperceptible from accessible wilderness. Over time, impacts to wilderness are expected to decline as releases are needed less frequently and/or become more efficient.

In summary, the selected alternative will impact wilderness character qualities including the untrammeled quality, undeveloped quality, and opportunity for solitude from the use of mechanized equipment to release incompatible mosquitoes. However, the selected alternative will likely support a considerable recovery to natural conditions previously present on the island, thus benefiting the natural quality of wilderness. Under the selected alternative the small temporary adverse impacts to the undeveloped quality, untrammeled quality, and opportunity for solitude from mosquito releases will result in a substantial long-term benefit to the natural quality of wilderness through the protection and recovery of native forest birds. Impacts to wilderness will not be significant because adverse impacts to the undeveloped quality will be temporary and intermittent, occurring only when mechanized and motorized activities are being conducted; impacts to the opportunity for solitude will be barely perceptible because wilderness in the project area is not accessible to the public; and impacts to the natural quality of wilderness will be beneficial over the long term. The majority of the park's wilderness is outside the project area and will remain mostly unaffected by actions under the selected alternative.

Visitor Use and Experience

As discussed in chapter 3 of the EA, drones will be the primary mosquito release method and will have minimal adverse impacts on visitor experience as the visual and auditory disturbance will be short in duration, likely from 15 seconds to a few minutes (drones may hover for less than 15 seconds over a particular location).

When drones are not available, intermittent adverse impacts on visitor experience from helicopter overflights will occur. Adverse impacts will result from elevated sound levels along helicopter flight paths while accessing the project area. Impacts to the visitor experience could occur over a relatively short duration (15 seconds to a few minutes) primarily due to noise (maximum of 82 dBA at 150 feet AGL). The limited use of helicopters under the selected alternative will likely not be substantially noticeable to the public.

During mosquito release and monitoring activities, there will be a minimal adverse impact on visitor experience from the use of helicopters, mechanized and motorized equipment, and human activity. The core area contains many places where there is little to no public use. The most well-used areas with established public trails are within the lower Kīpahulu District area where people use the Pīpīwai Trail to access Waimoku Falls. Visitors to these areas could be subject to helicopter overflights for monitoring up to twice a week, on weekdays only. Adverse noise impacts on visitor experience from helicopters will be variable but will not be sustained, as ground teams and equipment will only be dropped off and picked up on a quarterly basis at the beginning and end of each monitoring effort (when some pedestrian releases could occur). Generators will only be used during mosquito monitoring activities which occur in remote areas, far from public access and out of earshot of public visitors.

In summary, mosquito release activities under the selected alternative will contribute periodic adverse impacts on visitor experience near LZs, helibases, flight paths, and trails from the use of drones, mechanized equipment, and helicopters largely in the form of noise and visual intrusion. Adverse impacts from the pedestrian release method will be confined to a small portion of the overall project area. Impacts to visitor experience will not be significant because the majority of the project area is closed to the public and therefore there will be only intermittent impacts during mosquito release and monitoring activities, mostly concentrated near LZs, helibases, and flight paths. These impacts will only occur during daylight hours on weekdays, as operations will not occur at night or on weekends. A permanent beneficial impact on the visitor experience is anticipated under the selected alternative, if the mosquito control effort is successful and native forest bird populations stabilize or recover. For those who are visiting portions of the analysis area to enjoy a unique native rainforest ecosystem or birdwatching, the beneficial impact could be considered substantial. Overall adverse impacts to visitor use and experience will be brief and minimal and should be outweighed by the overall benefits to wildlife and ecosystems enjoyed by visitors to the park.

Threatened and Endangered Wildlife Species and Wildlife Species of Concern

As discussed in chapter 3 of the EA, the selected alternative will result in limited adverse impacts on federally listed wildlife species, designated critical habitat, and wildlife species of concern and their habitats and will include primarily a risk of wildlife noise disturbance from drones, helicopters, and generators; minimal risk of wildlife collision; and an indirect impact of increased risk of invasive species introduction from failed biosecurity during field operations. The most pronounced risk of impacts from noise disturbance, risk of collision, or biosecurity lapses will occur in the vicinity of LZs, helibases, fence lines, roads, and trails. Over time, impacts may decline as releases are needed less frequently and/or become more efficient. Potential minimal adverse effects to federally listed wildlife or wildlife species of concern from mosquito releases and monitoring include a low risk of disturbance from the presence of drones and drone/helicopter/generator noise to Hawaiian honeycreeper species; low risk of aircraft, drone, or vehicle collision with or noise disturbance to pueo (Hawaiian Short-eared Owl); low risk of pup and day roost disturbance with helicopter rotor wash, drone use, and LZ/camp use to‘ōpe‘ape‘a (Hawaiian Hoary Bat); low risk of flock or brood disturbance and low risk of helicopter drone or vehicle interaction-collisions to nēnē (Hawaiian Goose); and a low risk of drone or helicopter collision with or disturbance to transiting seabirds (‘iwa [Great Frigatebird], koa‘e kea [White-tailed Tropicbird], kōlea [Pacific Golden-Plover], and ‘ua‘u [Hawaiian Petrel]). Potential impacts to Hawaiian honeycreeper species will be minimized by the planned flight elevations, speed of release operations, use of drones, and limited ground or helicopter activity in critical habitats.

All six remaining Hawaiian honeycreeper species (both federally listed and state species of concern) on Maui will substantially benefit from the selected alternative due to the suppression of mosquito populations and thereby avian malaria transmission. Indirect beneficial impacts include conservation biodiversity and reduced exposure by Hawaiian honeycreepers, nēnē, and other disease-susceptible birds to avian pox virus. More broadly, the selected alternative may help restore ecosystem integrity of the rainforest (including designated critical habitat) by substantially reducing the extinction risk of culturally significant and vital avian pollinators and seed dispersers (the Hawaiian honeycreepers).

In summary, impacts to federally listed wildlife and state wildlife species of concern will not be significant because very few direct impacts are anticipated from mosquito release and monitoring activities, and indirect impacts will be limited in duration, frequency, and intensity. In their February 24, 2023 correspondence, the USFWS concurred with the NPS that the selected alternative would not likely adversely affect listed wildlife species. Over the long term, there will be a substantial beneficial impact to listed birds and bird species of concern due to anticipated suppression of the mosquito population that transmits avian malaria to forest birds on Maui.

Threatened and Endangered Plant Species and State Plant Species at Risk

As discussed in chapter 3 of the EA, the only ground-based activities associated with drone releases will be the use of temporary helibases for drone launch locations. No vegetation clearing will occur at these drone launch locations; therefore, there will be no impact to listed plants, designated critical habitat, or plant species at risk from vegetation clearing. The use of temporary helibases for drone launch locations could result in the introduction or spread of invasive plant species or pathogens (e.g., fungal pathogens responsible for rapid ‘ōhi‘a death) through the spread of invasive plant pathogens, seeds, spores, or propagules on equipment or clothes of personnel. With implementation of mitigation measures (as described in detail in Appendix D of the EA), potential adverse impacts to listed plant species, designated critical habitat, and plant species at risk from the introduction or spread of invasive plant species or pathogens under the drone release method will be negligible.

Similar to the drone release method, the only ground-based activities associated with short-term (up to two months), temporary helicopter longline releases will be the use of temporary helibases for attachment of the longline and release mechanisms by ground teams. No vegetation clearing will occur at these temporary helibases; therefore, there will be no impact to listed plants, designated critical habitat, or plant species at risk from vegetation clearing at these locations. With implementation of mitigation measures, potential adverse impacts to listed plant species, designated critical habitat, and plant species at risk from the introduction or spread of invasive plant species or pathogens under the helicopter longline release method will be negligible.

The pedestrian releases within upper Kīpahulu Valley Biological Reserve will likely only occur on a quarterly basis simultaneous with ground-based mosquito monitoring (discussed below). Vegetation clearing around existing management trails and fence lines or LZs, and increased use of existing trails, fence lines, camps, and LZs have the potential to result in physical damage to listed plant species or plant species at risk. Cutting and removal of vegetation surrounding listed plants or plant species at risk has the potential to alter microsite conditions (e.g., light, moisture, temperature), which could alter habitat, including designated critical habitat for these species. Although there is the potential for listed plant species or plant species at risk to be removed or harmed during trail clearing and vegetation removal, implementation of mitigation measures will make any direct harm to these species unlikely and therefore not significant.

Potential impacts to listed plant species, designated critical habitat, and plant species at risk during mosquito monitoring could occur through vegetation clearing, the removal or trampling of individual plants, physical damage to plant parts, introduction or spread of invasive plants or pathogens, or damage to habitat, including designated critical habitat, from clearing, maintenance, and increased use of existing management trails and fence lines, helicopter LZs, and camps. Only established trails, fence lines, camps, and helicopter LZs proposed for use under pedestrian releases will be used for monitoring activities; therefore, no additional adverse impacts from vegetation removal or trampling in these areas will be anticipated. With implementation of mitigation measures specified in Table 6 and Appendix D of the EA, potential impacts to federally listed plant species, designated critical habitat, and plant species at risk during mosquito monitoring will be negligible. Temporary disturbances such as vegetation removal around existing trails and LZs may affect the primary constituent elements (PCEs) of designated critical habitat units. In their February 24, 2023 correspondence, the USFWS concurred with the NPS that the selected alternative would not likely adversely affect federally listed species or designated critical habitats. With implementation of mitigation measures, the impacts to designated critical habitat are expected to be negligible and therefore not significant.

Degree to Which the Selected Alternative Affects Public Health and Safety

The selected alternative considers public health and safety during project implementation. Any risks to public health and safety from equipment use, drone operation, helicopters flights, and vehicle operation will be minimized by maintaining safe distances (to aircraft), appropriate planning, and mitigation measures as described earlier in this document and in Table 6 in the EA.

Mosquito releases will pose no risk to human health. Only male mosquitoes will be released and only female mosquitoes bite animals or humans. The risk of females being accidentally released is estimated to be 1 in 900 million (Crawford et al. 2020). Even if a female is released, a bite from a released female will pose no more risk to humans or wildlife than the invasive female mosquitoes currently in the environment. *Wolbachia* cannot live within vertebrate cells and cannot be transferred to humans or other vertebrates even through the bite of an infected mosquito (Popovici et al. 2010). Although *Wolbachia* infection has been shown to influence transmission of mosquito-borne diseases, the general trend seen in the peer-reviewed literature is that *Wolbachia* infection leads to lower rates of disease transmission including that of dengue, chikungunya, Zika, West Nile Virus, and malaria (e.g., Moreira et al. 2009, Hussain et al. 2012, Dutra et al. 2016). Of these listed diseases, only the avian form of malaria is endemic (consistently found and locally transmitted) within Hawaiʻi. Additionally, southern house mosquitoes in Hawaiʻi are already infected with *Wolbachia* and show high rates of transmission of avian malaria. Therefore, there is no potential for significant adverse impacts to human health from releasing incompatible male mosquitoes.

Effects That Would Violate Federal, State, Tribal, or Local Law Protecting the Environment
The selected alternative does not threaten or violate applicable federal, state, or local environmental laws or requirements imposed for the protection of the environment. Section 7 of the Endangered Species Act (ESA) requires federal agencies to ensure that the actions they authorize, fund, or carry out do not jeopardize the continued existence of listed species or destroy or adversely modify critical habitat.

Based on the analysis provided in Chapter 3 of the EA, project activities under the selected alternative *may affect, but are not likely to adversely affect* all analyzed federally listed plant species and their designated critical habitat, as applicable. Based on the analysis provided in Chapter 3 of the EA, project activities under the selected alternative *may affect, but are not likely to adversely affect* all analyzed federally listed wildlife species and their designated critical habitat, as applicable. **Table 1** provides ESA Section 7 determinations for listed wildlife species under the selected alternative.

TABLE 1: THREATENED AND ENDANGERED WILDLIFE SECTION 7 DETERMINATIONS

Scientific Name	Common Name	Selected alternative Sec. 7 Determination
Branta sandvicensis	Nēnē, Hawaiian Goose	*May affect, but not likely to adversely affect*
Drepanis coccinea	ʻIʻiwi	*May affect, but not likely to adversely affect*
Palmeria dolei	ʻĀkohekohe	*May affect, but not likely to adversely affect*
Pseudonestor xanthophrys	Kiwikiu or Maui Parrotbill	*May affect, but not likely to adversely affect*
Aeorestes semotus	ʻŌpeʻapeʻa, Hawaiian Hoary Bat	*May affect, but not likely to adversely affect*
Oceanodroma castro	'Akē'akē, Band-rumped Storm-Petrel	*May affect, but not likely to adversely affect*
Pterodroma sandwichensis	ʻUaʻu, Hawaiian Petrel	*May affect, but not likely to adversely affect*
Puffinus auricularis newelli	ʻAʻo, Newell's Shearwater	*May affect, but not likely to adversely affect*

NPS coordinated with the USFWS Pacific Islands Field Office to ensure compliance with Section 7 of the ESA. An official Species List and associated avoidance and minimization measures from the USFWS Pacific Islands Fish and Wildlife Office was received on January 20, 2022 and aided in developing mitigation measures and assessing potential impacts of the project. The USFWS reviewed and commented on an internal draft EA and a meeting with the NPS was held on October 24, 2022, to discuss potential impacts to threatened and endangered species. The EA served as a Biological Assessment with Section 7 determinations provided for federally listed plant and wildlife species. On February 24, 2023, the NPS received a concurrence letter from the USFWS stating that they concur with the NPS's determination that the selected alternative *may affect, but is not likely to adversely affect* federally listed species or designated critical habitats. Because the selected alternative would not result in adverse impacts to federally listed species, there would be no potential for significant impacts.

Compliance with Section 106 of the National Historic Preservation Act was conducted in consultation with the Hawaiʻi State Historic Preservation Division (SHPD), Native Hawaiian Organizations, and individuals with familial/traditional ties to Haleakalā concurrently during the NEPA/HEPA planning process. The expected determination of effect is *No adverse effect* under Section 106 and *No historic properties affected* under HRS Chapter 6e.

In December 2021, NPS sent initial letters establishing the Area of Potential Effect (APE) and identifying historic properties to the Hawaiʻi SHPD and consulting parties (including Native Hawaiian Organizations and individuals with familial/traditional ties to Haleakalā). SHPD replied on January 5, 2022. The SHPD had no objections to the APE. The SHPD noted that the APE is a very large area and requested "additional information pertaining to what type of work, if any, will be conducted on the ground which may impact historic properties, if present, and the location of that work" (Project No. 2021PR01527; Doc No. 2201SH01). No substantial comments were received by consulting parties.

In August 2022, NPS sent preliminary determination of effect letters to the Hawaiʻi SHPD and consulting parties, including additional information pertaining to what type of work, if any, will be conducted on the ground which may impact historic properties, if present, and the location of that work. No comments were received. A third letter, describing refinements to the proposed action based upon new information gathered during the EA process, as well as final determination of effect, was sent to consulting parties with the EA and Cultural Impact Assessment when it was released to the public in December 2022. No response has been received from SHPD as of March 1, 2023. Since there are no expected adverse effects to cultural resources, there is no potential for significant impacts.

1.5 FINDING OF NO SIGNIFICANT IMPACT

Based on the information contained in the EA, I have determined that the selected alternative does not constitute a major federal action having a significant effect on the human environment. Therefore, an EIS will not be required.

This finding is based on consideration of CEQ criteria for significance (40 CFR 1501.3 (b)), regarding the potentially affected environment and degrees of effects of the impacts described in the EA.

ATTACHMENT A: RESPONSES TO SUBSTANTIVE PUBLIC COMMENTS ON ENVIRONMENTAL ASSESSMENT

CONCERN 1: Commentors were concerned that the level of analysis presented in the Environmental Assessment (EA) was insufficient, and that an Environmental Impact Statement (EIS) should be prepared.

Response: Both the Environmental Assessment (EA) and Environmental Impact Statement (EIS) processes involve rigorous analysis of potential environmental and cultural impacts of proposed agency actions, as required by federal (NEPA) and state (HEPA) regulations. The NEPA and HEPA regulations state, however, that an agency shall prepare an EA for a proposed action that is not likely to have significant effects or when the significance of the effects is unknown. Prior to and during the preparation of this mosquito suppression EA, the project team spent a considerable amount of time analyzing numerous potential effects of the proposed action. Ultimately, none of those potential impacts were determined to be significant, and effects resulting from the selected alternative are known, as indicated in the FONSI, which is supported by the impact analysis in the EA. Therefore, an EIS was not prepared.

CONCERN 2: Commentors were concerned that potential impacts to public health and safety, largely from a concern of perceived increased risk of disease transmission particularly over the long term, were not sufficiently addressed.

Response: The released mosquitoes would pose no risk to human health. Only male mosquitoes would be released. Male mosquitoes do not bite humans or animals and do not transmit diseases. Only female mosquitoes bite humans or animals. The risk of females being accidentally released is estimated to be 1 in 900 million (Crawford et al. 2020). Even if a female mosquito is released, a bite from it would pose no greater risk to humans or wildlife than the wild female mosquitoes currently present in the environment.

The *Wolbachia* bacteria used to generate the incompatible male mosquitoes is already present in Hawaiʻi in the Asian tiger mosquito (*Aedes albopictus*). *Wolbachia* cannot live within vertebrate cells and cannot be transferred to humans even through the bite of a mosquito that carries it (Popovic et al. 2010). Residents of Hawaiʻi are commonly bitten by the Asian tiger mosquito, which is distributed statewide and has remained one of the most abundant mosquitoes at lower elevations since its introduction in 1896. Residents of Hawaiʻi are also commonly bitten by the southern house mosquito (*Culex quinquefasciatus*), the target species in the proposed action, which was introduced to Hawaiʻi in 1826 and occupies both lower elevation and upper elevation habitats across the state. The southern house mosquito is also already naturally infected with *Wolbachia*. Humans in Hawaiʻi therefore are regularly bitten by mosquitoes containing *Wolbachia*, including the strain that would be used in the proposed action (wAlb). No adverse effects have ever been reported in humans, nor is there a biological mechanism allowing adverse effects to occur.

As stated above, the southern house mosquito and the *Wolbachia* bacteria are already present in Hawaiʻi. No new organisms would therefore be introduced to Hawaiʻi by the proposed action. Further, there is no indication that the released mosquitoes would be any better at transmitting disease to humans or wildlife (Popovici et al. 2010). The southern house mosquito does not transmit any human diseases in Hawaiʻi. In contrast, the southern house mosquito is already a remarkably efficient vector of the avian malaria parasite, with an estimated 85–97% of southern house mosquitoes being susceptible to infection and transmission (LaPointe et al. 2005). Increasing the vector competence (ability to transmit disease) of the southern house mosquito is therefore highly unlikely and ecologically insignificant when compared to the known risk of allowing these mosquitoes to proliferate on the landscape. The proposed action has been vetted and remains supported by all state, federal, and private conservation organizations that have management responsibilities towards the recovery of endangered forest birds on East Maui.

The incompatible insect technique (IIT) using *Wolbachia* is an approach that was researched, developed, and first used over 50 years ago for the express purpose of human public health (Laven 1967). Over the following half-century, the approach has continued to be studied, patented, and applied specifically for the benefit of improving public health outcomes for humans where mosquito-borne diseases are a threat. New text was added to Appendix B (Page B-9) of the EA to better describe why there would be no impacts to human health from releasing incompatible male mosquitoes.

CONCERN 3: Commentors were concerned that previous attempts to introduce biological control mechanisms in the past in Hawai'i have had unforeseen and adverse impacts (e.g., mongoose introduction to control rats) and that this will occur with the proposed mosquito releases.

Response: No new organisms would be introduced to Hawaiʻi by the proposed action. The southern house mosquito (*Culex quinquefasciatus*) and the *Wolbachia* bacteria are already present in Hawaiʻi. The *Wolbachia* bacteria used to generate incompatible male mosquitoes occurs in Hawaiʻi in the Asian tiger mosquito (*Aedes albopictus*), introduced to Hawaiʻi in 1896. The southern house mosquito has been widely established in Hawaiʻi since its introduction in 1826 and already naturally carries a strain of *Wolbachia* bacteria.

Researchers and resource managers possess long-term data that aptly demonstrate that the worst-case scenario for native wildlife is currently well underway (Pratt et al. 2009; Paxton et al. 2022). The southern house mosquito continues to vector the parasite to native honeycreepers that causes avian malaria, driving these irreplaceable biocultural resources to extinction. The proposed project aims to control the southern house mosquito in forest habitat, where male and female mosquitoes are already present and causing widespread mortality to endangered forest birds. If released, incompatible male mosquitoes are expected to survive for less than a week before mating and then dying. If releases of incompatible male mosquitoes are halted, there will be no lasting effect on the environment.

The history of biological control in Hawaiʻi is complicated, with success stories largely overshadowed by misinformation. The same lack of regulations and biosecurity measures that enabled the southern house mosquito to first be introduced to Hawaiʻi in 1826 also enabled private plantation owners on Hawaiʻi Island to import the Small Indian Mongoose (*Urva auropunctata*) from Jamaica in 1883 with no official review or oversight. Many other regrettable and ill-planned species introductions were completed prior to the Kingdom of Hawaiʻi publishing the first "Laws of the Hawaiian Islands" in 1890, which sought to regulate pest species introductions and spread. It was not until the 1960's when the now State of Hawaiʻi began to comply with federal laws, including the National Environmental Policy Act (1970) and Endangered Species Act (1973), and established State laws (HRS 150A and HRS 343) to ensure any new species introductions of plants or animals were carefully studied and reviewed. The proposed management action is subject to each of these State and Federal laws, regulations, and review.

CONCERN 4: Commentors were concerned that the introduced mosquitoes would be "genetically modified," "bioengineered," or be considered an unsafe "pesticide."

Response: The proposed use of incompatible male mosquitoes is a non-GMO approach. The U.S. Environmental Protection Agency (EPA) is not regulating this approach as a GMO or a genetically engineered product. According to the EPA, a genetically modified organism (GMO) is "a plant, animal, or microorganism that has had its genetic material (DNA) changed using technology that generally involves the specific modification of DNA, including the transfer of specific DNA from one organism to another. Scientists often refer to this process as genetic engineering."

The proposed technique does not modify any or part of the genome of either mosquitoes or *Wolbachia* bacteria. The incompatible male mosquitoes this project proposes for release are incapable of successfully reproducing and therefore cannot pass on their genes to successive generations. If releases are stopped, the population of mosquitoes already present in the forest within the proposed project area will gradually return to pre-release levels.

The EPA has reviewed the use of incompatible male mosquitoes with *Wolbachia* as a biopesticide. The agency defines biopesticides as "naturally occurring substances that control pests (biochemical pesticides), microorganisms that control pests (microbial pesticides), and pesticidal substances produced by plants containing added genetic material (plant-incorporated protectants) or PIPs." Many biopesticides registered by the EPA can be used in and around lands cultivated for certified organic food production if ingredients also meet U.S. Department of Agriculture standards.

CONCERN 5: Commentors were concerned that the proposed action is not a long-term solution.

Response: There is no single solution to the extinction crisis endangered Hawaiian forest birds currently face. However, the release of incompatible male mosquitoes with *Wolbachia* is the most promising new approach that resource managers can implement in the near-term to control the primary threat to native forest birds in remote natural areas.

While it is true that the IIT method requires consistent releases of incompatible male mosquitoes to maintain suppression of mosquito populations, this is a method that can be used on a landscape-scale over long periods. It is common for management projects to require repeated actions to maintain the success of the project. For example, fencing to keep out problematic mammals (e.g., rats, pigs, and deer) from sensitive habitats requires regular maintenance. Similarly, controlling weeds or invasive insects usually requires repeated visits to affected sites, sometimes for many decades after an infestation is discovered.

The proposed IIT mosquito suppression project was identified as a priority for Hawaiʻi at local and international planning meetings in 2016 and 2017. Over the last six years, federal and state agencies and non-governmental organizations (NGOs) have participated in exhaustive research, development, and planning, and have initiated permitting and environmental compliance. The program would be part of a suite of management actions that are currently in place, or are being considered, designed to protect native forest birds from extinction. These include captive propagation of forest birds, potential translocations of birds to Hawaiʻi Island, and future mosquito suppression techniques (USDOI, 2022). These tools, however, are not permanent solutions either. There is a considerable urgency to control mosquito populations to save these birds from extinction. Although IIT is not a permanent solution, the birds cannot afford to wait until new tools are developed, perhaps many years in the future. Should a more long-lasting technique be developed to the point where it could be applied to the landscape, it could be considered in the future, with appropriate environmental compliance. It is also possible that future mosquito suppression techniques will benefit from the procedures developed for the proposed action.

CONCERN 6: Commentors were concerned that the proposed action may be inefficient, ineffective, and costly.

Response: Conservation and resource management in Hawaiʻi can be costly. Programs that aim to preserve Hawaiʻi's watershed forests, protect near-shore beaches and reefs, stabilize and recover endangered species, control destructive invasive species, and support commercial and recreational fishing and hunting programs all require significant recurring state and federal funding. Sometimes funds are used to study and develop new management tools and approaches, while other funds are directed towards specific on-the-ground actions. As mentioned in the response to Concern 5, the proposed action is the most promising tool currently available to protect native forest birds in their present habitat.

The National Park Service (NPS) directs resources, funds, and personnel to preserve the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. Likewise, the Hawaiʻi Department of Land and Natural Resources (DLNR) is charged with the task of enhancing, protecting, conserving and managing Hawaiʻi's unique and limited natural, cultural and historic resources that are held in public trust for current and future generations of the people of Hawaiʻi nei, and its visitors, in partnership with others from the public and private sectors.

The NPS and the DLNR have not only the legal mandate, but the kuleana (privilege and responsibility) to protect biocultural resources. Hawaiʻi's unique biodiversity is deeply interlaced with Hawaiian culture. Both NPS and DLNR stewardship aim to perpetuate the unique and continuing connections between Hawaiian culture and this sacred and evolving land. Honeycreepers such as the ʻākohekohe and kiwikiu are ʻaumakua (familial guardians or ancestors), and their endurance in the native forest is an embodiment of Hawaiian culture. As noted in the Cultural Impact Assessment, pg. 48: "Hawaiian culture views natural and cultural resources as being one and the same: without the resources provided by nature, cultural resources could and would not be procured. From a Hawaiian perspective, all natural and cultural resources are interrelated, and all natural and cultural resources are culturally significant. Kepā Maly, ethnographer and Hawaiian language scholar, points out, "In any culturally sensitive discussion of land use in Hawaiʻi, one must understand that Hawaiian culture evolved in close partnership with its natural environment. Thus, Hawaiian culture does not have a clear dividing line of where culture ends and nature begins" (Maly 2001:1).

The Rapid ʻŌhiʻa Death project is an example of another program that requires extensive federal and state funding to preserve ʻōhiʻa (*Metrosideros polymorpha*), a species that is the backbone of the native forest and a significant biocultural resource.

CONCERN 7: Commentors were concerned that the entire range of alternatives was not fully assessed, including alternatives such as reforestation, gene drive in mosquitoes, radiation to sterilize the mosquitoes, or the use of a *Cordyceps* fungus.

Response: With respect to gene drive and radiation, those alternatives were considered but dismissed and are discussed in detail in Appendix B of the EA.

Regarding the use of *Cordyceps* fungus, in 2017 a group of biologists, entomologists, biotechnology experts, and public health specialists discussed the possible solutions to the problem of mosquito-borne diseases (https://reviverestore.org/the-plan-to-restore-a-mosquito-free-hawaii/). The group identified the sterile insect technique, the incompatible insect technique using the *Wolbachia* bacteria, and self-limiting insect approaches using next generation gene tools. *Cordyceps* or other fungus species were not identified as tools for suppressing mosquito populations, and there is not a fungus that is effective at suppressing populations of the southern house mosquito (*Culex quinquefasciatus*). New technology as it becomes available will be explored as potential options in the future.

Reforestation and habitat restoration have occurred in the past and are ongoing actions in and around the project area and are expected to continue. While these efforts contribute significantly to the long-term restoration of suitable habitat throughout endangered forest bird critical habitat, these efforts alone will not prevent the extinction of the species.

Loss of suitable habitat has been extensive in the Hawaiian Islands and is an important threat to forest birds generally. However, introduced mosquitoes are also a threat because forest birds on Maui are highly susceptible to mosquito-borne diseases and are not expected to persist in areas where mosquitoes are present. Therefore, restoration of suitable habitat through reforestation of areas in which mosquitoes are present is not expected to be an effective alternative strategy to prevent the extinction of those species. Restoration of suitable habitat in high elevation areas where mosquitoes are not present, or not expected to be present as global temperatures rise, is an important part of recovery efforts. However, it does not constitute an effective alternative to mosquito control at this time because, 1) the acreage of potential suitable habitat at those high elevations is vanishingly small, and 2) restoration of suitable habitat in those areas takes decades and cannot be completed before the projected extinction timeline of the affected species.

As previously mentioned, the proposed action would be part of a suite of management actions designed, at least in part, for the preservation of native forest birds. The US Fish and Wildlife Service (USFWS) detailed a long-term conservation and recovery plan for several taxa of endangered Hawaiian forest birds, including the remaining populations of ʻākohekohe and kiwikiu on East Maui (USFWS 2006). The plan prioritized measures to improve and restore degraded habitat through invasive species control and reforestation. The Maui Forest Bird Recovery Working Group (MFBWG) created a comprehensive Kiwikiu Conservation Translocation Plan (MFBWG 2018), which detailed strategies for establishing a kiwikiu population, via conservation translocation, in the Nakula Natural Area Reserve (NAR). The reserve was identified by the USFWS as a forest that held great potential for providing habitat for kiwikiu. The Maui Forest Bird Recovery Project (MFBRP) and the State of Hawaiʻi Department of Land and Natural Resources (DLNR) – Division of Forestry and Wildlife (DOFAW) Native Ecosystem Protection and Management (NEPM) program began reforestation efforts in the reserve and conducted experimental restoration trials to explore techniques that may be employed to increase density and diversity of native vegetation within the reserve (Warren et al. 2019). MFBRP and NEPM planted over 170,000 native seedlings from 2012 to 2019, which transformed non-native grasslands to native forest suitable for sustaining a population of kiwikiu. In 2019, after many years of preparation, 14 kiwikiu individuals were transferred to Nakula NAR. After release, birds were monitored using radio telemetry and most birds showed encouraging behavior in the new habitat, foraging independently, and remaining near the release site. Unfortunately, every bird was exposed to avian malaria and 12 of them had either died or disappeared by late November 2019. The failure to establish another population in restored forest further demonstrated the dangers imposed by avian malaria in a changing climate. Population viability models predicted time to extinction of kiwikiu as soon as 2027 (Mounce et al. 2018, Paxton et al. 2022), which further demonstrates the urgency for implementing mosquito suppression techniques in both current and previously occupied ranges where reforestation, habitat restoration, and invasive species control is ongoing. Information has been added to Appendix E of the EA to provide details regarding ongoing habitat restoration efforts, particularly at the state level.

CONCERN 8: A commentor was concerned that insufficient time was provided to review the EA and respond.

Response: The NPS and DLNR prepared a full environmental assessment and provided more than the legally required time for the public to review and comment. The State HEPA regulations require a 30-day public review period for an EA and the NEPA regulations have no minimum requirement for public review periods for an EA, although the NPS NEPA Handbook recommends a 30-day review period. In this case, the EA was open for public review and comment from December 6, 2022 through January 23, 2023, for a total of 48 days. Please see the response to Concern 1 for an explanation of why the NPS and DLNR did not prepare an Environmental Impact Statement (EIS).

CONCERN 9: Commentors were concerned that there has been insufficient study of the proposed action, that more studies should be completed, and that the proposed action is a "rash" decision.

Response: The southern house mosquito has been present in Hawaiʻi for nearly 200 years and already naturally carries the *Wolbachia* bacteria within its cells. This species of mosquito has invaded native forest habitat, which is the last refuge for critically endangered forest birds, and also occupies suburban and urban areas - even taking advantage of breeding indoors in air conditioner condensation/drip pans/drain pans in high rise buildings. As a result, residents of Hawaiʻi have been interacting with and bitten by the southern house mosquito (carrying *Wolbachia*) for generations.

While this project is the first proposed use of incompatible male mosquitoes with *Wolbachia* for conservation purposes, and the first time the approach would be used in Hawaiʻi, there is a substantial body of data that demonstrate the approach is safe, targeted, and results in no adverse effects to humans or the environment (Laven 1967; Moreira et al. 2009; Atyame et al. 2011; Atayme et al. 2015; Kittayapong et al. 2019; Zheng et al. 2019; Crawford et al. 2020; Beebe et al. 2021).

The proposed mosquito suppression project using incompatible male mosquitoes was identified as a priority for Hawaiʻi at local and international planning meetings in 2016 and 2017. Over the following six years, Federal and State agencies and NGOs have participated in exhaustive research, development and planning to facilitate project implementation, and initiated permitting and environmental compliance. Outreach related to the use of incompatible male mosquitoes has been ongoing since 2018, and the use of this approach has been recommended by both executive and legislative branch leadership across the state.

In 2017, the Hawaiʻi Invasive Species Council adopted Resolution 17-2, supporting research and evaluation of landscape-scale control technologies for mosquitoes, and encouraging researchers to review and evaluate approaches that could potentially benefit both native wildlife and human health in Hawai'i. In 2019, House Resolution (HR) 297 passed the Hawaiʻi State House and directed the "[Department of Agriculture] to review the *Aedes aegypti* mosquito with *Wolbachia* bacteria, including *Aedes aegypti* mosquitoes originating from Hawaiʻi stock that could be imported for landscape scale mosquito control, and render a determination to place it on the appropriate animal import list." The resolution required the Departments of Health (DOH), Agriculture (DOA), and Land and Natural Resources (DLNR) to collaborate on a report to the Legislature with recommendations for appropriate vector control programs. In 2021, House Resolution (HR) 95 subsequently passed the Hawaiʻi State House urging DLNR, DOA, DOH and the University of Hawaiʻi to implement a mosquito control program using *Wolbachia* to reduce mosquito population levels throughout the state. In 2022, the Hawaiʻi Board of Agriculture voted to approve the administrative rule change and issuance of an import permit that would enable the proposed project to be implemented.

The period during which these resolutions were introduced and approved, highlights the timeline over which this approach has been under public review and subject to public comment

CONCERN 10: Commentors were concerned that the *Wolbachia* bacteria in the mosquitoes to be released is "foreign" or would be "introduced" to an environment on Maui where it currently does not occur.

Response: The proposed action will not involve introducing any new or foreign organisms to Hawaiʻi (see response to Concern 3). Any releases of organisms of this kind are rightfully scrutinized, well studied, and regulated. The incompatible male mosquitoes reared in the lab would be derived from mosquitoes initially collected in Hawaiʻi. These are the same species of mosquito, the southern house mosquito (*Culex quinquefasciatus*), that are present in Hawaiʻi and responsible for spreading avian malaria. Similarly, the strain of *Wolbachia* in the released male mosquitoes is also present in Hawaiʻi in the bodies of another mosquito common in the state, the Asian tiger mosquito (*Aedes albopictus*).

The southern house mosquitoes that exist in Hawaiʻi today carry a strain of *Wolbachia* call wPip. The Asian tiger mosquito carries a different strain of *Wolbachia* called wAlb. To create the incompatible southern house mosquitoes, scientists would create a laboratory line of Hawaiʻi mosquitoes with the wAlb *Wolbachia* strain. This is done through a multi-step process involving rearing mosquitoes in the lab and removing the wPip *Wolbachia* from their bodies with common antibiotics. The new strain (wAlb) of *Wolbachia* is then injected into the eggs of the *Wolbachia*-free mosquitoes. The resulting mosquitoes are southern house mosquitoes with a stable infection of wAlb *Wolbachia*. These are reared for several generations and carefully tested. All this work is done in sterile laboratory conditions.

The success of the suppression program is predicated on only releasing male southern house mosquitoes. As *Wolbachia* is maternally inherited, no local establishment of wAlb southern house mosquitoes is expected or likely to occur (see response to Concern 12 for more on the issues of female contamination and local establishment). However, as no organisms (mosquito or *Wolbachia*) used in this proposed project are novel to Hawaiʻi, local establishment would not constitute introduction of any foreign species. Text has been added to page 6 of the EA to provide this clarification.

CONCERN 11: Commentors were concerned that the proposed project would be an "experiment" that has not been implemented prior.

Response: As mentioned in the response to Concern 9, the proposed action is an application of an established method for controlling insect populations. The IIT method has been used for decades in over ten countries including elsewhere in the United States. This is neither an experiment nor a novel technique being tested in Hawaiʻi. The IIT method is a highly effective and safe technique with a strong record of peer-reviewed studies and successful applications around the world. What is new about this proposed action is that it has not been employed in Hawaiʻi nor for wildlife conservation. As such, protocols will need to be developed for its use in Maui's native forest and other local conditions.

CONCERN 12: Commentors were concerned that female mosquitoes would be released that could ultimately breed and perpetuate or increase rather than suppress the mosquito population.

Response: Several commentors correctly identified that the release of females, "female contamination", would negatively impact the ability of the proposed action to suppress mosquito populations. Potentially released females, however, present no more risk to humans or animals than the mosquitoes that currently occur on Maui. Nor would releases of females increase the population of mosquitoes on Maui.

Given the importance of only releasing male mosquitoes, sorting out females is a vital part of the process. In previous IIT programs similar to the proposed action, sex sorting was accomplished in several ways, with varying rates of success. One of the primary methods used to separate and eliminate females uses sieves, or another similar physical separation method, taking advantage of the fact the female pupae are larger than male pupae. This method alone is estimated to remove >95% of all females, and various additional methods have been used to eliminate remaining females or render them sterile (e.g., exposure to radiation). Using the methods likely to be employed in the proposed action, it is estimated that the risk of releasing a female is 1 out of 900 million released mosquitoes (Crawford et al. 2020). This highly technical process uses physical separation of pupae, followed by imaging and sorting of emerged adults via artificial intelligence (AI) programs to remove remaining females. Following this, an iterative process of vetting AI scanned images is used to further reduce the risk of females being present in any given batch of mosquitoes bound for release. Following the methods described by Crawford et al. (2020), Beebe et al. (2021) did not detect any released females (or larvae containing control *Wolbachia*) throughout the life of their project in Australia. Using a different method, Zeng et al. (2022) estimated a female contamination rate of <1% and saw no local establishment of *Wolbachia*-infected mosquitoes in their study site. The Crawford et al. (2020) sex sorting would result in a female contamination rate that is several orders of magnitude smaller than reported in Zeng et al. (2022).

The released southern house mosquitoes would be transinfected with the wAlb *Wolbachia* strain and the wild mosquitoes in Hawai‘i currently are naturally infected by the wPip *Wolbachia* strain (see response to Concern 10 for more explanation). Should a wAlb female be released, she would be compatible with the released wAlb male mosquitoes and could produce viable offspring. As such, every effort would be made to reduce or eliminate female contamination in released male mosquitoes. For local establishment of a wAlb population of southern house mosquitoes to form, females would first need to be released and survive long enough to reproduce (mate, find a blood meal, and lay eggs). If overflooding rates of released males are correctly calculated, it is possible that a released female could find a compatible male with which to mate. Scientists have confirmed bidirectional incompatibility between the wAlb and wPip southern house mosquitoes. This means that pairings of wAlb males and wPip females are incompatible, as are pairings of wPip males and wAlb females. Should a released female mate with a wild type wPip male, no offspring would be produced. If a released female successfully produces offspring with a released male, all those offspring would be infected with the wAlb *Wolbachia* strain. These offspring would then need to mate with other wAlb southern house mosquitoes to continue the reproductive cycle, as would all successive generations. Meanwhile, any mating events with wPip wild type mosquitoes would suppress any developing wAlb population. Successful establishment of a wAlb population would thus be the product of a series of extremely unlikely events. Should local establishment be detected, halting releases of wAlb males would allow the wild type wPip mosquitoes to reinvade a portion of treatment area and eliminate the wAlb population. Deliberately releasing wild type wPip male mosquitoes could similarly accomplish the same objective.

Attempting to establish a population of mosquitoes with a *Wolbachia* strain other than that which is already present in an environment is an extremely challenging and resource intensive exercise. In contrast to the releases proposed in this EA, other IIT programs are specifically designed with the goal of replacing a population of mosquitoes with others infected with *Wolbachia* to reduce the transmission of disease. In that type of program both males and females are released. Examining the success of those programs gives some insight into the number of females that may need to be released to successfully establish a population. For example, Hoffman et al. (2011) released between 5,000 and 11,000 females per week (assuming a 1:1 sex ratio). Even at that rate, it took multiple releases over several months to increase the *Wolbachia* frequency in the mosquito population above 50% (indicating they had replaced half the population). Hoffman et al. (2011) also continued to document suppression of their *Wolbachia* mosquitoes through ingress of females from outside the release area. The methods expected to be used in the proposed action estimate that one female may be inadvertently released out of 900 million released mosquitoes

(Crawford et al. 2020). Thus, very few females are likely to be released; likely too few to result in local establishment.

CONCERN 13: Commentors were concerned that there is a risk that the release of *Wolbachia*-infected mosquitoes could increase, rather than diminish, disease transmission within the ecosystem and to humans (e.g., malaria, dengue fever, yellow fever, Zika virus, and West Nile Virus).

Response: There is no indication that the released incompatible male mosquitoes will increase disease transmission in humans or wildlife. The general trend seen in the peer-reviewed literature is that *Wolbachia* infection leads to lower rates of disease transmission including that of dengue, chikungunya, Zika, West Nile Virus, and malaria (e.g., Moreira et al. 2009, Hussain et al. 2012, Dutra et al. 2016). The ability of *Wolbachia* to suppress disease transmission is the basis for several applications of IIT. Prime examples are projects aimed at replacing populations of the yellow fever mosquito (*Aedes aegypti*), which is naturally *Wolbachia*-free, with those infected with *Wolbachia*, thereby reducing the spread of dengue and other diseases (e.g., Eliminate Dengue [Eliminate Dengue | FHI 360]).

As several commentors mentioned, there are a few select studies that show the opposite pattern, i.e., increased disease transmission in *Wolbachia*-infected mosquitoes. However, there are significant differences between the proposed action and the methods employed by these studies and the study systems involved. In all the studies highlighted by commentors, the *Wolbachia* infection involved was either natural or achieved by inoculating adult mosquitoes, resulting in transient (unstable) infections (Zele et al. 2013, Dodson et al. 2014, Hughes et al. 2014). As Dodson et al. (2014) stated, "It should be noted that these experiments were performed with mosquitoes transiently infected in the somatic tissues with *Wolbachia*, rather than a stable maternally inherited infection. It remains to be seen whether a stable wAlbB infection will enhance WNV [West Nile Virus] in a similar way." The released mosquitoes in the proposed action would inherit their *Wolbachia* maternally and the infection would be stable and concentrated in sex cells. It should be noted that local transmission of West Nile Virus, chikungunya, Zika, and malaria (any other form besides avian) has not been documented in Hawai'i.

Over 200 species of *Plasmodium*, the malaria parasite, have been identified and each species is host specific, meaning it can only infect certain kinds of animals. Further, most *Plasmodium* species are spread by specific mosquito species or a closely related group of species. Hughes et al. (2014) reviewed the effects of *Wolbachia* infection on transmission of various malaria parasite species. These authors showed that while most *Wolbachia* infections led to a reduction in malaria transmission, some *Wolbachia* infections led to an increase in transmission of rat malaria (*Plasmodium berghei* and *P. yoelli*; limited to Africa), chicken malaria (*P. gallinaceum*; not present in Hawai'i), and one case of avian malaria (*P. relictum*). As noted in the response to Concern 2, the southern house mosquito is already a highly efficient vector of the avian malaria parasite, with 85–97% of mosquitoes being susceptible to infection and transmission (LaPointe et al. 2005) and it is improbable that susceptibility could increase beyond what is currently seen in the wild. Notably, Hughes et al. (2014) also showed that *Wolbachia* infection consistently led to a decrease in transmission of human malaria (*P. falciparum*). Regardless, neither the species of mosquito that carries human malaria, nor human malaria itself, are present in Hawai'i.

Another important difference between the studies that found increases in disease transmission in *Wolbachia*-infected mosquitoes and the proposed action is that these studies compared *Wolbachia*-uninfected and *Wolbachia*-infected mosquitoes. Zele et al. (2013), referenced in Hughes et al. (2014), found an increase in avian malaria infection between *Wolbachia*-uninfected southern house mosquitoes versus *Wolbachia*-infected southern house mosquitoes. In Hawai'i, nearly 100% of southern house mosquitoes are naturally infected with *Wolbachia* (Atkinson et al.

2016) as would be the released incompatible males. A comparison with Zele et al. (2013) is therefore inappropriate.

The text in the Human Health and Safety section of Appendix B (Page B-9) has been updated to include information from this response.

CONCERN 14: Commentors were concerned that transinfected *Wolbachia* will make its way into other mosquito or other insect species non-maternally, i.e. via "horizontal transfer."

Response: *Wolbachia* (wPipV) is already present in the southern house mosquito (C*ulex quinquefasciatus*) in Hawaiʻi, and *Wolbachia* (wAlbA and wAlbB) strains are already found in the Asian tiger mosquito (*Aedes albopictus)* in Hawaiʻi as well. These mosquito species have been in Hawaiʻi since 1826 and 1896, respectively. It is highly improbable that incompatible male mosquitoes, which cannot reproduce and will die out in the environment less than a week after release, are more likely to undergo horizontal transmission of *Wolbachia* than the existing populations of mosquitoes which have been reproducing on the landscape for the last 125–200 years. Further, *Wolbachia* is common among native Hawaiian insects (Bennett et al. 2012).

Wolbachia is an endosymbiotic organism (living within the cells of another organism) that is maternally inherited, i.e., passed down from a mother to her offspring; also known as "vertical transfer". "Horizontal transfer" in this case would be the transmission of *Wolbachia* from one organism to another non-maternally. The mechanism for such a transfer in *Wolbachia* is not known, would only occur following a series of extremely unlikely events, and would require the *Wolbachia* to live outside of their host cells for some period of time. In a laboratory setting, keeping *Wolbachia* alive outside of host cells requires precise conditions to preserve them in a cell-free medium for even short periods (Rasgon et al 2006). In fact, this is required in the process of creating the incompatible mosquitoes in the proposed action. However, some have asserted or implied that the ability to preserve *Wolbachia* outside of cells in a laboratory setting (Rasgon et al. 2006) represents evidence that *Wolbachia* can live extracellularly in the wild (Tolley et al. 2019). But there has yet to be any evidence of free-living *Wolbachia* in the wild and there are numerous environmental factors that would severely limit the lifespan of *Wolbachia* outside of their host cells (e.g., pH, UV radiation). The mechanism for horizontal transmission of *Wolbachia* remains unknown, but the theories for how this has occurred in the past have little relevance to the system in the proposed action. Tolley et al. (2019) suggested that horizontal transfer in ants could have occurred through social interactions or predation, but there remains no direct evidence of this, and this theory is purely speculative.

There is good evidence that, over millions of years, horizontal transfer of *Wolbachia* has occurred numerous times (Tolley et al. 2019, Ding et al. 2020). However, *Wolbachia* shows a high degree of host endemism (only lives within one host species or closely related species) especially the strains involved here, wPip and wAlb (Ding et al. 2020). This high rate of endemism itself is evidence of the rarity of horizontal transfer. Just as several commentors suggested, Loreto and Wallau (2016) theorized that horizontal transfer between mosquito species (or other insects) may cause some unknown impacts in an IIT program. O'Neill (2016) directly addresses the concerns of Loreto and Wallau (2016) and makes several relevant points regarding horizontal transfer including, 1) horizontal transfer is very rare in nature (e.g., Hamm et al. 2014), and 2) natural experiments indicate a low rate of horizontal transfer including in closely related sympatric (living in the same place) mosquitoes. To the second point, both the Asian tiger mosquito (*Aedes albopictus*) and the yellow fever mosquito (*Aedes aegypti*) live in the same environments in many parts of the world, including on Hawaiʻi Island. The Asian tiger mosquito is nearly always infected with *Wolbachia* naturally (the same strain that would be used in the proposed action), while the yellow fever mosquito is naturally uninfected by *Wolbachia,* and yet there has never been evidence of horizontal transfer of *Wolbachia* between these species. There also is no evidence that the strain of *Wolbachia* found in southern house mosquitoes has been transmitted to the Asian tiger mosquito (or any other mosquito), or vice versa, in Hawaiʻi (or anywhere else) despite co-occurrence for the past >130 years (Atkinson et al. 2016). Further, there is no evidence of transfer of any mosquito *Wolbachia* to other arthropods, including native Hawaiian insects. The low rate of horizontal transfer among related species, such as *A. albopictus* and *A. aegypti*, would suggest that the rate of transfer among unrelated arthropods would be even lower.

CONCERN 15: Commentors were concerned that horizontal gene transfer may occur within the transinfected mosquitoes and unknown evolutionary events may occur as a result.

Response: Commentors listed concerns regarding horizontal gene transfer between the *Wolbachia* endosymbiont and the mosquito. To clarify, this is different from the concerns of horizontal *Wolbachia* transfer involving non-heritable movement of the *Wolbachia* organism between insect species (see response to Concern 14). Horizontal gene transfer in this context would be the theoretical movement of genetic material (DNA) from *Wolbachia* into the southern house mosquito genome. Horizontal gene transfer is a natural process that has occurred innumerable times throughout evolutionary history. Scientists have found segments of DNA within numerous eukaryotic (e.g., animal) organisms that can be traced back to a prokaryotic (i.e., bacteria) organism, often in parasite-host interactions. This may in fact be an important evolutionary process that is just now being realized. However, the process of horizontal gene transfer itself is not a concern. Rather if such a transfer includes transcriptional phenotypic traits that could be acted upon by selective pressures that allows for beneficial traits to be developed. A segment of DNA does not necessarily contain all the required information to be transcribed (read) and conferred into new traits or functions. Much of a genome in fact contains sequences of non-coding DNA, often referred to as "junk DNA." Thus, the likelihood that such an event could somehow alter the genome of the mosquito in a meaningful way is exceptionally low. Further, horizontal transfer of genes between *Wolbachia* and a mosquito would not constitute the creation of a new species of mosquito as some commentors suggested.

Some commentors singled out a study by Klassen et al. (2009) that purported to show evidence of horizontal gene transfer between *Wolbachia* (wPip) and the yellow fever mosquito (*Aedes aegypti*). These authors found several sequences of DNA within the (typically *Wolbachia*-free) yellow fever mosquito's genome that had previously been identified from the *Wolbachia* genome. These authors do acknowledge, however, that while the most likely direction of transfer was from the *Wolbachia* to the mosquito, it cannot be determined for certain the transfer did not occur in the opposite direction. Most importantly, these examples of gene transfer occurred as a result of a natural evolutionary event(s), not as a result of any human-caused process, such as in the proposed action, therefore the timescale required for these transfer events is unknown. Further, given that the wPip strain of *Wolbachia* has co-evolved with the southern house mosquito likely for millions of years, it is considerably more likely that horizontal gene transfer may have naturally occurred between these species than between the transinfected wAlb and the southern house mosquito.

Finally, concerns such as horizontal gene transfer are predicated on establishment of a reproducing population of southern house mosquitoes infected with wAlb strain of *Wolbachia.* The purpose of the proposed action is to suppress the population of southern house mosquitoes within the project area on East Maui. Local establishment of wAlb southern house mosquitoes would work against that goal and extreme care would be taken to avoid that scenario. For more information, please see response to Concern 12.

CONCERN 16: Commentors were concerned that Native Hawaiian concerns, including Environmental Justice, were not appropriately addressed and that they would be disproportionately affected by the project.

Response: With respect to Environmental Justice, there is no evidence that the release of incompatible male mosquitoes on east Maui will have any human health impacts. Therefore, there would be no disproportionately high and adverse human health impacts to Native Hawaiians that would result in Environmental Justice concerns. Please refer to Appendix B of the EA for a discussion of Environmental Justice and how it was considered but dismissed from further analysis.

Impacts to Ethnographic Resources and Traditional Cultural Practices are addressed in Appendix B of the EA. The proposed action will result in limited visual and noise impacts to the feeling and setting of ethnographic resources, including the Haleakalā Summit, Kīpahulu Valley, and Kaupō Gap Traditional Cultural Property. Noise associated with helicopter or drone flights and their visual intrusion could potentially be a disturbance to the traditional users of park or state areas and could potentially detract from their enjoyment and use. However, these noise and visual impacts have been minimized in order to limit negative impacts to ethnographic resources. Park operations, e.g., flight times and flight paths, would be planned to balance efficiency and any potential impacts. The proposed action will minimize the use of helicopters and focus on the use of drones, which are smaller and quieter than helicopters. Any necessary helicopter flights would be planned to avoid the park's annual commercial-free days. As specified in the park's Commercial Services Plan, commercial-free days are opportunities for Kānaka Maoli (Native Hawaiians) to conduct traditional cultural practices in the park without commercial tours present. In 2023, the commercial-free days will occur on January 6 (end of Makahiki); May 24 (Zenith Noon); June 21 (Summer Solstice); July 18 (Zenith Noon); October 27 (start of Makahiki); and December 21 (Winter Solstice). The commercial-free days are designated prior to the start of the calendar year and change slightly each year. They are determined in consultation with the Native Hawaiian Community.

The NPS consulted with the Native Hawaiian Community, including 11 individuals and 17 Native Hawaiian Organizations, to identify any impacts from the proposed action and no substantial comments have been received to date. Additionally, DLNR prepared a Cultural Impact Assessment (CIA) as part of compliance with the Hawaiʻi, Environmental Policy Act (HEPA). Based on the research and ethnographic data within the CIA report, it was found that it would be unlikely that the proposed action would adversely impact traditional or customary practices. Yet, the interviews completed as part of the CIA make it clear that additional education and outreach is needed, particularly to the practitioner community. There was concern expressed by interviewees that the project could potentially and adversely impact native flora and fauna. The CIA recommended education and outreach to the East Maui community, particularly hunters and other practitioners, as a critical component of the project (Watson 2022: 85).

Thus far the NPS has conducted two virtual public meetings to collect initial comments in the development of the. Information may be found here: ParkPlanning - Suppression of Invasive Mosquito Populations to Reduce Transmission of Avian Malaria to Threatened and Endangered Forest Birds on East Maui (nps.gov) and here: About | Birds Not Mosquitoes. The state DLNR and Birds not Mosquitoes, a public-private partnership, plans to do additional outreach to East Maui communities, and statewide, to educate about this project.

Additionally, to mitigate potential public concerns regarding *Wolbachia*-incompatible mosquito releases, the IIT project team consulted with the DLNR Maui Branch Manager to identify areas on state lands commonly used by hunters or cultural practitioners. Most public hunting areas within the East Maui project area are only open on weekends when it's unlikely that mosquito release operations will take place. Further, most treatment area points on public hunting lands are in remote upland areas rarely visited by hunters. The one exception is the Makawao Forest Reserve, where there are approximately 60 release points, which would take 1–2 hours per release to treat by aerial methods. The reserve is open for hunting and other recreational activities daily. Those activities may include plant and flower gathering for lei making and other traditional Hawaiian practices. The project team met with the DLNR Na Ala Hele trail advisory committee on July 27, 2022, to discuss potential concerns and how best to communicate IIT implementation plans in that popular recreational area. The project team will work with DLNR to post signage on trails communicating release plans, and to participate in public outreach events. On DLNR lands, Native Hawaiian organizations would be notified prior to any planned release efforts.

The CIA also found that native birds could be considered a cultural resource as they are entwined in both Hawaiian culture and tradition across the islands. The history of the birds in Hawaiʻi is one of tremendous adaptive radiation due to geographic isolation resulting in numerous species of birds found nowhere else on earth. The use of helicopters and drones under the proposed action could temporarily disturb native forest birds, but over the long term there would be substantial benefits by minimizing the spread of avian malaria and reducing bird mortality. Any minimal impacts to ethnographic resources and traditional cultural practices would likely be temporary at any given location, though releases would likely occur over the long term. Reduction of avian malaria as proposed would conserve numerous rare birds important to Native Hawaiian culture providing a beneficial impact, outweighing the adverse impacts.

CONCERN 17: During the public comment period, commenters submitted additional literature for review.

Response: The NPS and DLNR reviewed all literature that was submitted during the public comment period on the EA and incorporated relevant information into the EA or comment responses as necessary.

CONCERN 18: Commenters were concerned that wildland fires would be ignited by drones and helicopters.

Response: Wildland fire mitigation measures for helicopters are included in Table 6 of the EA.

All uncrewed aircraft systems (UAS), also known as “drones”, will be closely monitored by the operator and field teams while adhering to guidance developed by the NPS Natural Resource Stewardship and Science Directorate and policies established by Federal Aviation Administration. The DLNR Division of Forestry and Wildlife (DOFAW) is mandated under the Land Fire Protection Law, Chapter 185, Hawaiʻi Revised Statute to take measures for the prevention, control, and extinguishment of wildland fires within all forest reserves and natural area reserves on East Maui (DLNR, DOFAW 2018). DOFAW is statutorily required to cooperate with county and federal government fire control agencies to develop plans for wildfire prevention. UAS operators under NPS or DOFAW operational control will be required to have an up-to-date FAA 14 CFR Part 107 Remote Pilot Certificate and FAA Certificate of Waiver or Authorization. UAS operations will follow best practice protocols established by the National Wildfire Coordinating Group which provides guidance detailed in the Interagency Helicopter Operation Guide. NPS law enforcement will monitor UAS operations and approve flight plans and thus will be able to respond immediately to UAS mishaps. The Hawaiʻi Fire Department, in coordination with NPS Fire Management officers and the DOFAW Fire Management Program, will respond to any on-site emergency, including downed UAS vehicles to ensure that there is no risk of wildfire. Text was added to Table 6 in the EA to include these practices as mitigation measures under the proposed action.

CONCERN 19: Commenters expressed concern about impacts to bats and dragonflies that would eat the transinfected male mosquitoes released under the proposed action.

Response: Native taxa such as damselflies and bats have been consuming multiple mosquito species containing *Wolbachia* (including *Aedes albopictus* and *Culex quinquefasciatus*) since the introduction of mosquitoes intermittently with no adverse effects. *Wolbachia* cannot live in vertebrates and thus cannot affect bats (Popovici et al. 2010). See the response to Concern 14 for examination of "horizontal transfer" of *Wolbachia.* There is no indication that consumption of transinfected mosquitoes would present a risk to native damselflies. In Hawaiʻi, native wildlife do not rely on mosquitoes as a prey base. Hawaiʻi's native fauna evolved over millions of years as constituents in a diverse community assemblage. In contrast, mosquitoes are comparatively recent introductions, having invaded Hawaiʻi less than 200 years ago.

CONCERN 20: Commenters suggested that the EA did not analyze the environmental effects of dropping mosquito packaging in the project area.

Response: Although the final design has not been decided upon, agency and private partners are committed to designing release packaging that is suitably biodegradable and will maintain biosecurity protocols. However, until a final product is designed, specific decay rates or other relevant variables are not known. As strict biosecurity protocols will be followed, the release packets present no risk to the environment. Although many thousands of release packets would be dropped across the project area throughout the duration of the project, the small packets would be spread diffusely and the biodegradable material would decompose quickly; thus, the impact to the environment would be negligible.

From a visitor experience standpoint, the release packets are unlikely to be observed by members of the public. The appearance of the release packets is not yet known and would depend on how the packets are designed to fall and land (e.g., on the ground or in trees). However, to fit into a release mechanism of a drone, the release packets are likely to only be a few inches wide and be very light. The visibility of the packets to members of the public will depend on two primary factors, 1) public access to the project area, and 2) spacing of releases. The vast majority of the project area is not publicly accessible and thus, the public would not have an opportunity to come across any release packets prior to the packets degrading throughout most of the project area. In the areas that the public can access, the large spacing between release points would make encountering a release packet very unlikely. The distance between release locations would be determined by initial trials but are likely to be several hundred meters apart. A spacing of 400 meters (1,312 feet), as presented in the EA, would mean that for a member of the public to see a release packet, they would be finding an object only a few inches wide within an equivalent area of approximately 30 football fields of dense forest. The rate of decay of the packets will dictate how many packets within an area one could observe at any given moment, but this decay rate is likely very high given typical rainfall patterns, making the chance of observing multiple packets unlikely.

CONCERN 21: Commenters suggested the restoration of natural water flow on Maui would be a possible solution to the abundance of mosquitoes on Maui.

Response: It is true that human infrastructure in streams in Hawaiʻi can create additional larval habitat for the southern house mosquito. However, the abundance of mosquitoes on Maui is not caused by stream diversions or other human-caused water flow disturbances. Mosquitoes breed in all kinds of natural water sources including, but not limited to, tree cavities, pig wallows, natural depressions, and streamside pools. Kīpahulu Valley's Palikea Stream is a prime example as it has no human infrastructure or streamflow interruptions in core area of the project, where mosquito larval habitat is found in natural features along the stream.

CONCERN 22: Commenters wanted clarification on the number of bird species protected by the Migratory Bird Treaty Act (MBTA) that are within the project area because there are two different numbers stated in the EA.

Response: There are eight (8) bird species protected by the MBTA in the project area. The EA text has been revised to reflect the presence of those 8 bird species.

CONCERN 23: One commenter suggested that under the no-action alternative there would be adverse impacts to visitors trying to experience wilderness solitude due to the presence of biting mosquitoes in wilderness areas and that suppression of mosquitoes would be a benefit to this wilderness quality.

Response: Currently, there is no public access to designated wilderness within the project area, so there would be no impacts to visitors' ability to experience solitude or primitive and unconfined recreation associated with the presence or suppression of mosquitoes. Effects on visitors' ability to experience threatened and endangered bird species (outside of wilderness) is described in the Visitor Use and Experience section of the EA. Also, the impact of the preservation or loss of forest bird species is described under the natural quality of wilderness character.

CONCERN 24: One commenter suggested that the EA acknowledge the concerns around unanticipated outcomes and that a monitoring and response plan will be implemented.

Response: Although the EA implies that a monitoring plan will be developed, we have added text on page 13 of the EA to specifically indicate that a monitoring plan will be developed. The monitoring plan will likely include measures of success as well as certain provisions looking for unanticipated outcomes, such as female contamination.

CONCERN 25: One commenter suggested that there was a discrepancy in the EA regarding the number of monitoring sites that would be used. More specifically, page 14 of the EA indicates that eight sites would be used where the table only lists five monitoring sites.

Response: The EA text and Table 5 indicate that five monitoring sites will be accessed by helicopter and the remaining three will not require the use of helicopters. However, the text on page 14 of the EA has been revised to state this more clearly.

CONCERN 26: One commenter noted that page 20 of the EA states that "personnel would not disturb, remove or trim woody plants greater than 15 feet tall during the bat birthing and pup rearing season of June 1 through September 15" and that the EA also states that any tree cover would not be removed during the forest bird breeding season of November 1 through June 30. This would mean there are only 6 weeks a year of allowable trail clearing time. If ground releases become necessary and it falls outside of that limited window, crews may not be able to access key areas.

Response: It is possible that the commenter is confusing trail clearing with tree clearing. Trail clearing and maintenance could occur throughout the year without disturbance to birds and bats.

CONCERN 27: One commenter was concerned about limiting mosquito releases to two months out of the year by helicopter could limit the effectiveness of the project. A commenter was also concerned with limiting drone releases to two times per week in the entire project area.

Response: As the commenter suggested, a primary goal of the EA was to limit negative impacts to the environment from the proposed action. This required limiting the number of helicopter flights and, thus, the impacts of those flights (e.g., noise). It was determined that the stated helicopter use frequency of two months per year would allow for an acceptable level of impacts. To estimate impacts for the use of helicopters to release mosquitoes, it was necessary to specify the number of flights projected for use. As such the language suggested by the commentors to remove specific limits on helicopter flights could not be incorporated into the EA. However, the impact analysis would apply to any use of helicopters for 56–78 flight hours per year, which could be applied at a different schedule than two months. These flights would also not necessarily have to take place within a single calendar year. Similarly, the helicopter impacts analysis would apply to flights for helicopter-assisted drone flights up to 78 flight hours per year provided they are not in addition to direct helicopter releases.

One commentor suggested clarifying language regarding the frequency of releases of incompatible male mosquitoes. The frequency of release is estimated to be up to two times per week per release location (as indicated on page 8 of the EA). Figure 2 shows potential release locations throughout the core of the project area. Each of these locations could receive incompatible male mosquitoes up to twice per week. It is anticipated that a subset of the project area will receive mosquito releases in the initial phase of the project. This would reduce the total number of release locations accessed during a planned treatment, but each release location may still receive mosquitoes at a frequency of up to two times per week.

CONCERN 28: One commenter was concerned about limiting drone launch sites to "front country" areas only.

Response: Operating drones from backcountry locations would typically necessitate the use of helicopters to transport operators to launch sites. The frequency of releases, estimated up to twice per week per location, would require a much greater impact from helicopters than is included in the impacts analysis of this EA and would present additional logistical challenges. The front country launch sites shown in Figure 3 are examples of sites that may be used, but do not represent all possible launch sites. Drone models exist that can access the vast majority of the project area from road-accessible locations. However, there may be some as-yet-determined limitations to the drone releases that require launch sites closer to release sites. Should helicopter-assisted drone operations be required on a regular basis, such as to access a portion of the project area, the additional impacts may need to be analyzed. Furthermore, should the required release frequency be determined to be less than twice per week, helicopter-assisted drone operation may not unduly increase the impacts of additional helicopter flights. The subheading for Figure 3 on page 11 of the EA was revised to clarify that that the drone launch locations are examples of sites that might be used.

ATTACHMENT B: ERRATA INDICATING TEXT CHANGES TO THE ENVIRONMENTAL ASSESSMENT

INTRODUCTION

This errata documents changes (corrections and minor revisions) to the text of the EA as a result of comments received on the EA during the public review process, as well as other corrections.

Page numbers referenced pertain to the EA released to the public for review on December 6, 2022. Original text from the EA is included to provide context and to allow for comparison to the text change. Additions to text are underlined, and deleted text is shown by ~~strikeout~~.

ERRATA

Page 1

At least two endangered bird species on East Maui, kiwikiu (Maui Parrotbill, *Pseudonestor xanthophrys*) and ʻākohekohe (*Palmeria ~~doeli~~ dolei*)

Page 2

...Hawaiʻi ʻamakihi (*Chlorodrepanis* virens), and ʻapapane (*Himatione ~~sanginea~~ sanguinea*)

Page 6, Mosquito Transport and Storage

The lab-reared incompatible mosquitoes ~~may~~ would be derived from southern house mosquito eggs initially collected ~~on Maui~~ in Hawaiʻi. The *Wolbachia* strain transinfected into the southern house mosquitoes is also found in Hawaiʻi, including Maui. As such, no foreign organisms would be introduced to Maui via the proposed action.

Page 11, Figure 3 Subheading

EXAMPLE DRONE FLIGHT PATHS FROM ~~PRIMARY~~ POSSIBLE LAUNCH LOCATIONS INTO THE CORE AREA."

Page 13, Mosquito Monitoring

NPS and DLNR will work with partners to prepare a detailed monitoring plan. Field teams would conduct a variety of monitoring activities to measure the effectiveness of the proposed action.

Page 14

Monitoring would likely occur quarterly (four times/year). Baseline monitoring data are available from areas of Kīpahulu Valley, TNC's Waikamoi Preserve, and Hanawī Natural Area Reserve (Aruch et al. 2007, MFBRP unpublished), and monitoring would be continued at these locations. Monitoring would be more frequent at the start of the project and would vary depending on the availability of incompatible mosquitoes and personnel. It is assumed that four locations would be selected on state lands (e.g., two within Hanawī Natural Area Reserve and two within Forest Reserves), two locations within the park (within the Kīpahulu Valley Biological Reserve), and two locations within TNC's Waikamoi Preserve. ~~Field teams at the five remote monitoring locations would need to use portable generators to charge the batteries in the mosquito traps.~~

~~Mosquito monitoring would involve field teams camping at established remote shelters or helicopter LZs for overnight stays for approximately one week at a time. Where needed, a helicopter would deliver field teams to established LZs within Haleakalā National Park, TNC's Waikamoi Preserve, Hanawī Natural Area Reserve, or other state reserves.~~ A total of five sites within Haleakalā National Park, TNC's Waikamoi Preserve, and Hanawī Natural Area Reserve are helicopter access only, where mosquito monitoring field teams would camp at established remote shelters or helicopter LZs. Crews would conduct monitoring activities remotely for approximately one week at a time and would need to use portable generators to charge mosquito trap batteries, GPS units, and field radios. Table 5 estimates helicopter flight hours required to transport teams in and out of the field for necessary mosquito population monitoring. Figure 4 shows existing helicopter infrastructure that includes the main heliport at Kahului Airport (OGG) and several LZs throughout the project area. Three other sites within the analysis area are accessible by vehicle, where field teams could commute from management offices daily for monitoring activities.

Page 17, Table 6, add new row under "Wildland Fire" section, with the following text:

All uncrewed aircraft systems (UAS) will be closely monitored by the operator and field teams while adhering to guidance developed by the NPS Natural Resource Stewardship and Science Directorate and policies established by Federal Aviation Administration. The DLNR Division of Forestry and Wildlife (DOFAW) is mandated under the Land Fire Protection Law, Chapter 185, Hawai'i Revised Statute to take measures for the prevention, control, and extinguishment of wildland fires within all forest reserves and natural area reserves on East Maui (DLNR, DOFAW 2018). DOFAW is statutorily required to cooperate with county and federal government fire control agencies to develop plans for wildfire prevention. UAS operators under NPS or DOFAW operational control will be required to have an up-to-date FAA 14 CFR Part 107 Remote Pilot Certificate and FAA Certificate of Waiver or Authorization. UAS operations will follow best practice protocols established by the National Wildfire Coordinating Group which provides guidance detailed in the Interagency Helicopter Operation Guide. NPS law enforcement will monitor UAS operations and approve flight plans and thus will be able to respond immediately to UAS mishaps. The Hawai'i Fire Department, in coordination with NPS Fire Management officers and the DOFAW Fire Management Program, will respond to any on-site emergency, including downed UAS vehicles to assure that there is no risk of wildfire.

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These mosquito packages (dropped via aerial means) would result in an impact to the undeveloped quality of wilderness for as long as they remain in the environment (until they biodegrade).

…

however, flights over or near designated wilderness within the Kīpahulu Valley Biological Reserve (2,318 acres of the 64,666-acre project ~~acre~~ area) would likely require…

Page 62

However, ~~forest-type~~ forest-based activities do not necessarily impact nēnē since they do not have suitable habitat in forested areas.

Page 63

However, ~~forest-type~~ forest-based activities do not necessarily apply to seabirds since the vast majority of known nesting sites are in subalpine habitats on Maui.

Page 66

Approximately 32 wildlife species of concern potentially occur in the analysis area but only ~~7~~ 8 native and migratory bird species protected under the MBTA that occur or transit NPS, state, and TNC/private lands could possibly be impacted by the proposed action.

…

The potential exists for human-caused sounds to adversely impact wildlife under any of the release methods described in Chapter 2 because many animals rely on auditory ~~clues~~ cues for predator avoidance, mate attraction, obtaining nesting territories, and finding prey (Dufour 1980).

Page 72

Thus, the ~~no-a ction~~ no-action alternative is expected to substantially and permanently adversely affect Hawaiian honeycreepers and to a lesser extent other native birds.

low risk of flock or brood disturbance and low risk of helicopter drone or vehicle interaction- collisions to nēnē; and a low risk of drone or helicopter collision with or disturbance to transiting ~~se abirds~~ seabirds

Appendix A - References

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Keir, M., personal communication, November 15, 2022
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Maui Forest Bird ~~Working Group~~ Recovery Project
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Warren, C., personal communication, October 27, 2022

Page B-9, Appendix B, Human Health and Safety

The released mosquitoes pose no risk to human health. Only male mosquitoes will be released and only female mosquitoes bite animals or humans. The risk of females being accidentally released is estimated to be 1 out of 900 million (Crawford et al. 2020). Even if a female is released, a bite from a released female will pose no risk to humans and no greater risk to wildlife than a wild female mosquito currently in the environment. *Wolbachia* cannot live within vertebrate cells and cannot be transferred to humans even through the bite of an infected mosquito (Popovici et al. 2010). Additionally, no new organisms would be introduced to Hawaiʻi by the proposed action. Humans are commonly bitten by the Asian tiger mosquito, *Aedes albopictus*, infected with the strain of *Wolbachia* that would be transfected into the southern house mosquitoes for release. The southern house mosquito also bites humans, and this species is also naturally infected with *Wolbachia*. Thus, humans in Hawaiʻi are regularly bitten by mosquitoes containing *Wolbachia*, including the strain that would be used in the proposed action, and no ill effects have ever been reported nor would there be a mechanism for this to occur. Further, there is no indication that the released mosquitoes would be any better at transmitting disease to humans or wildlife. Popovici et al. (2010) addresses many potential concerns in regards to releasing *Wolbachia*-infected mosquitoes.

…

Given the proposed action includes activities that are routinely carried out already and there would be no or only minimal risk to visitors, and that released mosquitoes pose no risk to human health, this issue was considered and dismissed from further analysis.

Page E-4, Appendix E, add the following bullet under Department of Land and Natural Resources

- *Habitat Restoration Efforts.* The efforts include reforestation and outplanting of more than 250,000 trees throughout agency and partner lands in east Maui, the purchase of Kamehamenui lands, and lands at Nu‘u by Haleakalā National Park with habitat restoration efforts underway, continued support for the Division of Forestry and Wildlife Forestry Reserve System and Natural Area Reserve System, the East Maui Watershed Partnership, the Mauna Kahalawai Watershed Partnership, and the Leeward Haleakalā Watershed Partnership, all of which support habitat restoration and protection in critical habitat areas.

ATTACHMENT C: DETERMINATION OF NO IMPAIRMENT

The National Park Service (NPS) Organic Act of 1916 directs the NPS to "conserve the scenery, natural, and historic objects, and wild life in the System units and to provide for the enjoyment of the scenery, natural and historic objects, and wild life in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (54 USC 100101). NPS Management Policies 2006, Section 1.4.4, explains the prohibition on impairment of park resources and values:

> *"While Congress has given the Service the management discretion to allow impacts within parks, that discretion is limited by the statutory requirement (generally enforceable by the federal courts) that the Park Service must leave park resources and values unimpaired unless a particular law directly and specifically provides otherwise. This, the cornerstone of the Organic Act, establishes the primary responsibility of the National Park Service. It ensures that park resources and values will continue to exist in a condition that will allow the American people to have present and future opportunities for enjoyment of them."*

An action constitutes impairment when its impacts “harm the integrity of park resources or values, including the opportunities that otherwise will be present for the enjoyment of those resources or values” (NPS 2006, Section 1.4.5). To determine impairment, the NPS must evaluate the “particular resources and values that will be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts. An impact on any park resource or value may constitute impairment, but an impact would be more likely to constitute an impairment to the extent that it affects a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of
- the park;
- key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- identified in the park’s general management plan or other relevant NPS planning documents as being of significance (NPS 2006, Section 1.4.5).

Resources that were carried forward for detailed analysis in the Environmental Assessment (EA), and for which a non-impairment determination has been made, include threatened and endangered wildlife species and wildlife species of concern, threatened and endangered plant species and state plant species at risk, and acoustic environment. A non-impairment determination is not necessary for visitor use and experience or wilderness character because these impact topics are not generally considered a park resource or value subject to the non-impairment standard (see NPS 2006, Section 1.4.6).

ACOUSTIC ENVIRONMENT

The natural acoustic environment of the park is a key fundamental resource and value (NPS 2015), and is important for wildlife, visitors, and native Hawaiian ceremonies. Common natural sounds include weather-related sounds (wind in the forest canopy, thunder, and rain), water flowing, waterfalls rushing, bird calls, insects buzzing, and other animal calls or communications (Lynch 2012, Lee et al. 2016, Job et al. 2018). Overall, the acoustic environment of the park is generally in good condition, even though aircraft are documented as the most prevalent noise source adversely affecting the soundscape (Wood 2015, Lee et al. 2016). Commercial air tours, commercial flights, private aviation, and other administrative flights currently contribute noise to the park.

Noise from the drone and helicopter longline mosquito release methods and monitoring will be the most intense acoustic impacts to result from this project. However, the adverse impacts from the drone and helicopter longline release methods and monitoring will be confined largely to backcountry areas and will largely go unnoticed by humans and will only briefly disturb wildlife. And because drones would be the primary mosquito release method rather than helicopters, noise impacts from aerial releases would be minimized. Humans and animals will experience slight perceptible increases (likely not to exceed 15 seconds at a time) in sound/noise in certain areas at certain times resulting in fleeting disruption or annoyance. The selected alternative will contribute a measurable but largely unnoticeable adverse impact to the acoustic environment during mosquito release and monitoring activities. Mitigation measures (e.g., timing of flights, selection of flight paths, use of drones as the primary release method, etc.) have been incorporated in the selected alternative to avoid or minimize potential impacts to the acoustic environment. Park visitors will still be able to enjoy the park's natural quiet and no operations will occur at night or on weekends. Because the noise impacts are short in duration, low in intensity, and not widespread throughout the park, the NPS has determined that the selected alternative will not result in impairment of the acoustic environment.

THREATENED AND ENDANGERED PLANT SPECIES AND STATE PLANT SPECIES AT RISK

Currently, 425 plant species in Hawaiʻi are federally and state listed as threatened or endangered (USFWS 2022b). Many of these plant species persist at very low numbers and are in rapid decline. Existing threats to listed plant species across the Hawaiian Islands include habitat loss, degradation, and modification of habitat from non-native invasive plants and animals, and disease (USFWS 2021). Fourteen plant species listed as endangered under the federal Endangered Species Act and Hawaii Revised Statutes Chapter 195D occur within the plant analysis area within the park (Table F-1 in Appendix F of the EA). The majority of the listed plant species occurring in the analysis area are found in lowland or montane, wet to mesic forests. The plant analysis area also includes designated critical habitat for 37 federally listed plant species on park lands (USFWS 2022a).

Impacts to listed plant species, designated critical habitat, and plant species at risk during mosquito monitoring could occur through vegetation clearing, the removal or trampling of individual plants, physical damage to plant parts, introduction or spread of invasive plants or pathogens, or damage to habitat, including designated critical habitat, from clearing, maintenance, and increased use of existing management trails and fence lines, helicopter LZs, and camps. Only established trails, fence lines, camps, and helicopter LZs proposed for use under pedestrian releases will be used for monitoring activities; therefore, no additional adverse impacts from vegetation removal or trampling in these areas will be anticipated. With implementation of mitigation measures specifically called out in Table 6 and Appendix D of the EA, potential impacts to federally listed plant species, designated critical habitat, and plant species at risk during mosquito monitoring will be negligible and impacts to designated critical habitat are expected to be negligible. The selected alternative includes mitigations to limit potential impacts to these plant species and impacts are expected to be so small that they would not impact the integrity of the resources nor change the prevalence in the park. Because the expected impacts are so minimal, the USFWS concurred that any impacts to these plant species would not adversely affect them. Therefore, the NPS has determined the selected alternative will not result in impairment of threatened and endangered plant species and state plant species at risk.

THREATENED AND ENDANGERED WILDLIFE SPECIES AND WILDLIFE SPECIES OF CONCERN

Island species co-evolved in isolation over millions of years with unique adaptations to their environments. Hawai‘i’s endemic plants, birds, and insect pollinators are remarkably co-specialized (Carlquist 1974). Habitat destruction, invasive plants, non-native predators and competitors, introduced ungulates, and introduced diseases have decimated the diverse, endemic native animal community of the Hawaiian archipelago (Pratt 2009). The ecosystems of East Maui (and the project area) include numerous intermittent and perennial streams, bogs, small montane lakes, and rainforest that provide habitat for native birds, bats, invertebrates, and aquatic organisms. The upper elevation habitats from approximately 3,900 feet to 6,400 feet are characterized as very wet, high-quality native-dominated rainforest (Price et al. 2007). Nine species of federally listed threatened and endangered wildlife (one insect, eight bird species, and one mammal) are known to occur within the project area. Three of these listed bird species are Hawaiian honeycreepers—kiwikiu, ‘ākohekohe and ‘i‘iwi—and are declining rapidly due to mosquito-borne avian malaria and other threats.

Minimal adverse effects to federally listed wildlife or wildlife species of concern from mosquito releases and monitoring include a low risk of disturbance from the presence of drones and drone/helicopter/generator noise to Hawaiian honeycreeper species; low risk of aircraft, drone, or vehicle collision with or noise disturbance to pueo; low risk of pup and day roost disturbance with helicopter rotor wash, drone use, and LZ/camp use to‘ōpe‘ape‘a; low risk of flock or brood disturbance and low risk of helicopter drone or vehicle interaction-collisions to nēnē; and a low risk of drone or helicopter collision with or disturbance to transiting seabirds. Mitigation measures have been incorporated in the selected alternative to avoid or minimize these impacts. On February 24, 2023, the NPS received a concurrence letter from the USFWS stating that they concur with the NPS’s determination that the selected alternative *may affect, but is not likely to adversely affect* federally listed species or designated critical habitats. All six remaining Hawaiian honeycreeper species (both federally listed and species of concern) on Maui in the project area will substantially benefit from the selected alternative to suppress mosquito populations and thereby avian malaria transmission. Therefore, the NPS has determined the selected alternative will not result in impairment of threatened and endangered wildlife species and state wildlife species of concern.

SUMMARY

The NPS has determined that implementation of the selected alternative will not constitute impairment of the resources of the park. This conclusion is based on consideration of the park’s purpose and significance, a thorough analysis of the environmental impacts described in the EA, comments provided by the public and others, and the professional judgment of the decision maker guided by the direction in NPS Management Policies 2006.

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