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Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for 21 Species and Proposed Threatened Status for 2 Species in Guam and the Commonwealth of the Northern Mariana Islands; Proposed Rule

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R1–ES–2014–0038: 4500030113]

RIN 1018–BA13

Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for 21 Species and Proposed Threatened Status for 2 Species in Guam and the Commonwealth of the Northern Mariana Islands

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Proposed rule.

SUMMARY: We, the U.S. Fish and Wildlife Service, propose to list 21 plant and animal species from the Mariana Islands (the U.S. Territory of Guam and the U.S. Commonwealth of the Northern Mariana Islands) as endangered species under the Endangered Species Act of 1973, as amended. We also propose to list two plant species from the Mariana Islands in the U.S. Territory of Guam and the U.S. Commonwealth of the Northern Mariana Islands as threatened species under the Act. If we finalize this rule as proposed, it would extend the Act's protections to these 23 species. The effect of this regulation will be to add these 23 species to the Federal Lists of Endangered and Threatened Wildlife and Plants.

DATES: We will accept comments received or postmarked on or before December 1, 2014. Comments submitted electronically using the Federal eRulemaking Portal (see **ADDRESSES** below) must be received by 11:59 p.m. Eastern Time on the closing date. We must receive requests for public hearings, in writing, at the address shown in **FOR FURTHER INFORMATION CONTACT** by November 17, 2014.

ADDRESSES: You may submit comments by one of the following methods:

(1) *Electronically:* Go to the Federal eRulemaking Portal:

http://www.regulations.gov. In the Search box, enter FWS–R1–ES–2014–0038, which is the docket number for this rulemaking. Then, in the Search panel on the left side of the screen, under the Document Type heading, click on the Proposed Rules link to locate this document. You may submit a comment by clicking on ''Comment Now!''

(2) *By Hard Copy:* Submit by U.S. mail or hand-delivery to: Public Comments Processing, Attn: FWS–R1–ES–2014–0038; Division of Policy and Directives Management; U.S. Fish & Wildlife Headquarters, MS: BPHC, 5275 Leesburg Pike, Falls Church, VA 22041–3803.

We request that you send comments **only** by the methods described above. We will post all comments on *http://www.regulations.gov.* This generally means that we will post any personal information you provide us (see *Public Comments* below for more information).

FOR FURTHER INFORMATION CONTACT: Loyal Mehrhoff, Field Supervisor, Pacific Islands Fish and Wildlife Office, 300 Ala Moana Boulevard, Honolulu, HI 96850; by telephone at 808–792–9400; or by facsimile at 808–792–9581. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

Why we need to publish a rule. Under the Endangered Species Act of 1973, as amended (Act), if a species is determined to be an endangered or threatened species throughout all or a significant portion of its range, we, the U.S. Fish and Wildlife Service (FWS), are required to promptly publish a proposal in the **Federal Register** and make a determination on our proposal within 1 year. Critical habitat shall be designated, to the maximum extent prudent and determinable, for any species determined to be an endangered or threatened species under the Act. Listing a species as an endangered or threatened species and designations and revisions of critical habitat can only be completed by issuing a rule. We will address designation of critical habitat for these 23 species in a separate rule.

This rule will propose the listing of 23 species from the Mariana Islands as endangered or threatened species. Twenty-one of these species are proposed as endangered species (12 plants: *Bulbophyllum guamense* (cebello halumtano), *Dendrobium guamense* (no common name (NCN)), *Eugenia bryanii* (NCN), *Hedyotis megalantha* (paudedo), *Heritiera longipetiolata* (ufa-halumtano), *Maesa walkeri* (NCN), *Phyllanthus saffordii* (NCN), *Psychotria malaspinae* (aplokating-palaoan), *Solanum guamense* (berenghenas halomtano), *Nervilia jacksoniae* (NCN), *Tinospora homosepala* (NCN), and *Tuberolabium guamense* (NCN)); and 9 animals: the Pacific sheath-tailed bat (*Emballonura semicaudata rotensis;* liyang), Slevin's skink (*Emoia slevini;* guali'ek halomtano), the Mariana eight-spot butterfly (*Hypolimnas octocula mariannensis;* NCN), the Mariana wandering butterfly (*Vagrans egistina;* NCN), the Rota blue damselfly (*Ischnura luta;* NCN), the fragile tree snail (*Samoana fragilis;* akaleha), the Guam tree snail (*Partula radiolata;* akaleha), the humped tree snail (*Partula gibba;* akaleha), and Langford's tree snail (*Partula langfordi;* akaleha)). Two plant species (*Cycas micronesica* (fadang) and *Tabernaemontana rotensis* (NCN)) are proposed for listing as threatened species. Seven of these 23 species (1 bat, 2 butterflies, and 4 tree snails) are candidate species for which we have on file sufficient information on biological vulnerability and threats to support preparation of a listing proposal, but for which development of a listing regulation had been previously precluded by other higher priority listing activities. This rule will reassess all available information regarding status of and threats to these seven species. Sixteen of the 23 species (14 plant species and 2 animal species (Slevin's skink and Rota damselfly)) are Mariana Islands species for which we have sufficient information on biological vulnerabilities and threats to propose for listing as endangered or threatened, but which have not been previously recognized as candidate species.

The basis for our action. Under the Act, we can determine that a species is an endangered or threatened species based on any of five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) Overutilization for commercial, recreational, scientific, or educational purposes; (C) Disease or predation; (D) The inadequacy of existing regulatory mechanisms; or (E) Other natural or manmade factors affecting its continued existence. As described in this document, these 23 species are experiencing population-level impacts as the result of the following current and ongoing threats:

- Habitat loss and degradation due to development, military activities, and urbanization; nonnative feral ungulates (hoofed mammals, for example, deer, pigs, and water buffalo) and nonnative plants; rats; snakes; wildfire; typhoons; water extraction, and climate change.
- Predation or herbivory by nonnative feral ungulates, rats, snakes, monitor lizards, slugs, flatworms, ants, and wasps.
- Inadequate existing regulatory mechanisms to prevent the introduction and spread of nonnative plants and animals.
- Ordnance and live-fire from military training, recreational vehicles,

and vulnerability to extinction due to small numbers of individuals and populations.

As a consequence of these threats, we propose to list 2 of these species as threatened species, and 21 of these species as endangered species. We, therefore, propose adding these 23 Mariana Islands species to the Federal Lists of Endangered and Threatened Wildlife and Plants.

We will seek peer review. We will seek comments from independent specialists to ensure that our designation is based on scientifically sound data, assumptions, and analyses. We will invite these peer reviewers to comment on our listing proposal. Because we will consider all comments and information received during the comment period, our final determinations may differ from this proposal.

Information Requested

Public Comments

We intend that any final action resulting from this proposed rule will be based on the best scientific and commercial data available and be as accurate and as effective as possible. Therefore, we request comments or information from the public, including landowners, land managers, and residents of the U.S. Territory of Guam (Guam) and the U.S. Commonwealth of the Northern Mariana Islands (CNMI), the scientific community, industry, or any other interested parties concerning this proposed rule. We particularly seek comments concerning:

(1) The biology, range, and population trends of these species, including:

(a) Biological or ecological requirements, including habitat requirements for feeding, breeding, and sheltering;

(b) Genetics and taxonomy;

(c) Historical and current range including distribution patterns;

(d) Historical and current population levels, and current and projected trends; and

(e) Past and ongoing conservation measures for these species, their habitats, or both.

(2) Factors that may affect the continued existence of these species, which may include habitat modification or destruction, overutilization, disease, predation, the inadequacy of existing regulatory mechanisms, or other natural or manmade factors.

(3) Biological, commercial trade, or other relevant data concerning any threats (or lack thereof) to these species and existing regulations that may be addressing those threats.

(4) Additional information concerning the historical and current status, range, distribution, and population size of these species, including the locations of any additional populations of these species.

(5) Any information regarding the taxonomy of *Tinospora homosepala,* with particular regard to the question of whether *T. homosepala* may be the same species as the more common *T. glabra,* or is a variety of that species.

Please include sufficient information with your submission (such as scientific journal articles or other publications) to allow us to verify any scientific or commercial information you include.

Please note that submissions merely stating support for or opposition to the action under consideration without providing supporting information, although noted, will not be considered in making a determination, as section 4(b)(1)(A) of the Act directs that determinations as to whether any species is a threatened or endangered species must be made ''solely on the basis of the best scientific and commercial data available.''

You may submit your comments and materials concerning this proposed rule by one of the methods listed in **ADDRESSES**. We request that you send comments **only** by the methods described in **ADDRESSES**.

If you submit information via *http://www.regulations.gov,* your entire submission—including any personal identifying information—will be posted on the Web site. If your submission is made via a hardcopy that includes personal identifying information, you may request at the top of your document that we withhold this information from public review. However, we cannot guarantee that we will be able to do so. We will post all hardcopy submissions on *http://www.regulations.gov.* Please include sufficient information with your comments to allow us to verify any scientific or commercial information you include.

Comments and materials we receive, as well as supporting documentation we used in preparing this proposed rule, will be available for public inspection on *http://www.regulations.gov,* or by appointment, during normal business hours, at the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office (see **FOR FURTHER INFORMATION CONTACT**).

Public Hearing

Section 4(b)(5) of the Act provides for one or more public hearings on this proposal, if requested. Requests must be received within 45 days after the date of publication of this proposed rule in the **Federal Register**. Such requests must be sent to the address shown in **FOR FURTHER INFORMATION CONTACT**. We will schedule public hearings on this proposal, if any are requested, and announce the dates, times, and places of those hearings, as well as how to obtain reasonable accommodations, in the **Federal Register** and local newspapers at least 15 days before the hearing.

Peer Review

In accordance with our joint policy on peer review published in the **Federal Register** on July 1, 1994 (59 FR 34270), we have sought the expert opinions of 10 appropriate and independent specialists regarding this proposed rule. The purpose of peer review is to ensure that our listing determinations are based on scientifically sound data, assumptions, and analyses. The peer reviewers have expertise about one or more of the 23 species' biology, habitat, life-history needs, and vulnerability to threats, which will inform our determination. We invite comment from the peer reviewers during this public comment period. A copy of our peer review plan is available for public review at *http://www.fws.gov/pacific/informationquality*.

Previous Federal Actions

Seven of the 23 species proposed for listing as endangered species are candidate species (77 FR 70103; November 22, 2013). Candidate species are those taxa for which the U.S. Fish and Wildlife Service (Service) has sufficient information on their biological status and threats to propose them for listing under the Act, but for which the development of a listing regulation has been precluded to date by other higher priority listing activities. The current candidate species addressed in this proposed listing rule include the following seven animal species: the Pacific sheath-tailed bat (*Emballonura semicaudata rotensis*), the Mariana eight-spot butterfly (*Hypolimnas octocula marianensis*), the Mariana wandering butterfly (*Vagrans egistina*), the fragile tree snail (*Samoana fragilis*), the Guam tree snail (*Partula radiolata*), the humped tree snail (*Partula gibba*), and Langford's tree snail (*Partula langfordi*). The candidate status of these species was most recently reaffirmed in the November 22, 2013, Review of Native Species that are Candidates for Listing as Endangered or Threatened (CNOR) (77 FR 70103).

On May 4, 2004, the Center for Biological Diversity petitioned the Secretary of the Interior to list 225 species of plants and animals, including the 7 candidate species listed above, as endangered or threatened under the provisions of the Act. Since then, we

have published our annual findings on the May 4, 2004, petition (including our findings on the seven candidate species listed above) in the CNORs dated May 11, 2005 (70 FR 24870), September 12, 2006 (71 FR 53756), December 6, 2007 (72 FR 69034), December 10, 2008 (73 FR 75176), November 9, 2009 (74 FR 57804), November 10, 2010 (75 FR 69222), October 26, 2011 (76 FR 66370), November 21, 2012 (77 FR 69994), and November 22, 2013 (77 FR 70103). This proposed rule constitutes a further response to the 2004 petition.

In addition to the 7 candidate species, we are proposing to list 16 additional species that occur in the Mariana Islands as endangered or threatened species, including 14 plants (*Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Eugenia bryanii, Hedyotis megalantha, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordii, Psychotria malaspinae, Solanum guamense, Tabernaemontana rotensis, Tinospora homosepala,* and *Tuberolabium guamense*) and 2 animals (Slevin's skink (*Emoia slevini*) and the Rota blue damselfly (*Ischnura luta*)). Three of these plant species, *Heritiera longipetiolata, Maesa walkeri,* and *Psychotria malaspinae,* have been identified as the ''rarest of the rare'' Mariana plant species and in need of immediate conservation under the multiagency (Federal and Territorial) Guam Plant Extinction Prevention Program (GPEPP). The goal of GPEPP is to prevent the extinction of plant species that have fewer than 200 individuals remaining in the wild on the island of Guam (GPEPP 2014, in litt.). We believe these 14 plants and 2 animal species warrant listing under the Act for the reasons discussed in the ''Summary of Factors Affecting the Species'' section (below). Because these 16 species occur within 2 of the same ecosystems as the 7 candidate species, and share common threats with them, we have included them in this proposed rule to provide them with protection under the Act in an expeditious manner.

We will be publishing a proposal to address critical habitat for the 23 Mariana Islands species under the Act in the near future.

Background

Mariana Islands Species Addressed in this Proposed Rule

Table 1 below provides the scientific name, common name, listing status, and range (islands on which the species is found) for the 23 Mariana Islands species that are addressed in this proposed rule.

TABLE 1—THE 23 SPECIES ADDRESSED IN THIS PROPOSED RULE

Scientific name	Common name(s)	Listing status	Range
PLANTS			
Bulbophyllum guamense	cebello halumtano[Ch]	Proposed–Endangered.	Guam, Rota, Saipan (H), Pagan (H).
Cycas micronesica	fadang[Ch]	Proposed–Threatened	Guam, Rota, Pagan, Palau,* Yap.*
Dendrobium guamense	NCN	Proposed–Endangered.	Guam, Rota, Tinian (H), Saipan (H).
Eugenia bryanii	NCN	Proposed–Endangered.	Guam.
Hedyotis megalantha	paudedo[Ch]	Proposed–Endangered.	Guam.
Heritiera longipetiolata	ufa-halomtano[Ch]	Proposed–Endangered.	Guam, Saipan, Tinian, Rota (H).
Maesa walkeri	NCN	Proposed–Endangered.	Guam, Rota.
Nervilia jacksoniae	NCN	Proposed–Endangered.	Guam, Rota.
Phyllanthus saffordii	NCN	Proposed–Endangered.	Guam.
Psychotria malaspinae	aplokating-palaoan[Ch]	Proposed–Endangered.	Guam.
Solanum guamense	berenghenas halomtano[Ch].	Proposed–Endangered.	Guam, Rota (H), Tinian (H), Saipan (H), Asuncion (H), Guguan (H), Maug (H).
Tabernaemontana rotensis	NCN	Proposed–Threatened	Guam, Rota.
Tinospora homosepala	NCN	Proposed–Endangered.	Guam.
Tuberolabium guamense	NCN	Proposed–Endangered.	Guam, Rota, Aguiguan (H), Tinian (H).
ANIMALS			
Emballonura semicaudata rotensis	Pacific sheath-tailed bat, liyang[Ch], payesyes[Ca], pai scheei[Cl].	Proposed–Endangered (C).	Aguiguan, Guam (H), Rota (H), Tinian (H), Saipan (H), Anatahan (H*), Maug (H*).
Emoia slevini	Slevin's skink, Marianas Emoia, guali'ek halom tano[Ch].	Proposed–Endangered.	Guam (Cocos Island), Alamagan, Asuncion, Guguan, Pagan, Sarigan.
Hypolimnas octocula mariannensis	Mariana eight-spot butterfly.	Proposed–Endangered (C).	Guam, Saipan (H).
Vagrans egistina	Mariana wandering butterfly.	Proposed–Endangered (C).	Rota, Guam (H).
Ischnura luta	Rota blue damselfly	Proposed–Endangered.	Rota.
Partula gibba	humped tree snail, akaleha'[Ch].	Proposed–Endangered (C).	Guam, Rota, Aguiguan, Alamagan, Pagan, Sarigan, Saipan, Tinian (H), Anatahan (H).
Partula langfordi	Langford's tree snail, akaleha'[Ch].	Proposed–Endangered (C).	Aguiguan.

TABLE 1—THE 23 SPECIES ADDRESSED IN THIS PROPOSED RULE—Continued

Scientific name	Common name(s)	Listing status	Range
Partula radiolata	Guam tree snail, akaleha'Ch	Proposed–Endangered (C).	Guam.
Samoana fragilis	fragile tree snail, akaleha'Ch.	Proposed–Endangered (C).	Guam, Rota.

NCN = no common name.
(C) = Candidate Species.
H) = historical occurrence.
(H*) = possible historical occurrence.
Ch = Chamorro name.
Ca = Carolinian name.
* = range outside of the Mariana Islands.

The Mariana Islands

Geography

The Mariana Islands is a longitudinallyarranged archipelago consisting of 15 main islands and various smaller islets located in western Micronesia between latitudes 21° and 13° N and longitudes 144° and 146° E. The Mariana Islands vary in age, between 5 million years old in the north and 50 million years old in the south. The archipelago was formed by the collision of the Pacific and Philippine tectonic plates at the Mariana Trench, which resulted in volcanic activity that built up a chain of mountains protruding from the sea floor (see Figure 1) (Raulerson and Rinehart 1992, p. 3; Scripps Institution of Oceanography (SIO) 2014, in litt.). Scientists biogeographically separate the Mariana Islands into the ''northern'' and ''southern'' islands based on geological time of formation and associated substratum (Fosberg et al. 1975, pp. 1 – 5; Mueller-Dombois and Fosberg 1998, p. 241). The primarily volcanic northern islands include Farallon de Medinilla, Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, Maug, and Uracas, while the limestone and volcanic southern islands include Guam, Rota, Aguiguan, Tinian, and Saipan. The northern islands of Anatahan, Guguan, Alamagan, Asuncion, Pagan, and Uracas are still volcanically active. Only the southern islands of Guam, Cocos Island, Rota, Tinian, and Saipan are regularly inhabited by humans; all of the other Mariana Islands are considered uninhabited, although some (e.g., Aguiguan, Pagan) may be visited on occasion.

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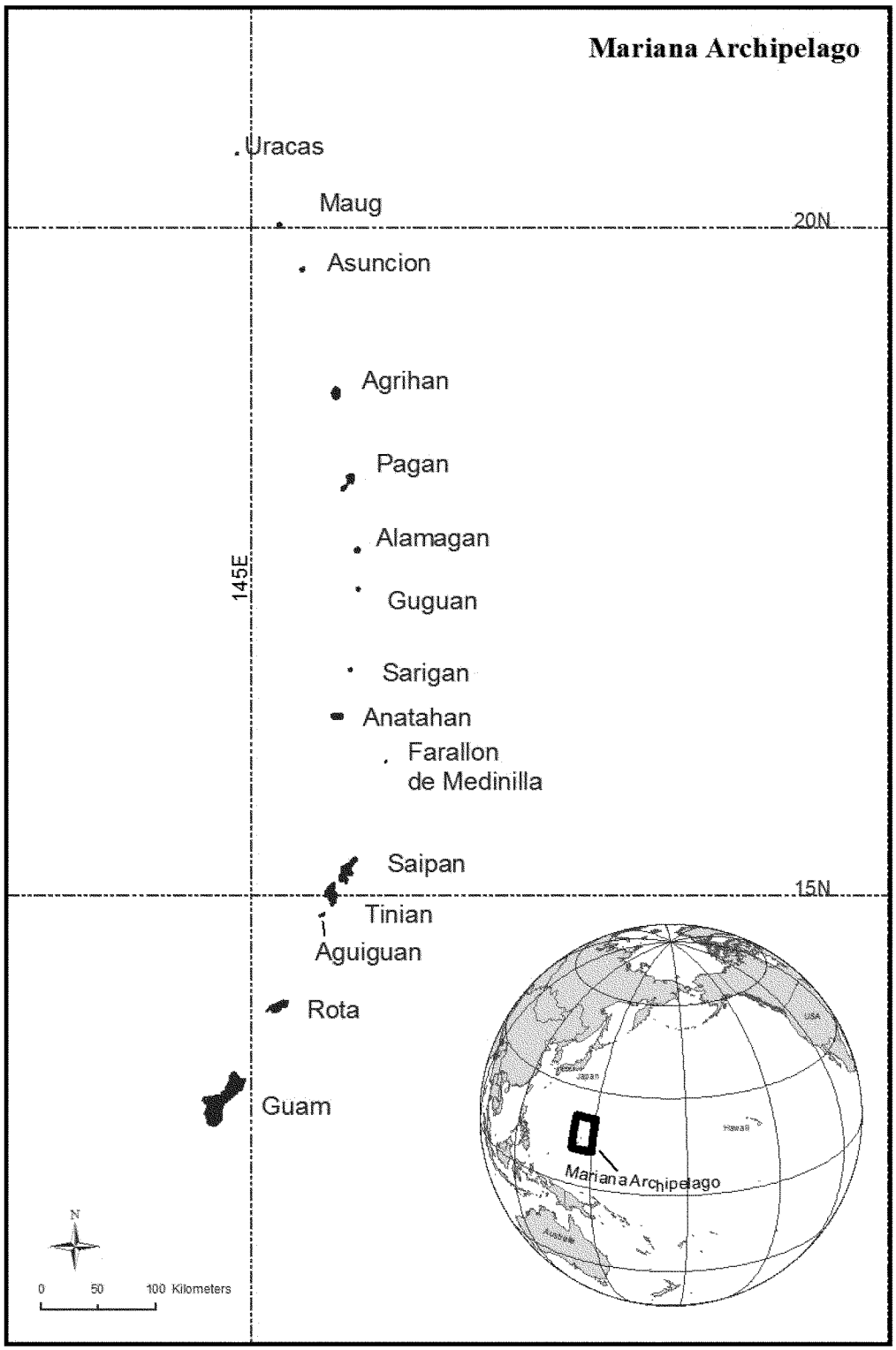
Figure 1. Map of the Mariana Archipelago.



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Geology

The substratum of the younger northern islands is of volcanic origin, while the substratum of the older southern islands is coral limestone (Mueller-Dombois and Fosberg 1998, p. 241). The limestone substratum of the southern islands is composed of ancient coral reef limestone that developed as the islands rose from the ocean floor and eventually above sea level (Berger et al. 2005, p. 9). The northern islands contain very little limestone substratum

due to their young age and because many of them (Uracas, Pagan, Asuncion, Guguan and Anatahan) remain volcanically active (Ohba 1994, p. 14; U.S. Geological Survey (USGS) 2006, in litt.). The northern islands are composed of black basalts and are typically cone-shaped volcanoes with steep slopes, many of which have eroded into steep ravines often widened by erosion (Ohba 1994, p. 14). Areas of exposed weathered volcanic substratum can be found on the southern islands, particularly on the southern half of Guam, in strong contrast to the predominant karst limestone composition of the northern half of the island (Mueller-Dombois and Fosberg 1998, p. 241).

Vegetation

Both the intentional and inadvertent introduction of alien plant and animal species has contributed to the reduction in range of native vegetation throughout the Mariana Islands (throughout this rule, the terms ''alien,'' ''feral,'' ''nonnative,'' and ''introduced'' all refer to species that are not naturally native to the Mariana Islands). Currently, most of the extant native vegetation on the islands persists on rugged karst or steep limestone slopes and precipitous cliffs, ridgelines, valleys, and other regions where unsuitable topography prevents urbanization and agricultural development, or where inaccessibility limits encroachment by nonnative plants and grazing by feral ungulates (Amidon 2000, p. 5; Berger et al. 2005, pp. 37, 44–45).

Hydrology

There are no year-round surface water sources in the northern islands, with the exception of two small lakes on the island of Pagan. The southern islands, in contrast, exhibit multiple year-round surface water sources including wetlands and streams on Saipan, two perennial streams and two springs on Rota, a small wetland on Tinian, and several wetlands, rivers, and streams on the volcanic portions of southern Guam, particularly in the Tolofofo River region (CNMI Statewide Assessment and Resource Strategy Council (CNMI–SWARS) 2010, pp. 9–10, 30, 32; Mueller-Dombois and Fosberg 1998, pp. 248, 254, 260, 266, 269; SIO 2014, in litt.).

Climate

Their relatively low elevation above sea level (the highest point in the chain is Mt. Agrihan on Agrihan at 3,166 ft (965 m)), juxtaposed with their close proximity to the equator, insulate the Mariana Islands from seasonal variation in weather and climate. The entire archipelago is defined as the ''tropical rainforest climate'' according to the Koeppen climate classification (Ohba 1994, p. 16); however, there are very few year-round meteorological weather stations in the Mariana Islands, resulting in limited available meteorological data. Additional data has been collected from Iwo-Jima from which patterns are collectively extrapolated across the Mariana archipelago (Ohba 1994, pp. 15–16).

The Mariana archipelago exhibits two distinct seasons, a notably wetter season from July through October, and a drier season from November through June, with April characteristically being the driest month out of the year (Ohba 1994, p. 16; Mueller-Dombois and Fosberg 1998, p. 241). Precipitation averages 96 in (218 cm) per year, dependent in part upon elevation. Some of the tallest peaks across the islands experience frequent cloud cover, particularly the northern island summits of Anatahan, Alamagan, Pagan, and Sarigan (Dahl 1980, pp. 22, 64; Ohba 1994, pp. 18, 41, 48). Stone (1970, p. 12) observed the southern Mariana Islands (from Anatahan southward) to be warmer than the northern islands.

The Mariana Islands receive relatively constant trade winds with a weak westerly monsoon influence in summer months (Mueller-Dombois and Fosberg 1998, p. 241). Storms and typhoons originating from the southeast and east occur frequently with an average of one typhoon per year affecting the Mariana Islands (Mueller-Dombois and Fosberg 1998, p. 241).

Biogeography

In general, the younger, northern islands, particularly the five active volcanic islands (Uracas, Pagan, Asuncion, Guguan, and Anatahan), support fewer species and ecosystem types than the southern islands, due primarily to factors including age, time since last eruption, island size, and highest point of elevation (Ohba 1994, pp. 15–18; Mueller-Dombois and Fosberg 1998, p. 241). Historically, volcanic eruptions have proved very disruptive to the ecology of the more northern Mariana Islands when they occur (USGS 2006, in litt.; Zoology Unlimited, LLC (Limited Liability Company) 2013, pp. 9–11). For example, in May 2003, the island of Anatahan experienced a powerful and explosive eruption that destroyed 80 to 90 percent of the island's forest cover and was believed to have caused the extirpation of the Mariana fruit bat (*Pteropus mariannus mariannus*) and Micronesian megapode (*Megapodius laperouse laperouse*) (Zoology Unlimited, LLC. 2013, pp. 10–11). Fortunately, these two species have been observed on Anatahan in recent years, albeit in low numbers (Zoology Unlimited, LLC. 2013, pp. 10–11).

The cumulative literature portrays Guam and Rota, in the southern part of the archipelago, as the most species-rich of the Mariana Islands. Mueller-Dombois and Fosberg (1998, p. 243) conducted one of the most comprehensive vegetation analyses of the Mariana Islands (building upon their previous works and those of Stone (1970, 659 pp.), Ohba (1994, p. 18), and many others) and observed that, although the primary substratum differs between the northern and southern islands (*e.g.,* volcanic versus limestone, respectively), the physical nature of the substratum may be of equal or more importance than the chemical nature in determining vegetation patterns. For example, some areas covered by rough lava flows found on the northern islands exhibit convergent forest type compared to forests found on the karst limestone in the southern islands (Mueller-Dombois and Fosberg 1998, pp. 243–245). Additionally, grassland (*i.e.,* savanna) species in the northern islands overlap with species found in the southern islands grasslands, although species richness is greater on the southern islands (Mueller-Dombois and Fosberg 1998, p. 241). The northern islands are predominantly primary grasslands (colonized relatively recently after volcanic activity) with areas of secondary forest. Conversely, the southern islands are predominantly primary and secondary forests with secondary grasslands, a situation that likely arose from grassland expansion through agricultural burning and clearing (Mueller-Dombois and Fosberg 1998, p. 241).

Micronesia, together with Polynesia, is described as the Polynesia-Micronesia Hotspot, meaning that these island groups contain an exceptional concentration of endemic (found nowhere else in the world) species, and are currently experiencing exceptional habitat loss (Myers et al. 2000, pp. 853–855).

Pre-Historical Human Impact

Archaeological evidence indicates that the Mariana Islands had been settled approximately 2,000 B.C. by the pre-contact Chamorro people, who migrated from Southeast Asia (SIO 2014, in litt.). The Chamorro people introduced to the islands a variety of food plants including rice, breadfruit, sugar cane, bananas, coconuts, and taro (Stone 1970, pp. 182, 200). The exact

extent to which these early settlers modified the landscape is unknown; however, it is believed to be not insignificant (Fosberg 1960, pp. 36, 42–43). These environmental impacts may parallel those documented in the Hawaiian Islands by early Hawaiian settlers; however, early Chamorro impacts in the Mariana Islands are not as well documented.

The Chamorro established their largest settlements in the southern islands including Guam, Rota, and Saipan (Russell 1998, p. 87). However, multiple smaller settlements existed in the northern islands and these were likely dependent in part on the larger communities in the relatively resource-rich southern islands (Russell 1998, p. 84). Researchers estimate that 100,000 to 150,000 Chamorro may have inhabited these islands, a number that declined to below 5,000 individuals just a few hundred years after European contact due to introduced diseases and other factors (SIO 2014, in litt.).

Historical and Ongoing Human Impacts

After the initial Chamorro modifications for agriculture and villages, the flora and fauna on the Mariana Islands continued to undergo alterations due not only to ongoing volcanic activity in the northern islands, but also to land use activities and nonnative species introduced by European colonialists. The arrival of the Spanish in 1591 further imposed degradation of the ecosystems of the Mariana Islands with the introduction of numerous nonnative animals and plants. The Spanish occupied the Mariana Islands for nearly 300 years (SIO 2014, in litt.). In 1899, Spain sold the Mariana Islands to Germany, with the exception of Guam, which was ceded to the United States as a result of the Spanish-American war (SIO 2012, in litt.; Encyclopedia Britannica 2014, in litt.).

The German administration altered the forest ecosystem on Rota, Saipan, and Tinian, and on some of the northern islands, by means of *Cocos nucifera* (coconut) farming, which was encouraged for the production of copra (the dried fleshy part of a coconut used to make coconut oil) (Russell 1998, pp. 94–95). Upon the start of World War I, the Japanese quickly took over German occupied islands and accelerated the alteration of the landscape by clearing large areas of native forest on Rota, Saipan, and Tinian for growing *Saccharum officinarum* (sugarcane) and building associated refineries and for planting *Acacia confusa* (sosugi) to provide fuel wood (CNMI–SWARS 2010, pp. 6–7). The Japanese drastically altered the islands of Rota, Saipan, and Tinian, leaving little native forest. Military activities during World War II further altered the landscape on Saipan and Tinian. Rota was a notable exception, left relatively untouched (CNMI–SWARS 2010, p. 7). Japan also occupied Guam at the onset of World War II; however, by 1944 the U.S. neutralized the Mariana Islands with the recapture of Saipan, Tinian and Guam (Encyclopedia Britannica 2014, in litt.). Since World War II, the U.S. military has developed a strong presence in the Mariana Islands, particularly on the island of Guam, where both the U.S. Navy and U.S. Air Force operate large military installations. The island of Farallon de Medinilla is used for military ordnance training (Berger et al. 2005, p. 130).

Currently, the U.S. Department of Defense is implementing a project referred to as the ''Guam and Commonwealth of the Northern Mariana Islands Military Relocation'' (Joint Guam Program Office (JGPO)–Naval Facilities Engineering Command, Pacific (JGPO–NavFac, Pacific) 2010a, p. ES–1; JGPO–NavFac, Pacific 2013, pp. 1–1—1–3). This military relocation proposes: (1) the relocation of a portion of the U.S. Marine Corps (Marine Corps) currently in Okinawa, Japan, which consists of up to 5,000 Marines and their 1,300 dependents, as revised in the Draft Supplemental Environmental Impact Statement (SEIS) (NavFac Engineering Command Pacific 2014, p. ES–3), in addition to the development and construction of facilities and infrastructure to support training and operations on Guam and Tinian for the relocated Marines; (2) the construction of a deep-draft wharf with shoreside infrastructure at Apra Harbor, Guam, to support the U.S. Navy (Navy) transiting nuclear-powered aircraft carrier; and (3) the development of facilities and infrastructure on Guam to support the relocation of military personnel and their dependents to establish and operate a U.S. Army (Army) and Missiles Defense Task Force (JGPO–NavFac, Pacific 2010a, p. ES–7).

Both Guam and Tinian are located within the Mariana Islands Range Complex, an area used by the Department of Defense (DOD) for readiness training (JGPO–NavFac, Pacific 2010a, pp. ES–2—ES–3). The northern two-thirds of Tinian are leased to the DOD, and the development of these lands will negatively impact the habitat of 1 of the 23 species in the forest ecosystem (*Heritiera longipetiolata*). The draft 2014 SEIS focuses on the change to the preferred alternatives identified in the 2010 Final EIS (NavFac Engineering Command Pacific 2014, p. ES–1). The preferred alternative sites on Guam for the implementation of the Marine relocation efforts and development of a live-fire training range complex now include Alternative A Finegayan and Alternative 5 Northwest Field on Andersen Air Force Base (AFB), where, in total, 18 of the 23 species or their habitat are known to occur (13 of the 14 plants: *Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Eugenia bryanii, Hedyotis megalantha, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordii, Psychotria malaspinae, Solanum guamense, Tabernaemontana rotensis*, and *Tuberolabium guamense;* and 5 of the 9 animals: the Mariana eight-spot butterfly, the Mariana wandering butterfly, the Guam tree snail, the humped tree snail, and the fragile tree snail) (NavFac Engineering Command Pacific 2014, pp. ES–18—ES–22). The draft SEIS describes: (1) a more moderate construction activity over 13 years instead of a 7-year intense construction boom; (2) a significant reduction in peak and steady state population increases, from more than 79,000 new Guam residents down to 7,400 new residents; (3) a reduction in the project area at Finegayan from 2,580 ac (1,044 ha) to 1,452 ac (588 ha); (4) no new land acquisition; (5) a reduction in project area at Northwest Field (instead of Route 15); and (6) an overall decrease in power and water demands (NavFac Engineering Command Pacific 2014, p. ES–3).

In conjunction with the relocation efforts discussed above, the U.S. military is planning to improve existing and develop new live-fire military training areas on the islands of Tinian and Pagan (JPGO–NavFac, Pacific 2010a, pp. ES–5, ES–16–17, ES 19–20, ES–40; CJMT EIS–OEIS (see below)). The Marine Corps (the Executive Agent designated by the U.S. Pacific Command) recently published their ''Commonwealth of the Northern Mariana Islands Joint Military Training Environmental Impact Statement—Overseas Environmental Impact Statement (CJMT EIS–OEIS at *http://www.cnmijointmilitarytrainingeis.com/about*). The CJMT EIS–OEIS Final Scoping Summary Report informs the public that the military plans to maximize use of DOD-leased lands within CNMI, specifically Tinian and Pagan. The live-fire training range project area on Tinian overlaps with the relocation effort areas discussed above (the northern two-thirds of the island). Likewise, the live-fire training range

project will negatively impact the plant species *Heritiera longipetiolata,* as discussed above. On Pagan, both Alternative 1 and Alternative 2 claim the entire island as a live-fire training area (NavFac Engineering Command Pacific 2014, p. 13). In addition, the live-fire training range project proposes the designation of special use air and sea spaces around the entire islands of Pagan, Tinian, and Aguiguan (just south of Tinian), and most of Saipan (north of Tinian). If the entire island of Pagan is used as a live-fire training range area, it would negatively impact 4 of the 23 species (*Cycas micronesica,* Slevin's skink, humped tree snail, and habitat for *Bulbophyllum guamense*) and their habitat in the forest ecosystem.

In addition to military spending, Guam's economy depends on tourism. More than 1 million tourists visit Guam annually, mostly arriving from Japan, Korea, and other Asian countries. In the early 1960s, military contributions to Guam's economy approached 60 percent, with tourism adding almost another 30 percent. There was a downturn in military presence and tourism in the 70s and 80s; however, recently, with the projected increase in military employees and their dependents, and with Guam seeking a ''no visa required'' status for visitors from Russia and China, monitoring of sea ports and airports against inadvertent introduction of harmful and invasive species is especially important (*http://www.guamvisitorsbureau.com/,* accessed April 25, 2014; *http://guampedia.com/evolution-of-the-tourism-industry-on-guam-2/#toc-consequences-and-conclusions,* accessed April 25, 2014) (see *Factor D. The Inadequacy of Existing Regulatory Mechanisms*).

Political Division

Micronesia consists of several island groups: (1) Mariana Islands (collectively the U.S. Commonwealth of the Northern Mariana Islands (CNMI) and the U.S. Territory of Guam); (2) the Federated States of Micronesia, including the Caroline Islands, Yap, Chuuk, Pohnpei, and Kosrae and the Republic of Palau, the Republic of Kiribati, the Republic of the Marshall Islands, Nauru, and Wake Island.

Islands in the Mariana Archipelago

A brief summary of each island in the Mariana archipelago, from south to north, follows below (for detailed information see Stone 1970, 75 pp.; Falanruw et al. 1989, 11 pp.; Ohba 1994, 56 pp.; Mueller-Dombois and Fosberg 1998, 32 pp.). Here we describe each of the islands in the Mariana archipelago, even if the species addressed in this proposed rule do not currently occur there, or were not found there historically, to provide the reader context for understanding various issues discussed in this document or in subsequent rulemakings that may make reference to the various islands.

Guam

Guam is the largest and southernmost island of the Mariana Islands. It is nearly 31 miles (mi) (50 kilometers (km)) long and from 4 to 9 mi (7 to 15 km) wide, with a peak elevation of 1,332 feet (ft) (406 meters (m)) at Mt. Lamlam (Muller-Dombois and Fosberg 1998, p. 269). Guam is located in the northwestern Pacific Ocean, 1,200 mi (1,930 km) east of the Philippines, 3,500 mi (5,632 km) west of the Hawaiian Islands, and 54 mi (87 km) south of Rota. The northern and southern regions of the island show marked contrast due to their geologic history. The northern region is an extensive, upraised, terraced, limestone plateau or ''mesa'' between 300 and 600 ft (90 and 183 m) above sea level interrupted by a few low hills, of which two (Mataguac and Mt. Santa Rosa) are volcanic in nature; others are exclusively coralline limestone (e.g., Barrigada Hill and Ritidian Point (Stone 1970, p. 12)). The southern region is primarily volcanic material (e.g., basalts) with several areas capped by a layer of limestone (Stone 1970, p. 12).

Of all the Mariana Islands, Guam contains the most extensive stream and drainage systems, particularly in the Talofofo Region (Stone 1970, p. 13; Muller-Dombois and Fosberg 1998, p. 269). Fairly extensive wetland areas are located on both coasts of the southern region as well as the higher elevation Agana Swamp located in the middle of the island. Guam is also the most populated of all the Mariana Islands, with more than 180,000 residents. Guam has experienced impacts from at least 4,000 years of human contact, starting with the Chamorro, followed by the Spanish, Germans, Japanese, and Americans (see ''Pre-Historical Human Impact'' and ''Historical and Ongoing Human Impacts,'' above). World War II and subsequent U.S. military activity have also negatively impacted natural habitats on Guam; however, the buffer zones around the U.S. Navy and Air Force bases on Guam and conservation areas designated on these bases support some of the rarest species. There are three conservation areas designated by the Guam Department of Aquatic and Wildlife Resources (GDAWR): (1) Anao Conservation Area; (2) Bolanos Conservation Area; and, (3) Cotal Conservation Area (GDAWR 2006, p. 39; Sablan Environmental, Inc. 2008, p. 3). Guam supports the forest, savanna, stream, and cave ecosystems (see ''Mariana Islands Ecosystems,'' below). Twenty of the 23 species addressed in this proposed rule occur on Guam (all 14 plants: *Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Eugenia bryanii, Hedyotis megalantha, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordii, Psychotria malaspinae, Solanum guamense, Tabernaemontana rotensis, Tinospora homosepala,* and *Tuberolabium guamense;* and 6 of the 9 animals: Slevin's skink (Cocos Island, off Guam), the Mariana eight-spot butterfly, the Mariana wandering butterfly, the Guam tree snail, the humped tree snail, and the fragile tree snail. The Pacific sheath-tailed bat occurred on Guam historically.

Rota

Just northeast of Guam (36 mi; 58 km) and southwest of Aguiguan (47 mi; 76 km), Rota is the fourth largest island in the Mariana Islands, measuring 33 square miles (mi^2) (96 square kilometers (km^2)) in land area (Mueller-Dombois and Fosberg 1998, p. 265; CNMI–SWARS 2010, p. 6). The highest point on the island is Mount Sabana or the ''Sabana plateau,'' at just over 1,600 ft (488 m) (Mueller-Dombois and Fosberg 1998, p. 265). The Sabana plateau is characterized by a savanna ringed by forest that extends onto the surrounding karst limestone cliffs and down the rugged slopes that encircle all sides of the Sabana (Mueller-Dombois and Fosberg 1998, pp. 265–266). Rota consists primarily of terraced limestone surrounding a volcanic core that protrudes from the topmost plateau, or Sabana. The Sabana is noticeably wetter than the rest of the island and is the only location known to support all four orchids proposed for listing as endangered or threatened species in this rule (*Bulbophyllum guamense, Dendrobium guamense, Nervilia jacksoniae,* and *Tuberolabium guamense*) (Harrington et al. 2012, in litt.).

Rota has experienced land alterations since the arrival of the first Chamorro more than 4,000 years ago. When the Mariana Islands were occupied by the Japanese (1914–1944) they cleared forest areas to plant large sugarcane plantations and conducted phosphate mining on the Sabana plateau (Amidon 2000, pp. 4–5; Engbring 1986, pp. 10, 27). Although Rota was never invaded during World War II, it was heavily bombed by U.S. military forces

(Engbring et al. 1986, pp. 8, 11). Rota has a population of approximately 3,000 people. In recent years, three terrestrial conservation areas have been designated on Rota by the CNMI Department of Land and Natural Resources: (1) The Sabana Heights Wildlife Conservation Area; (2) I-Chenchon Park Wildlife Conservation Area and Bird Sanctuary; and, (3) Wedding Cake Mountain Wildlife Conservation Area (Berger et al. 2005, p. 14).

Rota supports the forest, savanna, stream, and cave ecosystems. Eleven of the 23 species addressed in this proposed rule currently occur on Rota (7 of the 14 plants: *Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Maesa walkeri, Nervilia jacksoniae, Tabernaemontana rotensis,* and *Tuberolabium guamense;* and 4 of the 9 animals: the Mariana wandering butterfly, the Rota blue damselfly, the fragile tree snail, and the humped tree snail). The plants *Heritiera longipetiolata* and *Solanum guamense* and the Pacific sheath-tailed bat were known from Rota historically.

Aguiguan

Aguiguan is known as ''Goat Island'' due to the presence of a large feral goat population (Engbring et al. 1986, p. 8). Located approximately 8 km (5 mi) southwest of Tinian, Aguiguan is a small uninhabited island measuring 7 mi^2 (18 km^2) in land area with a peak elevation of 515 ft (157 m) at Mt. Alutom (CNMI–SWARS 2010, p. 6). This island was historically inhabited by the Chamorro people (Russell 1998, pp. 90–91). Aguiguan is entirely limestone, with very steep cliffs fringing nearly the entire island, making access difficult (Berger et al. 2005, p. 36). There are no streams on the island (Engbring et al. 1986, p. 8). During the Japanese occupation, large areas of native forest were cleared for sugarcane plantations, a large runway and other war-related structures (Engbring et al. 1986, p. 8; Mueller-Dombois and Fosberg 1998, p. 264). Ecosystem types on Aguiguan include forest and cave. Three of the 23 species addressed in this proposed rule occur on Aguiguan: the Pacific sheath-tailed bat, the humped tree snail, and Langford's tree snail. The plant *Tuberolabium guamense* was known from Aguiguan historically.

Tinian

Located approximately 3 mi (5 km) southeast of Saipan and 7 mi (9 km) north of Aguiguan, Tinian is the third largest island in the Mariana Islands, measuring 40 mi^2 (101 km^2) in area, with a peak elevation of 584 ft (178 m) at Lasso Hill (Engbring et al. 1986, p. 5). The island of Tinian has a population of more than 3,000 residents. Tinian's climate is the same as that of Guam (see *''The Mariana Islands,''* above). The island is predominantly limestone with low-lying plateaus and ridges, and lacks surface streams (Stafford et al. 2005, p. 15; Engbring et al. 1986, p. 5). Two small wetland areas, heavily overgrown with no open water, Hagoi Marsh and Marpo Swamp, serve as a domestic water source (Engbring et al. 1986, p. 5). Tinian has lost most of its primary (native) forest, due initially to clearing for agriculture by the Chamorro, followed by agricultural endeavors of German colonialists in the early 1900s (*e.g.,* coconut plantations) and then by Japanese settlers after 1914 (e.g., sugarcane plantations) (Berger et al. 2005, pp. 36–37). Impacts to Tinian's native vegetation were then compounded by impacts from military activities during World War II (Mueller-Dombois and Fosberg 1998, p. 262; Russell 1998, p. 98; CNMI–SWARS 2010, pp. 6–7, 28–29). Currently, approximately 5 percent of primary (native) forest remains on Tinian (Engbring et al. 1986, p. 25). Tinian supports the forest and cave ecosystems. Tinian currently has no designated conservation areas. One of the 23 species addressed in this proposed rule occurs on Tinian, *Heritiera longipetiolata.* The plants *Dendrobium guamense, Solanum guamense,* and *Tuberolabium guamense,* the Pacific sheath-tailed bat, and the humped tree snail were known from Tinian historically.

Saipan

Located approximately 3 mi (4.5 km) northeast of Tinian, Saipan is the second largest and second most populous of the Mariana Islands, measuring 44 mi^2 (115 km^2) with a peak elevation of 1,555 ft (474 m) at Mt. Tapochau (Mueller-Dombois and Fosberg 1998, p. 256). The island is composed primarily of terraced limestone peaks, with exposed volcanic ridges and slopes (Mueller-Dombois and Fosberg 1998, p. 256). Saipan supported a large population of Chamorro people for thousands of years, followed by the Spanish, Germans, Japanese, and the U.S. military forces, and was also heavily impacted by World War II. Saipan is the site of one of the largest battles in the Pacific between U.S. and Japanese forces. Much of Saipan's forests were destroyed during World War II, with only pockets of native forest surviving (Engbring et al. 1986, pp. 3–5, 10–12; Berger et al. 2005, pp. 38–39). Due to this widespread destruction of native forests and subsequent erosion, the nonnative tree *Leucaena leucocephala* (tangantangan) was seeded for erosion control (Berger et al. 2005, p. 32). Tangantangan is now a dominant tree species on the island, and forms a unique mixed-forest habitat not reported from the other islands (CNMI–SWARS 2010, p. 7). There are four conservation areas on Saipan: (1) Bird Island Wildlife Preserve; (2) Kagman Wildlife Conservation Area and Forbidden Island Sanctuary; (3) Marpi Forest; and (4) the Saipan Upland Mitigation Bank (Berger et al. 2005, p. 14). Ecosystem types on Saipan include forest, savanna, and cave. One of the 23 species addressed in this proposed rule occurs on Saipan, the humped tree snail. The plants *Bulbophyllum guamense, Dendrobium guamense,* and *Solanum guamense,* the Pacific sheath-tailed bat, and the Mariana eight-spot butterfly were known from Saipan historically.

Farallon de Medinilla

Located approximately 52 mi (83 km) northeast of Saipan, and 33 mi (53 km) south of Anatahan, Farallon de Medinilla (FDM) is a small, uninhabited island measuring less than 1 mi^2 (3 km^2) in area with a peak elevation of 1,047 ft (319 m) (CNMI–SWARS 2010, p. 6). None of the 23 species are currently or historically documented from this island.

Anatahan

Located approximately 23 mi (37 km) south of Sarigan, and 33 mi (53 km) northwest of FDM, Anatahan is an uninhabited volcanic island with recent activity, measuring 12 mi^2 (31 km^2) in land area, and a peak elevation of 2,582 ft (788 m) (Mueller-Dombois and Fosberg 1998, p. 252; CNMI–SWARS 2010, p. 6). This island is believed to have been inhabited by the Chamorro people, if not as a permanent residence, then as a collection site for natural resources (Russell 1998, p. 87). Climate on Anatahan is similar to Guam and the other southern Mariana Islands (see *''The Mariana Islands,''* above); however, being at a more northerly latitude, can be slightly cooler than the islands to the south (Ohba 1994, p. 14). Notable physical features of Anatahan include two volcanoes with an east to west trending summit depression formed by overlapping summit craters (Berger et al. 2005, p. 11). The largest caldera measures 1.5 by 2 mi (2 by 3 km) wide. Between 2003 and 2005, Anatahan erupted several times, with the largest eruption occurring in 2005, covering the island with at least 6 ft (2 m) of volcanic ash and destroying an estimated 98 percent of the forest and

savanna habitat (Berger et al. 2005, p. 11; Kessler 2011, pp. 321, 323). Coconut crabs (*Birgus latro*) and five species of resident land birds were eliminated along with most plants and other animals; however, cats (*Felis catus*), rats (*Rattus* spp.), and monitor lizards (*Varanus indicus*) survived (Kessler 2011, p. 323). Vegetation is slowly recovering, and if cats and rats were eliminated, Anatahan could be a good site for the reintroduction of native species—a ''clean slate'' (Kessler 2011, pp. 323–324). At this time, none of the 23 species are known to occur on Anatahan; however, the humped tree snail occurred there historically.

Sarigan

Located approximately 40 mi (64 km) south of Guguan and 23 mi (37 km) northeast of Anatahan, Sarigan is an uninhabited, roughly triangular, island measuring 2 mi^2 (5 km^2) in width with a peak elevation of 1,801 ft (549 m) (CNMI–SWARS 2010, p. 6). The island is believed to have been inhabited by the Chamorro people (Russell 1998, p. 86). Sarigan consists of a low truncated volcanic cone with a 2,460-ft (750-m)-wide summit crater containing a small ash cone. Other notable physical features of Sarigan include irregular shorelines with steep cliffs created by old lava flows (Berger et al. 2005, p. 12). Sarigan has undergone complete eradication of feral ungulates, following the recommendation of the 1998 Fish and Wildlife Biological Opinion for U.S. Navy mitigation for their bombing activities on FDM. The ungulate removal project was a cooperative effort by FWS, U.S. Navy, CNMI Division of Fish and Wildlife (DFW), and the Northern Islands Mayor's Office. The islands' native vegetation and fauna is now increasing in species richness and population numbers (Kessler 2011, pp. 320–322). Ecosystem types on Sarigan include forest and savanna. Two of the 23 species are known to occur on Sarigan (Slevin's skink and the humped tree snail). We are unaware of historical occurrences of the other 21 species on Sarigan.

Guguan

Located approximately 19 mi (30 km) south of Alamagan and 40 mi (64 km) northeast of Sarigan, Guguan is an uninhabited island with volcanic activity, measuring 2 mi^2 (4 km^2) and a peak elevation of 988 ft (301 m) (Ohba 1994, p. 16). The island is not believed to have been inhabited by the Chamorro people (Russell 1998, pp. 83–89). Its north side is devoid of vegetation resulting from volcanic activity, and its south side is a vegetated, eroded, volcanic cone. Other notable physical features of Guguan include steep cliffs along the shoreline and moist to wet ravines (SIO 2014, in litt.). Also notable is the presence of dense seabird colonies (Ohba 1994, p. 16; Berger et al. 2005, p. 12). Guguan supports the forest ecosystem. The entire island of Guguan is a designated conservation area (Berger et al. 2005, p. 15). One of the 23 species occurs on Guguan (Slevin's skink). The plant *Solanum guamense* occurred on Guguan historically.

Alamagan

Located approximately 18 mi (29 km) north of Guguan and 30 mi (48 km) south of Pagan, Alamagan is an uninhabited island with volcanic activity, measuring 4 mi^2 (11 km^2), and a peak elevation of 2,441 ft (744 m) at Mt. Alamagan (Ohba 1994, p. 16). Alamagan is an emergent summit of a large stratovolcano (steep, many-layered volcano characterized by periodic explosive eruptions) with a 1,148-ft (350-m) deep summit crater at the center of the island (Berger et al. 2005, p. 12). Most of the historically recent eruptions have been violently explosive (Berger et al. 2005, p. 12). The island was inhabited by the Chamorro people (Russell 1998, p. 86). Alamagan supports the forest and savanna ecosystems. Two of the 23 species are known to occur on Alamagan (Slevin's skink and the humped tree snail). We are unaware of historical occurrences of the other 21 species on Alamagan.

Pagan

Located 42 mi (68 km) from Agrihan and 30 mi (48 km) from Alamagan, Pagan is the fifth largest island in the Marianas archipelago, and the largest of the northern Mariana Islands, with an area of 19 mi^2 (48 km^2) (Ohba 1994, p. 17). Four volcanoes comprise Pagan: Mt. Pagan in the north, and an unnamed complex of three older volcanoes to the south (Ohba 1994, p. 17; Smithsonian Institution 2014a, in litt.). These volcanoes are connected by a narrow isthmus. The highest point on this island is Mt. Pagan, which rises 1,870 ft (570 m) above sea level. Mt. Pagan is one of the most active volcanoes in the Mariana Islands, with its most recent eruption in 2012 (Smithsonian Institution 2014b, in litt.). The largest eruption during historical times took place in 1981, when lava buried 10 percent of the island, and ash covered the entire island, forcing the 53 residents to flee to Saipan (Smithsonian Institution 2014b, in litt.). The island of Pagan supports the forest and savanna ecosystems. Three of the 23 species are known to occur on Pagan, the tree *Cycas micronesica* and the animals Slevin's skink and the humped tree snail. The plant *Bulbophyllum guamense* occurred historically on Pagan.

Agrihan

Located approximately 64 mi (102 km) south of Asuncion, and 39 mi (63 km) north of Pagan, Agrihan is an almost perfectly round, active volcanic cone (Ohba 1994, p. 17). None of the 23 species addressed in this proposed rule are known to have historically occurred, or to currently occur, on Agrihan, but other listed species, the Mariana fruit bat and the Micronesian megapode, occur there.

Asuncion

Asuncion is located approximately 23 mi (37 km) southeast of Maug and 62 mi (100 km) north of Agrihan. This island is an active, uninhabited volcano measuring 3 mi^2 (7 km^2), with a peak elevation of 2,923 ft (891 m) (Ohba 1994, p. 18; Mueller-Dombois and Fosberg 1998, p. 245). Historically, Asuncion was inhabited by Chamorro peoples when Sanvitores arrived in the mid 1600s, and as evidenced by coconut groves (Mueller-Dombois and Fosberg 1998, p. 235). The long interval since Asuncion's last confirmed eruption in 1906 (Smithsonian Institution 2014c, in litt.), in conjunction with its high summit often enclosed by clouds (Ohba 1994, p. 18), affords this cone-shaped volcanic island densely forested slopes with diverse vegetation. Asuncion supports the forest and savanna ecosystems (Ohba 1994, p. 18). The entire island of Asuncion is a designated conservation area (Berger et al. 2005, p. 15). One of the 23 species addressed in this proposed rule is known to occur on Asuncion (Slevin's skink). The plant *Solanum guamense* occurred historically on Asuncion.

Maug

Located approximately 43 mi (70 km) south of Uracas and 24 mi (39 km) north of Asuncion, Maug consists of three small, uninhabited islets (East Island, West Island, and North Island). The three islets are the emergent portions of a largely submerged volcano, with a central lagoon within a sunken crater (Ohba 1994, p. 18; Mueller-Dombois and Fosberg 1998, p. 244). The collective land mass of the three islets measures 0.8 mi^2 (2 km^2) with the highest elevation at 745 ft (227 m) at North Island (Ohba 1994, p. 18; Mueller-Dombois and Fosberg 1998, p. 244). Historically, Chamorro people inhabited Maug (Russell 1998, p. 88), and the islets were briefly inhabited by the Japanese during World War II (Russell

1998, pp. 96–97). Each of the three islets consists of narrow rocky ridges covered primarily by grasslands, sedges, and scrub; however, larger trees such as *Hernandia* sp., *Pisonia grandis,* and *Terminalia catappa* have been reported to occur in ravines on the leeward sides (Ohba 1994, p. 18; Mueller-Dombois and Fosberg 1998, pp. 244–245). Ecosystems on Maug include forest and savanna, which currently provide habitat for large breeding colonies of a variety of seabirds (Ohba 1994, p. 18). All three islets that comprise Maug are designated as a conservation area (Berger et al. 2005, p. 15). None of the 23 species addressed in this proposed rule are known to currently occur on the islands of Maug. The plant *Solanum guamense* occurred historically on Maug.

Uracas

Uracas (Farallon de pajaros), is the northernmost island of the Mariana archipelago, roughly 43 mi (70 km) northwest of Maug. The island is an active, uninhabited volcano measuring 0.9 mi^2 (2 km^2) and with a peak elevation of 1,180 ft (334 m) (Ohba 1994, p. 18). None of the 23 species addressed in this proposed rule, or any previously listed species, are known to have historically occurred, or to currently occur, on Uracas.

An Ecosystem-Based Approach to Assessing the Conservation Status of 23 Species in the Mariana Islands

In this document, we have analyzed the threats to each of the 23 Mariana Islands species individually to determine the appropriate status of each species on its own merits under the Act. However, because many of these species, and particularly those that share the same habitat types (henceforth referred to as ecosystems), share a very similar suite of threats, we have organized the 23 species addressed in this proposed rule by common ecosystem for efficiency, to reduce repetition for the reader, and to reduce publication costs. Therefore, we begin our analysis of the potential threats to each of the 23 species by first describing the relevant ecosystems in which these species occur, to avoid repeating the habitat characteristics associated with each individual species found in the same ecosystem. Organizing the rule in this way also allows us to describe threats that affect multiple species occurring in shared ecosystems in a more efficient manner, again reducing repetition for the reader and saving publication costs.

In addition, as an incidental benefit of assessing the threats to the 23 species using shared ecosystems as an organizational tool, we have laid the groundwork for better addressing threats to these species, should they be listed. On the Mariana Islands native species occurring in the same habitat types depend on many of the same physical and biological features and the successful functioning of their specific ecosystem to survive. Because these species that share ecosystems face a suite of shared threats, managing or eliminating these threats holistically at an ecosystem level is more cost effective and should lead to better resource protection for all native species. Cost-effective management of these threats requires implementation of conservation actions at the ecosystem level to enhance or restore critical ecological processes and provide for long-term viability of species and their habitat. Organizing the 23 Mariana Islands species by shared ecosystems sets the stage for a conservation management approach of protecting, restoring, and enhancing critical ecological processes at an ecosystem scale for the long-term viability of all associated native species in a given ecosystem type and locality, thus potentially preventing the future imperilment of any additional species that may require protection. This approach is in accord with the primary stated purpose of the Act (see section 2(b)): ''to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved.''

Each of the 23 Mariana Islands species is found in one of the four ecosystem types described in this rule: forest, savanna, stream, and cave (Table 2). Of the 23 species, only the Pacific sheath-tailed bat is found in more than one ecosystem type (forest and cave).

TABLE 2—THE 23 MARIANA ISLANDS SPECIES AND THE ECOSYSTEMS UPON WHICH THEY DEPEND

Ecosystem	Species	
	Plants	Animals
Forest ...	*Bulbophyllum guamense*.	Pacific sheath-tailed bat.
	Cycas micronesica.	Slevin's skink.
	Dendrobium guamense.	Mariana eight-spot butterfly.
	Eugenia bryanii	Mariana wandering butterfly.
	Heritiera longipetiolata.	Humped tree snail.
	Maesa walkeri	Langford's tree snail.
	Nervilia jacksoniae.	Guam tree snail.
	Psychotria malaspinae.	Fragile tree snail.
	Solanum guamense.	
	Tabernaemontana rotensis.	
	Tinospora homosepala.	
	Tuberolabium guamense.	
Savanna	*Hedyotis megalantha*.	
	Phyllanthus saffordii.	
Stream	.....	Rota blue damselfly.
Cave	.....	Pacific sheath-tailed bat.

For all of the proposed species, we identified and evaluated those factors that are threats to each individual species specifically (species-specific threats), as well as those factors which are common threats to all of the species of a given ecosystem type (ecosystem-level threats). For example, the degradation of habitat by nonnative ungulates is considered a direct or indirect threat to 17 of the 23 species proposed for listing as endangered or threatened species. We have labeled such threats that are shared by all species within the same ecosystem as an ''ecosystem-level threat,'' because they impact all proposed species occurring in that ecosystem type in terms of the nature of the impact, its severity, timing, and scope. Beyond ecosystem-level threats, we further identified and evaluated species-specific threats that may be unique to certain species. For example, the threat of predation by nonnative flatworms is unique and specific to the four tree snails addressed in this rule.

Mariana Islands Ecosystems

For the purposes of organizing our threats discussion for the 23 species by shared habitats, we describe four broad Mariana Islands ecosystems: Forest,

savanna, stream, and cave, based on physical features, elevation, substratum, vegetation type, and hydrology (see *''The Mariana Islands,''* above). We acknowledge the presence of other ecosystems (e.g., coastal, wetland) in the Mariana Islands, however we limit our discussion to these four because they are the relevant ecosystems that support the 23 species proposed for listing as endangered or threatened species in this rule.

Forest Ecosystem

There are two substrate types in the forest ecosystem, limestone and volcanic (Stone 1970, pp. 9, 14, 18–24; Falanruw et al. 1989, pp. 6–9; Ohba 1994, pp. 19–29; Mueller-Dombois and Fosberg 1998, p. 243). The annual rainfall in the forest ecosystem lies within the archipelago average, ranging from 78 to 100 inches (in) (2,000 to 2,500 millimeters (mm)), with a rainy season from June or July through October or November. The temperature of the forest ecosystem mirrors the archipelago monthly averages, between 75 degrees Fahrenheit (°F) and 82 °F (24 degrees Celsius (°C) and 28 °C), with extremes of 64 °F and 95 °F (18 °C and 35 °C). Multiple plant species are present throughout the forest ecosystem, and on most of the islands; however, variations in species structure are observed (Fosberg 1960, pp. 37, 56–59, plates 1–40; Falanruw et al. 1989, pp. 6–9; Ohba 1994, pp. 19–29; Mueller-Dombois and Fosberg 1998, pp. 257, 268, 270–271).

Native canopy species in the forest ecosystem (as defined here) include but are not limited to: *Artocarpus mariannensis, Barringtonia asiatica, Claoxylon* spp., *Cordia subcordata, Cyathea* spp., *Cyanometra ramiflora, Elaeocarpus joga, Ficus prolixa, Guamia mariannensis, Hernandia labyrinthica, H. sonora, Maytenus thompsonii, Merrilliodendron megacarpum, Ochrosia mariannensis, Pandanus dubius, P. tectorius, Pisonia grandis, Pouteria obovata,* and *Premna obtusifolia* (Falanruw et al. 1989, pp. 6–9; Raulerson and Rinehart 1991, pp. 6–7, 11, 14, 20, 24, 28, 33, 50, 52–53, 62–63, 72, 91, 96, 104; Ohba 1994, pp. 19–29; Mueller-Dombois and Fosberg 1998, pp. 257, 268, 270–271; Wiewel et al. 2009, pp. 206–207). Native subcanopy species include but are not limited to: *Aglaia mariannensis, Aidia cochinchinensis, Allophyllus timoriensis, Cyathea aramaganensis, Eugenia palumbis, E. reinwardtiana, Hibiscus tiliaceus, Neisosperma oppositifolia, Psychotria mariana,* and *Xylosma nelsonii* (Stone 1970, pp. 9, 14, 18–24; Falanruw et al. 1989, pp. 6–9; Raulerson and Rinehart 1991, pp. 13, 47, 56, 59, 68–69, 77, 84, 88; Ohba 1994, pp. 19–29; Mueller-Dombois and Fosberg 1998, pp. 252–253, 257, 268, 272); and native understory species include but are not limited to: *Discocalyx megacarpa, Hedyotis* spp., *Nephrolepis bisserrata, N. hirsutula, Phyllanthus marianus,* and *Piper guamense* (Falanruw et al. 1989, pp. 6–9; Ohba 1994, pp. 19–29; Mueller-Dombois and Fosberg 1998, pp. 247, 268). Further, in select areas of the forest ecosystem, usually where the forest is situated to receive and retain more moisture, the canopy trees are covered in various mosses and epiphytic ferns and orchids (Mueller-Dombois and Fosberg 1998, p. 268).

Dominant canopy, subcanopy, and understory species can vary from one location to the next on the same island, and from island to island. These species can be endemic to one island, occur on one or more of the southern islands (e.g., the understory species *Discocalyx megacarpa*), or occur on one or more of the northern islands (e.g., *Cyathea aramaganensis*). In addition, biologists have observed overlap of forest species on limestone and volcanic substrata, suggesting that physical properties may be more important than chemical properties of these substrates in determining vegetation characteristics (Mueller-Dombois and Fosberg 1998, pp. 262–264). Elevation also contributes to variations in vegetation, as observed on Mt. Alutom, Mt. Almagosa, Mt. Lamlam, and Mt. Bolanus on Guam; the Rota Sabana; and on the slopes of the northern islands (Stone 1970, pp. 9, 14, 18–24; Falanruw 1989, pp. 4–6; Mueller-Dombois and Fosberg 1998, pp. 262–264); although in some cases there is no definite correlation with elevation (i.e., the moisture-retaining, moss-and-epiphyte-covered sections of the forest ecosystem are found near the coast in some areas and also at mid to high elevations) (Fosberg 1960, p. 30).

Additionally, biologists have observed a change in distribution of *Hernandia* species with elevation. For example, *H. sonora,* dominant on the coastal side of the forest ecosystem, changes distinctly to *H. labyrinthica* as the elevation increases (Amidon 2000, p. 49). The significance of these interpretations of forest-associated species in the Mariana archipelago to the 14 plants in this rule is not adequately definitive to subclassify a forest type for each of the species in this rule; therefore, we describe a general forest ecosystem here, with the substrate, temperatures, rainfall, and associated native canopy, subcanopy, and understory species, listed above. The forest ecosystem supports 21 of the 23 species proposed for listing as endangered or threatened species in this rule (all except the plants *Hedyotis megalantha* and *Phyllanthus saffordii,* which occur only in the savanna ecosystem).

Savanna Ecosystem

The savanna ecosystem of the Mariana Islands is characterized by volcanic substrate, primarily of basalts, with laterite soil (red clay rich in iron and aluminum) and a vegetation type in which grasses are the dominant plants. The savanna ecosystem on Guam is segmented by multiple narrow ravine forests, with some grassland (Mueller-Dombois and Fosberg 1998, pp. 241, 272). Savanna is considered a primary ecosystem type; however, human clearing and burning of forests and the presence of feral ungulates have contributed toward the expansion of secondary savanna into areas that previously supported the forest ecosystem (Mueller-Dombois and Fosberg 1998, pp. 241–243; Stone 1970, p. 31). Some authorities have suggested that savanna should not be classified as a native ecosystem in the Mariana Islands (Athens and Ward 2004, p. 27); however, we concur with Mueller-Dombois and Fosberg (1998, pp. 241–243), Stone (1970, pp. 14, 19, 21, 23, 30), and Hunter-Anderson (2009, 16 pp.), that savanna can be classified as a primary ecosystem type. Hunter-Anderson published a detailed analysis of charcoal samples, historical climate change trends, patterns of soil deposition, known agricultural techniques used by the early settlers, and Holocene-age pollen and spore studies, all indicating that the first settlers did not use fire to create or enlarge new open areas (savanna) for agriculture (Hunter-Anderson 2009, 16 pp.). These findings support the theory that the savanna ecosystem type existed prior to human presence in the Mariana Islands.

Annual rainfall in the savanna ecosystem ranges from 78 to 100 in (2,000 to 2,500 mm), with a rainy season from June or July through October or November. Likewise, the temperature of the savanna ecosystem averages between 75 °F and 82 °F (24 °C and 28 °C), with extremes of 64 °F and 95 °F (18 °C and 35 °C). Several endemic plant species are associated with the savanna ecosystem: the grass *Dimeria chloridiformis;* the small herbaceous perennial *Dianella saffordiana,* and the small tree *Phyllanthus mariannensis* (Stone 1970, pp. 19, 388, 549; Mueller-Dombois and Fosberg 1998, pp. 241–243; Hunter-Anderson 2009, 16 pp). Other native savanna species include

the shrubs *Decaspermum fruticosum, Dodonaea viscosa, Melastoma marianum, Myrtella bennigseniana,* and *Wikstroemia elliptica,* the grass *Digitaria mariannensis;* and subspecies of the fern *Dicranopteris.* Another dominant but controversial component of the savanna ecosystem is the grass *Miscanthus floridulus* (giant miscanthus). Although *M. floridulus* occurred historically on Pagan as analyzed in fossil records studied in 1958 (Fosberg and Corwin 1958, pp. 8–9), and currently occurs on almost all of the 15 Mariana Islands, this species is considered invasive by most Mariana Islands ecologists. Recent field observations revealed that *M. floridulus* often grows in widespread, monotypic stands, whereas endemic plants such as *Hedyotis megalantha* and *Phyllanthus saffordii* grow compatibly within patches of the native fern *Dicranopteris linearis* (Gawel 2012, in litt.). The savanna ecosystem supports 2 of the 14 plant species proposed for listing as endangered or threatened species in this rule (*Hedyotis megalantha* and *Phyllanthus saffordii*).

Cave Ecosystem

The cave ecosystem is largely located in limestone (karst) areas on the southern islands of Saipan, Aguiguan, Rota, and Guam (Taborosi 2004, pp. 14–15). Limited areas of cave ecosystem also occur on the volcanic northern Mariana Islands where lava tubes and other crevices occur. The cave ecosystem includes stream caves, lava tubes, sea caves, and solution caves (Taborosi 2004, pp. 2, 11; Water and Environmental Research Institute and the Western Pacific-Island Research and Education Initiative (WERI–IREI) 2014, in litt.). Solution caves are the most common, except for on Tinian, which has mostly flank margin caves (Stafford et al. 2005, p. 20; WERI–IREI 2014, in litt.). Solution caves are cavities that have developed in the limestone substrate through the action of running water, erosion, and collapse (WERI–IREI 2014, in litt). Flank margin caves form at the distal margin of the fresh water lens, where mixing of fresh and saline waters occurs (Stafford et al. 2005, p. 20).

Ambient temperatures and rainfall in the cave ecosystem are the same as for surrounding areas in the Marianna Islands (average of 75 °F to 90 °F (24 °C to 32 °C); rainfall 78 in (2,000 mm) per year) (Wiles et al. 2009, p. 10 in O'Shea and Valdez 2009). Thermal characteristics of the interiors of caves show little variability, and relative humidity is high. Humidity measured in four caves on Aguiguan ranged from 92 to 96 percent (O'Shea and Valdez 2009, p. 78 in O'Shea and Valedez 2009). Internal cave temperatures (between caves) vary less than a few degrees, between 79 °F to 82 °F (26 °C to 28 °C), and temperatures within each cave are essentially constant (O'Shea and Valdez 2009, p. 77 in O'Shea and Valedez 2009). No major air movement was detected within caves to indicate any complex thermal patterns (O'Shea and Valdez 2009, p. 77 in O'Shea and Valedez 2009).

Cave sizes range from small (less than 49 ft (15 m) long and 538 ft^2 (50 m^2)) in floor area, with low rock overhangs, narrow vertical crevices, various cavities at the base of cliffs or under large boulders; to medium (538 ft^2 to 1,076 ft^2 (50 to 100 m^2) in floor area, with wider rooms; to large (over 1,076 ft^2 (100 m^2)) in floor area, with ceiling heights reaching 16 to 98 ft (5 to 30 m)) (Wiles et al. 2009, p. 11 in O'Shea and Valdez 2009).

Cave ecosystems suitable for the Pacific sheath-tailed bat should be within or near mature native forest, to provide an attainable food source (Wiles et al. 2009, p. 10 in O'Shea and Valdez 2009; Gorresen et al. 2009, p. 44 in O'Shea and Valdez 2009). Pacific sheath-tailed bats prefer the larger caves, if available (Wiles et al. 2009, p. 15 in O'Shea and Valdez 2009), but may also be found in smaller caves, especially where there may be less disturbance (e.g., use by goats or humans).

One of the 23 species proposed for listing as endangered in this rule, the Pacific sheath-tailed bat, depends on the cave ecosystem for its life-history needs.

Stream Ecosystem

Streams can be a part of a wetland ecosystem; however, for this proposed rule, we discuss only the more narrowly defined stream ecosystem. Only one species addressed in this rule is found in the stream ecosystem, the Rota blue damselfly, which occurs only on Rota.

Only two of the Mariana Islands have permanent streams, Guam and Rota. Guam has 14 named watersheds with more than 100 streams and rivers (WERI–IREI 2014, in litt.). Saipan has a brackish-water lake, Lake Susupe. Intermittent headwaters originating from Mount Tagpochau and the Fina Sisu ridge during heavy rains provide water to the lake, but there are no permanent streams on Saipan (Wong and Hill 2000, p. 1). Currently on Tinian, there are no permanent streams, and only one functional wetland, Lake Hagoi (Stinson 1995, in litt.). The limestone substrate of these southern islands is very porous, and rain that falls is evaporated, consumed by plants, runs directly off the land surface into the ocean, or recharges ground water (Carruth 2003, p. 13). The northern islands are not known to have permanent streams; however, Pagan has a freshwater lake with hot sulfur springs, and a small brackish-water lake (Guam.net, *http://www.guam.net/pub/sshs/depart/science/mancuso/marianas/pagan/pagan.htm,* accessed April 30, 2014).

The western end of Rota is dominated by the ''Sabana'' region, which is an irregular plateau 1,300 ft (400 m) high, 2.5 mi by 1.6 mi (4 km by 2.5 km), with two prominent peaks nearly 1,600 ft (500 m) high. The Sabana area is very porous, with internal caves, and any ponding water after a rainfall event filters quickly into the substrate, leaving ephemeral streams (Keel et al. 2007, pp. 12–16). The east, north and west of the plateau gradually drops off in a series of terraces. The south side of the plateau has steep cliffs in the Talakhaya area, with springs and the only surface streams on the island (Keel et al. 2007, p. 3). The stream ecosystem on Rota encompasses these streams and springs in the Talakhaya area, and is the only known location of the Rota blue damselfly (as described in ''*Animals*—Rota Blue Damselfly,'' below).

On Rota, there is a distinct rainy season from July through December, with an average annual rainfall of 102 in (2600 mm). Ambient temperature averages 81 °F (27 °C) (see ''Islands in the Mariana Archipelago,'' above). The rainy season and rainfall amounts can dramatically change (become drier) due to the El Niño-Southern Oscillation (ENSO) which also affects stream levels (Keel et al. 2007, p. 6).

The vegetation along the streams consists primarily of mature, tall-canopied, native limestone forest (Keel et al. 2007, p.10; U.S. Forest Service 2014, in litt.). The vegetation type and components are further described in Forest Ecosystem, above.

The Talakhaya Springs within the Sabana Watershed are used as a primary domestic water source. The springs consist of Water Cave (also known as Matan Hanum Spring) and As Onon Spring. The municipal water is obtained by gravity flow from these two springs (up to 1.8 million gallons a day (2.8 cubic feet per second)) (Keel et al. 2007, pp. 1, 5; Stafford et al. 2002, p. 17). Under ordinary climatic conditions, this area supplies water in excess of demand but ENSO-induced drought conditions can lead to significantly reduced discharge, or may completely dewater the streams (Keel et al. 2007, pp. 3, 6, 19). In 1998, water captured from the

springs was inadequate for municipal use, and water rationing was instituted (Keel et al. 2007, p. 6). As the annual temperature rises resulting from global climate change, other weather regime changes such as increases in droughts, floods, and typhoons will occur (Giambelluca et al. 1991, p. iii). Increasing night temperatures cause a change in mean precipitation, with increased occurrences of drought cycles (Loope and Giambelluca 1998, pp. 514–515; Emanuel et al. 2008, p. 365; U.S. Global Change Research Program (US–GCRP) 2009, pp. 145–149, 153; Keener et al. 2010, pp. 25–28; Finucane et al. 2012, pp. 23–26; Keener et al. 2012, pp. 47 – 51).

The limestone substrate of Rota is porous, with filtration through central Sabana being the sole water source for the few streams on the island and for human use. There are no other ground water supplies on the island, and limited storage capacity. The Rota blue damselfly is dependent upon any water that escapes the Talakhaya Springs naturally, what is not already removed for human use. The likelihood of dewatering of the Talakhaya Springs is high due to climate change causing increased ENSO conditions, and increased human demand. The ''Public and Agency Participation'' section of the Comprehensive Wildlife Conservation Strategy for the Commonwealth of the Northern Mariana Islands (2005, p. 347) cites ''individuals state the the Department of Public Works has been increasing their water extraction from Rota's spring/stream systems. Historically, this water source flowed year-around, yet now they are essentially dry most of each year.'' See the species description in ''Rota blue damselfly,'' below, and the ''Water Extraction'' section under *Factor E. Other Natural or Manmade Factors Affecting Their Continued Existence,* below, for further discussion.

Description of the 23 Mariana Islands Species

Plants

In order to avoid confusion regarding the number of populations of each species (i.e., because we do not consider an individual plant to represent a viable population), we use the word ''occurrence'' instead of ''population.'' Additionally, we use the word occurrence to refer only to wild (i.e., not propagated and outplanted) individuals because of the uncertainty of the persistence to at least the second generation (F2) of the outplanted individuals. A population consists of mature, reproducing individuals forming populations that are self-sustaining. Also, there is a high potential that one or more of the outplanted populations may be eliminated by normal or random adverse events such as fire, nonnative plant invasion, or disease, before a seed bank can be established.

Bulbophyllum guamense (cebello halumtano), an epiphyte in the orchid family (Orchidaceae), is known from widely distributed occurrences on the southern Mariana Islands of Guam and Rota, in the forest ecosystem (Ames 1914, p. 13; Raulerson and Rinehart 1992, p. 90; Costion and Lorence 2012, pp. 54, 66; Global Biodiversity Information Facility (GBIF) 2012a–*Online Herbarium Database*). *Bulbophyllum guamense* was recorded historically on Guam from clifflines encircling the island, and on the slopes of Mt. Lamlam and Mt. Almagosa. As recently as 1992, this species was reported to occur in large mat-like formations on trees ''all over the island,'' (Guam) (Raulerson and Rinehart 1992, p. 90). Currently, numbers have declined dramatically, and there are only 4 known occurrences (3 on Guam and 1 on Rota) totaling fewer than 250 individuals on Guam and fewer than 30 individuals on Rota. Historically, this species also occurred on Pagan (last observed in 1984) and Saipan (last observed in 1970). *Bulbophyllym guamense* has thus been lost from two of the four islands where it formerly occurred, and only a few small populations of the species remain on Guam and Rota. The remaining individuals of *B. guamense* are vulnerable to the effects of continued habitat loss and destruction from agriculture, urban development, nonnative animals and plants, fires, and typhoons, combined with predation by nonnative invertebrates such as slugs.

Cycas micronesica (fadang), a cycad in the cycad family (Cycadaceae), is known from Guam, Rota, and Pagan, as well as Palau (politically the independent Republic of Palau) and Yap (geographically part of the Caroline Islands; politically part of the Federated States of Micronesia), in the forest ecosystem (Hill et al. 2004, p. 280; Keppel et al. 2008, p. 1,006; Cibrian-Jaramillo et al. 2010, pp. 2,372–2,375; Marler 2013, in litt.).

Just 10 years ago, *Cycas micronesica* was ubiquitous on the island of Guam, and similarly common on Rota. *Cycas micronesica* is currently under attack by a nonnative insect, the cycad aulacaspis scale (*Aulacaspis yasumatsui*) that is causing rapid mortality of plants at all locations (Marler 2014, in litt.). As of January 2013, *C. micronesica* mortality reached 92 percent on Guam, and cycads on Rota are experiencing a similar fate (Marler 2013, in litt.). All seedlings of *C. micronesica* in a study area were observed to die within 9 months of infestation by *C. yasumatsui* (see *Factor C. Disease and Predation,* below for further discussion) (Marler and Muniappan 2006, p. 3; Marler and Lawrence 2012, p. 233; Marler 2013, pers. comm.; Western Pacific Tropical Research Center 2012, p. 4).

Currently, there are 15 to 20 occurrences of *Cycas micronesica* totaling 900,000 to 950,000 individuals on the Micronesian Islands of Guam, Rota, Pagan, Yap, and Palau. On Guam and Rota there are fewer than 630,000 (Marler 2013, pers. comm.). These totals do not distinguish between successfully reproducing adults and juveniles (Marler 2013, pers. comm.), which, because of the effects of the cycad aulacaspis scale, implies that the number of extant individuals that can successfully reproduce is much lower. On Guam, there are four fragmented occurrences, totaling fewer than 516,000 individuals: one occurrence along the shoreline to the base of the limestone cliffs on the north side; a second occurrence beginning at the forest edge along the cliffs and continuing into the forest on the north side; a third occurrence on the northern plateau; and a fourth occurrence along the ravines and rock outcrops on the southern side, with a few individuals occurring across the savanna.

On Rota, there are four known occurrences within the forest ecosystem, totaling fewer than 111,500 individuals (Marler 2013, in litt.). On the northeast shore the first occurrence totals fewer than 25,500 individuals; the second occurrence, on the northwest shore, totals fewer than 21,600 individuals; the third occurrence on the south shore totals fewer than 63,600 individuals; and the fourth occurrence on Wedding Cake peninsula totals fewer than 300 individuals.

There are likely a relatively limited number of individuals of *Cycas micronesica* on Pagan. In recent surveys, Pratt (2011, pp. 33–42) reported finding representatives of the species in a ravine on the southwestern part of the island.

Yap consists of a group of four islands, three of which are separated by water but share a common reef, with a total land area of 39 mi^2 (102 km^2). On Yap, there are three occurrences of *Cycas micronesica* totaling 288,450 individuals (Marler 2013, in litt). Palau consists of three larger islands, Babeldaob, Koror, and Ngeruktabel, and between 250 and 300 smaller islands referred to as the ''Rock Islands.'' The

total land area is 177 mi^2 (458 km^2). On Palau, four occurrences of *C. micronesica* total fewer than 2,500 individuals: (1) two occurrences on Ngeruktabel Island total fewer than 900 individuals, (2) one occurrence on Ngesomel Island totals fewer than 600 individuals, and (3) possibly as many as 1,000 individuals scattered on the Rock Islands (Marler 2013, in litt.). The aulacaspis scale was observed on the main islands of Palau in 2008 (Marler 2014, in litt.), and is expected to reach Yap as well (Marler 2013, in litt.).

Protecting and preserving *Cycas micronesica* on the islands of Guam and Rota is important, as it is an integral component of the forest ecosystem, and over 50 percent of the known individuals occur on these islands. The nonnative cycad aulacaspis scale quickly causes mortality of all life stages of *C. micronesica,* preventing reproduction of *C. micronesica,* and leading to its extirpation (see *Factor C. Disease and Predation,* below). The magnitude of the ongoing threats of predation by the scale and nonnative animals, secondary infestations by other insects, and loss of habitat due to development, typhoons, climate change, and direct damage and destruction by military live-fire training is large, and these threats are imminent. Although *C. micronesica* presently is found in relatively high numbers, the factors affecting this species can result in very rapid mortality of large numbers of individuals. A study by Marler and Lawrence (2012) shows that if the ongoing negative population density trajectory for *C. micronesica* established over 4 years is sustained, extirpation of *C. micronesica* from Guam and Rota will occur by 2019.

Dendrobium guamense (no common name (NCN)), an ephiphyte in the orchid family (Orchidaceae), is known from Guam, Rota, and Tinian, in the forest ecosystem (Ames 1914, p. 14; Raulerson and Rinehart 1992, p. 98; Costion and Lorence 2012, p. 66). As recently as the 1980s, this species was common in trees on Guam and Rota, with more than 12 occurrences on Guam and 17 occurrences on Rota (Bishop Museum 2013—*Online Herbarium Database;* Consortium Pacific Herbarium (CPH) 2012a—*Online Herbarium Database,* 5 pp.). Currently, there are 9 occurrences totaling approximately 550 individuals distributed among these islands. On Guam, there are 4 occurrences totaling fewer than 250 individuals (Harrington et al. 2012, in litt). On Rota, there are 4 occurrences of *D. guamense,* totaling fewer than 300 individuals (Harrington et al. 2012, in litt). There is one reported occurrence on the island of Tinian, with an unknown number of individuals (Quinata et al. 1994, p. 8; CPH 2012a—*Online Herbarium Database,* 5 pp.). Historically, *D. guamense* was also known from Saipan, in the forest ecosystem (CPH 2012a—*Online Herbarium Database,* 5 pp.). Formerly relatively common, the remaining populations of *D. guamense* and habitat for its reintroduction to Saipan are at risk; *D. guamense* populations are decreasing on Guam, Rota, and Tinian, and both the species and its habitat continues to be negatively affected by continued habitat loss and destruction from agriculture, urban development, nonnative animals and plants, fires, and typhoons, combined with predation by nonnative invertebrates such as slugs.

Eugenia bryanii (NCN), a perennial shrub in the Myrtle family (Myrtaceae), is known only from Guam. Historically, *E. bryanii* occurred on windy, exposed clifflines along the west and east coasts of the island, and from along the Pigua River, in the forest ecosystem (Costion and Lorence 2012, p. 82; Gutierrez 2012, in litt.). Currently, *E. bryanii* is known from 5 occurrences totaling fewer than 420 individuals (Gutierrez 2014, in litt.). Populations of *E. bryanii,* a single island endemic, are decreasing from initial numbers observed on Guam, and these remaining small populations are at risk, due to continued habitat loss and destruction from agriculture, urban development, nonnative animals and plants, and typhoons, combined with herbivory by deer.

Hedyotis megalantha (paudedo), a perennial herb in the coffee family (Rubiaceae), is known only from the savanna ecosystem on Guam. Historically, *H. megalantha* was reported solely from Guam; however, because several herbarium records reported this species on Rota and Saipan, we investigated other reports and taxonomic and genetic analyses concerning the range of this species. We believe the Rota and Saipan reports are misidentifications of one or more of the other *Hedyotis* species also found in the Mariana Islands (Fosberg et al. 1993, pp. 63–79; CPH 2012b—*Online Herbarium Database;* World Checklist of Select Plant Families (WCSP) 2012a—*Online Herbarium Database*). Between 1911 and 1966, this species ranged from the mid-central mountains and west coast of Guam, south to Mt. Lamlam (Bishop Museum 2013-*Online Herbarium Database*). Currently, *H. megalantha* is known from one large scattered occurrence totaling fewer than 1,000 individuals on southern Guam (Costion and Lorence 2012, pp. 54, 86; Gutierrez 2012, in litt.; Bishop Museum 2013—herbarium database; Gutierrez 2013, in litt.). *Hedyotis megalantha* typically occurs as lone individuals rather than in patches or groups (Gutierrez 2013, in litt.). In sum, the single known occurrence of *H. megalantha,* a single island endemic, is decreasing from initial numbers observed on Guam, and the remaining individuals are at continued risk due to ongoing habitat loss and destruction from agriculture, urban development, nonnative animals and plants, fires, and typhoons, combined with habitat destruction and direct damage by recreational vehicles.

Heritiera longipetiolata (ufa-halomtano; looking glass tree), a tree in the hibiscus family (Malvaceae), is known only from the Mariana Islands. A few herbarium records have cited *H. longipetiolata* on Palau, Chuuk, Pohnpei, and the Eastern Caroline Islands; however, upon a thorough review of the literature and herbarium records, and conferring with local botanical experts, we conclude that these few outlying occurrences are actually *H. littoralis,* not *H. longipetiolata* (Stone 1970, pp. 23, 420–421; Raulerson and Rinehart 1991, p. 94; Wiles 2012, in litt.; Center for Plant Conservation 2010, in litt.; CPH 2012c—*Online Herbarium Database;* GBIF 2014—*Online Herbarium Database;* Harrington et al. 2012, in litt.; Lorence 2013, in litt.).

Historically, *Heritiera longipetiolata* is reported from Guam, Rota, Saipan, and Tinian, in the forest ecosystem (Stone 1970, p. 420; Raulerson and Rinehart 1991, p. 94; CPH 2012c—*Online Herbarium Database;* GBIF 2014—*Online Herbarium Database*). By 1997, there were about 1,000 individuals on Guam, several hundred on Tinian, and fewer than 100 on Saipan, with none observed on Rota (Wiles in Internation Union for Conservation of Nature (IUCN) Red List 2014, in litt.). Currently, *H. longipetiolata* is known from 9 occurrences totaling fewer than 160 individuals, on Guam, Saipan, and Tinian, all within the forest ecosystem (M and E Pacific, Inc., pp. 6, 8, 31, 78; Harrington et al. 2012, in litt; Grimm 2013, in litt). On Tinian, *H. longipetiolata* is known from fewer than 10 individuals (Williams 2013, in litt.). On Saipan, *H. longipetiolata* is known from 3 occurrences, totaling fewer than 30 individuals. Wiles stated that there is strong evidence that *H. longipetiolata* is not regenerating, and that seedlings and seeds are eaten by ungulates and crabs (Wiles in IUCN Red List 2014, in litt.). *Heritiera longipetiolata* is on Guam's endangered species list, listed as Vulnerable on IUCN's Red List of

Threatened Species, and is also a species of concern for Guam's Plant Extinction Prevention Program. The remaining populations of *H. longipetiolata* persist only in small numbers, and are decreasing from initial numbers observed on Guam, Saipan, and Tinian. With fewer than 200 individuals remaining across three islands, the species *Heritiera longipetiolata* and habitat for the recovery of the species on Rota are at risk due to ongoing habitat loss and destruction from agriculture, urban development, nonnative animals and plants, and typhoons. Herbivory by pigs and deer, and habitat and direct destruction by military live-fire training also contribute to the decline of *H. longipetiolata.*

Maesa walkeri (NCN), a shrub or small tree in the primrose family (Primulaceae), is found only in the Mariana Islands. Historically, *M. walkeri* is known from the islands of Guam and Rota, within the forest ecosystem (Fosberg and Sachet 1979, pp. 368–369; Raulerson and Rinehart 1991, p. 67; M and E Pacific, Inc. 1998, pp. 31, 79; Costion and Lorence 2012, p. 84; CPH 2012d—*Online Herbarium Database;* GBIF 2012b—*Online Herbarium Database;* Wagner et al. 2012—*Flora of Micronesia*). Several voucher specimens (preserved and labeled representative whole plants or plant parts, used to compare and correctly identify plant species, usually kept as part of an herbarium collection) report *M. walkeri* from the Carolinian Island of Pohnpei, but after careful review of the best available data (cited above) we conclude that *M. walkeri* is endemic to the Mariana Islands. Historically, *M. walkeri* was known from at least 13 occurrences on Guam and 9 occurrences on Rota (Bishop Museum 2014—*Online Herbarium Database*). Currently, *M. walkeri* is known from 4 occurrences in the forest ecosystem on Guam and Rota, totaling fewer than 60 individuals. On Guam, there are two individuals (M and E Pacific, Inc. 1998, pp. 31, 79; Grimm 2013, in litt.). On Rota, *M. walkeri* is known from 2 occurrences totaling approximately 50 individuals (Harrington et al. 2012, in litt.; Gawel 2013, in litt.). *Maesa walkeri* is also a species of concern for Guam's Plant Extinction Prevention Program.

In summary, the species *Maesa walkeri* is vulnerable to extinction due to its very limited numbers, totaling fewer than 60 individuals (with only 2 on Guam). The remaining populations of *M. walkeri* are decreasing from initial numbers observed on Guam and Rota, and continue to be affected by ongoing habitat loss and destruction from agriculture, urban development, nonnative animals and plants, fires, and typhoons. The impacts on the species are exacerbated by the effects of low numbers of individuals resulting in loss of vigor and genetic representation, which limits its ability to compete with other species and adapt to changes in environmental conditions.

Nervilia jacksoniae (NCN), a small herb in the orchid family (Orchidaceae), is found only in the Mariana Islands. Historically, *N. jacksoniae* occurred on the islands of Guam and Rota, in the forest ecosystem, and ranged from northern to central Guam and only the southwestern point of Rota (Rinehart and Fosberg 1991, pp. 81–85; Raulerson and Rinehart 1992, p. 118; Costion and Lorence 2012, p. 67). Currently, there are approximately 15 occurrences totaling at least 520 individuals on the islands of Guam and Rota, in the forest ecosystem (Harrington et al. 2012, in litt.). On Guam, *N. jacksoniae* is known from 2 occurrences totaling fewer than 200 individuals (M and E Pacific, Inc. 1998, p. 58; Grimm 2012, in litt.; McConnell 2012, pers. comm.). On Rota, *N. jacksoniae* is known from 13 scattered occurrences totaling at least 320 individuals in the forest ecosystem (Rinehart and Fosberg 1991, pp. 81–85; Raulerson and Rinehart 1992, p. 118; Costion and Lorence 2012, p. 67; CPH 2012e—*Online Herbarium Database;* GBIF 2012c—*Online Herbarium Database;* McConnell 2012, pers. comm.). Populations of *N. jacksoniae* are decreasing from initial numbers observed on Guam and Rota and are at risk of further losses due to continued habitat loss and destruction from agriculture, urban development, nonnative animals and plants, fires, and typhoons, combined with predation by nonnative invertebrates such as slugs.

Phyllanthus saffordii (NCN), a woody shrub in the Phyllanthaceae family, is historically known only from the southern part of Guam within the savanna ecosystem. Several literature and database sources report this species from the northern Mariana Islands (Costion and Lorence 2012, pp. 82–83; Wagner 2012—*Flora of Micronesia;* U.S. Department of Agriculture–Agricultural Research Service–Germplasm Resources Information Network (USDA–ARS–GRIN) 2013—*Online Database;* WCSP 2012b—*Online Database*); however, a thorough review of the literature, databases, and herbaria records revealed recorded occurrences only on Guam (Merrill 1914, pp. 104–105; Glassman 1948, p. 181; Stone 1970, pp. 387–388; Pratt 2011, p. 59; Gutierrez 2012, in litt.; GBIF 2012d—*Online Herbarium Database;* Bishop Museum 2013—*Online Herbarium Database;* Smithsonian Institution 2014–*Flora of Micronesia Database*). Until the early 1980s, *P. saffordii* ranged from central to southern Guam (Bishop Museum 2014—*Herbarium Database*). Currently, *P. saffordii* is known from 4 scattered occurrences on southern Guam, totaling fewer than 1,400 individuals (Gutierrez 2013, in litt.; Gawel et al. 2013, in litt.). In summary, populations of *P. saffordii,* a single island endemic, are decreasing from initial numbers observed on Guam and are at risk, due to continued habitat loss and destruction from agriculture, urban development, nonnative animals and plants, fires, and typhoons, combined with habitat destruction and direct damage by recreational vehicles.

Psychotria malaspinae (aplokhating-palaoan), a shrub or small tree in the coffee family (Rubiaceae), is known only from Guam. Historically, *P. malaspinae* was known from scattered occurrences on the northeastern and southwestern sides of Guam, in the forest ecosystem (Merrill 1914, pp. 148–149; Stone 1970, pp. 554–555; Raulerson and Rinehart 1991, p. 83; Fosberg et al. 1993, pp. 111–112; Costion and Lorence 2012, pp. 54, 85–86; Bishop Museum 2014—*Online Database;* Wagner 2012—*Flora of Micronesia;* WCSP 2012c—*Online Database*). Currently, *P. malaspinae* is known from only three occurrences, each of a single individual (M and E Pacific, Inc. 1998, pp. 67, 79). None of these individuals has been observed within the last 5 years. Biologists searched for this species during rare plant surveys conducted in July 2012; however, none were located (Harrington et al. 2012, in litt.). A specimen collected from the Ritidian National Wildlife Refuge on Guam in August 2013 is currently pending identification (Gawel et al. 2013, in litt.). *Psychotria malaspinae* is also a species of concern for Guam's Plant Extinction Prevention Program.

The species *Psychotria malaspinae,* a single island endemic, has been reduced to three known individuals in the wild, rendering this species vulnerable to extinction. These remaining individuals are at risk, due to continued habitat loss and destruction from agriculture, urban development, nonnative animals and plants, and typhoons. Herbivory by pigs and deer, combined with the effects of low numbers of individuals, which results in loss of vigor and genetic representation, and limits its ability to compete with other species and adapt to changes in environmental conditions, contribute to the decline of *P. malaspinae.*

Solanum guamense (berenghenas halomtano), a small shrub in the

nightshade family (Solanaceae), is known only from the Mariana Islands (Merrill 1914, pp. 139–140; Stone 1970, p. 521; Costion and Lorence 2012, p. 89). Historically, *S. guamense* was reported from Guam, Rota, Saipan, Tinian, Asuncion, Guguan, and Maug (Stone 1970, p. 521; GBIF 2012e—*Online Database;* Bishop Museum 2014—*Online Database*). Currently, *S. guamense* is known from a single occurrence of one individual on Guam, in the forest ecosystem (Perlman and Wood 1994, pp. 135–136).

Once ranging across multiple islands, *Solanum guamense* is now vulnerable to extinction, the species having been reduced to a single remaining individual on Guam. This species, and habitat for its reintroduction to Rota, Saipan, Tinian, Asuncion, Guguan, and Maug, are at risk, due to continued habitat loss and destruction from agriculture, urban development, nonnative animals and plants, and typhoons. Herbivory by pigs and deer, combined with the effects of low numbers of individuals, which results in loss of vigor and genetic representation and limits its ability to compete with other species and adapt to changes in environmental conditions, contribute to the decline of *S. guamense.*

Tabernaemontana rotensis (NCN), a small to medium-sized tree in the dogbane family (Apocynaceae), is historically known from Guam and Rota, in the forest ecosystem (University of Guam (UOG) 2007, p. 6). The genus is widespread throughout tropical and subtropical regions. In 2004 (69 FR 1560, January 9, 2004), we proposed to list *T. rotensis;* however, in April 2004 (69 FR 18499) we did not list *T. rotensis* because an authoritative monographic work on the genus submerged this species in an expansive interpretation of the widespread species *T. pandacaqui.* In 2011, a genetic study was conducted on specimens from Rota, Guam, Asia, and the Pacific, to determine if those individuals on the Mariana Islands are a monophyletic lineage. The study determined that *T. rotensis* is a valid species, distinct from the widespread *T. pandacaqui* (Reynaud 2012, 27 pp. + appendices). In 2004, *T. rotensis* was known from 8 individuals on Rota, and at least 250 individuals on Guam. In 2007, more than 21,000 individuals were found throughout Andersen AFB, with a population structure representing seedlings, juveniles, and reproductive, mature individuals (UOG 2007 p. 4). Currently, on Rota, *T. rotensis* is known from two occurrences, each composed of fewer than five individuals (Harrington et al. 2012, in litt.). On Guam, *T. rotensis* is known from 6 occurrences totaling approximately 21,000 individuals (M and E Pacific, Inc. 1998, p. 61; UOG 2007, pp. 32–42).

In summary, populations of *Tabernaemontana rotensis* on Guam and Rota are at risk, due to continued habitat loss and destruction from agriculture, urban development, nonnative animals and plants, fires, and typhoons, combined with vandalism. The greatest concern regarding this species is not of population structure, but the small proximity of occurrences in an area that may be developed according to the proposed AFB and Navy base expansions (UOG 2007, p. 5; JGPO–NavFac Pacific 2010a, 2010b; JGPO–NavFac Pacific 2014).

Tinospora homosepala (NCN), a vine in the moonseed family (Menispermaceae), is historically known only from Guam (Merrill 1914, p. 83; Stone 1970, pp. 27, 277; Costion and Lorence 2012, pp. 92–93). Currently, *T. homosepala* is known from 3 occurrences totaling approximately 30 individuals, in the forest ecosystem (Yoshioka 2008, p. 15; Gawel et al. 2013, in litt.). There is discussion among botanists as to whether or not *T. homosepala* is either the same as a commonly occurring species found throughout Malaysia and the Philippines or a variety of that species (*T. glabra*) (Costion and Lorence 2012, pp. 92–93; Gawel et al. 2013, in litt.). *Tinospora homosepala* differs from *T. glabra* in having equal-sized sepals (petal-like structures of the calyx) as opposed to the outer sepals being much smaller than inner sepals as in *T. glabra* (Costion and Lorence 2012, p. 93; Forman 1981, pp. 381, 417, and 419).

While these discussions note that additional research on the taxonomy of *Tinospora homosepala* is appropriate to address questions, no changes to the currently accepted taxonomy have been proposed, although Forman (1981, p. 419) notes that, if fruits of *T. homosepala* are discovered and are indistinguishable from *T. glabra,* it may be preferable to reduce *T. homosepala* to subspecific rank under *T. glabra.* Regardless, any future reduction in rank from full species status to that of a subspecies or variety would not, in itself, disqualify this taxon from protection under the Act. All known individuals of *T. homosepala* on Guam are said to be males that reproduce clonally (Yoshioka 2008, p. 15; Gawel et al. 2013, in litt.). Clonal reproduction limits genetic diversity, reducing the ability of the species to form new genetic combinations to fit changing environmental conditions (Stebbins 1957, p. 352). In summary, the species *T. homosepala,* a single island endemic, has been reduced to roughly 30 individuals on Guam, and it is possible that no female representatives of this species remain. These few remaining individuals of the species are at risk of extinction, due to continued habitat loss and destruction from nonnative animals and plants, and typhoons, and by genetic limitations as a result of the possible loss of potential sexual reproduction.

Tuberolabium guamense (NCN) (*Trachoma guamense* is a synonym), an epiphyte in the orchid family (Orchidaceae), is known only from the Mariana Islands. Historically, *T. guamense* was reported from the islands of Guam, Rota, Tinian, and Aguiguan (Raulerson and Rinehart 1992, p. 127; CPH 2012f—*Online Herbarium Database;* GBIF 2012f—*Online Database*). The Royal Botanical Gardens at Kew's online database (WCSP 2012d—*Online Database*) describes the range for *T. guamense* as the Mariana Islands and the Cook Islands; however, we were unable to confirm this with herbarium specimens citing the Cook Islands as a site for collection (CPH 2012f—*Online Herbarium Database;* GBIF 2012f—*Online Herbarium Database;* Smithsonian Institution 2014–*Online Herbarium Database*). In 1992, *T. guamense* was found in ''trees and shrubs all over the island'' (Raulerson and Rinehart 1992, p. 127), and the Consortium of Pacific Herbaria has records of 22 collections from Guam, 5 collections from Rota, 15 collections from Tinian, and 3 collections from Aguiguan (CPH 2012f–*Online Herbarium Database*). Currently, *T. guamense* is known from three occurrences: one occurrence of one individual on Guam and two occurrences on Rota, in the forest ecosystem (Gawel et al. 2013, in litt.; Harrington et al. 2012, in litt.).

In summary, populations of *Tuberolabium guamense* are decreasing from initial numbers observed on Guam and Rota, and habitat for its reintroduction to Tinian and Aguiguan is at risk. The remaining few representatives of this species and its habitat are vulnerable to ongoing threats posed by the continued habitat loss and destruction from agriculture, urban development, nonnative animals and plants, fires, and typhoons. Herbivory by slugs, combined with the effects of low numbers of individuals which results in loss of vigor and genetic representation, and limits its ability to compete with other species and adapt to changes in environmental conditions, contribute to the decline of *T. guamense.*

Animals

Pacific Sheath-Tailed Bat

The Pacific sheath-tailed bat (*Emballonura semicaudata rotensis*) is a small insectivorous bat (forearm length about 1.8 in (45 mm), weight 0.2 ounces (oz) (5.5 grams (g)), in the family *Emballonuridae,* an Old World bat family that has an extensive distribution primarily in the tropics (Lemke 1986, pp. 743–745; Nowak 1994, pp. 90–91; Lemke 1986, pp. 743–744; Koopman 1997, pp. 358–359; Wiles and Worthington 2002, pp. 1–3; O'Shea and Valdez 2009, pp. 9–10). The Pacific sheath-tailed bat is a rich brown to dark brown above and paler below (Walker and Paradiso 1983, p. 211). The common name ''sheath-tailed bat'' refers to the nature of the tail attachment: the tail pierces the tail membrane and its tip appears completely free on the upper surface of the membrane (Walker and Paradiso 1983, p. 209).

The Pacific sheath-tailed bat was once common and widespread in Polynesia and Micronesia, and is the only insectivorous bat recorded from a large part of this area (Hutson et al. 2001, p. 138). The classification of the subspecies has received varied treatment, but the most thorough and recent taxonomic evaluation for this subspecies was conducted by Koopman (1997, pp. 358–360). Koopman recognizes four subspecies: *E. s. rotensis,* endemic to the Mariana Islands (Guam and the CNMI); *E. s. sulcata,* occurring in Chuuk and Pohnpei; *E. s. palauensis,* found in Palau; and *E. s. semicaudata,* occurring in American and Independent Samoa, Tonga, Fiji, and Vanuatu. Historically, in the Mariana Islands, the Pacific sheath-tailed bat was known from Guam, Rota, Aguiguan, Tinian, Saipan, and possibly Anatahan and Maug (Lemke 1986, pp. 743–745; Steadman 1999, p. 321; Wiles and Worthington 2002, pp. 1–3). Currently, the Pacific sheath-tailed bat appears to be extirpated from all but one island in the Mariana Islands, Aguiguan, where a single remaining population of this subspecies is estimated to number between 359 to 466 individuals (Wiles and Worthington 2002, p. 15; Wiles 2007, pers. comm.; O'Shea and Valdez 2009, pp. 2–3).

The biology of this subspecies, including reproduction, habitat use, and diet, was, until recently, largely unknown (Wiles and Worthington 2002, p. 19; Esselstyn et al. 2004, p. 304). A study by O'Shea and Valdez (2009, pp. 95–97) reveals more life-history information. Fecal pellets of the Pacific sheath-tailed bat collected from two caves on Aguiguan show these bats consume a diverse array of prey, mostly consisting of small-sized insects including hymenopterans (ants, wasps, and bees), lepidopterans (moths), and coleopterans (beetles) as the three major food items (O'Shea and Valdez 2009, pp. 63–65).

The Pacific sheath-tailed bat appears to be cave-dependent, roosting during the day in a wide range of cave-types, including overhanging cliffs, karst limestone caves, crevices, and lava tubes (Grant et al. 1994, pp. 134–135; O'Shea and Valdez 2009, pp. 105–108). Bats and cave swiftlets (birds, *Aerodramus* spp.) may be found sharing caves (Lemke 1986, pp. 744–745; Tarburton 2002, pp. 106–107; Wiles and Worthington 2002, pp. 7, 13; Lemke 1986, pp. 744–745). Analysis of data collected from echolocation stations deployed across Aguiguan indicates that the bats' peak activity and occurrences are related to canopy cover, vegetation structure, and distance to known roosts; and that native limestone forest is preferred foraging habitat (O'Shea and Valdez 2009, pp. 105–108).

A previous survey of habitat use on Aguiguan in 2003 revealed that bats foraged almost entirely in forests (native and nonnative) near their roosting caves and clearly did not utilize the non-forested habitats on the island (Esselstyn et al. 2004, p. 307). Bruner and Pratt (1979, p. 3) also observed sheath-tailed bats foraging in native forests on Pohnpei. Large roosting colonies appear to be common for the Palau subspecies, but smaller aggregations may be more typical of at least the Mariana Island subspecies and perhaps other *Emballonura* found elsewhere (Wiles et al. 1997, pp. 221–222; Wiles and Worthington 2002, pp. 15, 17). In 1995, roosting bats on Aguiguan were detected in only 5 of 77 caves surveyed (Wiles 2007, pers. comm.), with colony sizes ranging from 2 to 64 individuals. Observations in 2007 indicated that the bats preferred large caves (over 1,076 ft^2 (100 m^2)) in floor area, with ceiling heights reaching 16 to 98 ft (5 to 30 m)) (see ''Cave Ecosystem,'' above, for further cave description), as nearly all of the caves used for roosting were characterized as large by researchers (GDAWR 1995, pp. 95–96; O'Shea and Valdez 2009, pp. 9–17; Wiles and Worthington 2002, pp. 7, 13). The Pacific sheath-tailed bat is nocturnal and typically emerges around dusk to forage on insects (Craig et al. 1993, p. 51; Wiles and Worthington 2002, p. 13).

The Pacific sheath-tailed bat populations have declined drastically in the Mariana Islands, and the subspecies is now known to occur on only Aguiguan. While populations of other Pacific sheath-tailed bat subspecies appear to be healthy in some locations, mainly in the Caroline Islands, they have also declined drastically in other areas, including Independent and American Samoa, and Fiji (Bruner and Pratt 1979, p. 3; Grant et al. 1994, pp. 133–134; Wiles et al. 1997, pp. 222–223; Wiles and Worthington 2002, pp. 17–19). For example, populations of sheath-tailed bats (*E. s. semicaudata*) were noted to precipitously decline from American Samoa in the 1970s (Grant et al. 1994, pp. 133–134). It is speculated that disturbance of caves where the sheath-tailed bats roosted by successive storms contributed to the decline of sheath-tailed bats; however, it was noted that some caves were still inhabited by swiftlets (Grant et al. 1994, p. 134). Other factors contributing to the decline of sheath-tailed bats in American Samoa may include starvation during extended storms, human disturbance of caves, bombing and shelling during World War II, pesticides, and guano mining; however, the exact causes of sheath-tailed bat population declines in the American Samoa and other South Pacific islands are still uncertain (Grant et al. 1994, pp. 135–136). In contrast, large numbers of individuals of the sheath-tailed bat subspecies *E. s. palauensis* were readily observed by Wiles et al. in the 1990s (1997, p. 224).

In summary, the Pacific sheath-tailed bat (*E. s. rotensis*), once found on multiple islands on Guam and the Marianas, has been reduced to a single, small remaining population. The species has exhibited a significant decline from its initial numbers observed on Guam, Rota, Aguiguan, Tinian, Saipan, and its persistence in a single remaining population renders it vulnerable to extinction. The remaining population of the Pacific sheath-tailed bat continues to experience threats due to continued habitat loss and destruction from agriculture, urban development, nonnative animals, and typhoons. In addition, predation by monitor lizards, and possible predation by the brown tree snake, may contribute to the observed decline of the Pacific sheath-tailed bat.

Slevin's Skink

Slevin's skink (*Emoia slevini,* guali'ek halom tano) is a small lizard in the reptile family Scincidae, the largest lizard family in number of worldwide species. Slevin's skink was first described in 1972 by Walter C. Brown and Marjorie V.C. Falanruw, which is the most recent and accepted taxonomy (Brown and Falanruw 1972, p. 107). It

is the only lizard endemic to the Mariana Islands and is on the Government of Guam's Endangered Species List (Fritts and Rodda 1993, p. 3; Rodda et al. 1997, p. 568; Rodda 2002, p. 2; CNMI DFW 2005, p. 174; GDAWR 2006, p. 107; Guam Department of Agriculture 2014, in litt.). Slevin's skink previously occurred on the southern Mariana Islands (Guam, Cocos Island, Rota, Tinian, and Aguiguan), where it is now extirpated, except from Cocos Island off of Guam, where it was recently rediscovered (Fritts and Rodda 1993, p. 2; Steadman 1999; Lardner 2013, in litt.).

Surveys conducted in the 1980s and 1990s show that Slevin's skink was present on the northern islands of Sarigan, Guguan, Alamagan, Pagan, and Asuncion (Berger et al. 2005, pp. 174–175; GDAWR 2006, p. 107; Vogt 1997, in litt.); however, none were captured on Anatahan or Agrihan or ever reported historically from these islands (Berger et al. 2005, p. 175; Rodda et al. 1991, p. 202). The skink has not yet been reported from the southern island of Saipan, or the northern islands of Farallon de Medinilla, Maug, or Uracas. The densest population was on Alamagan (island area of 2,800 ac; 1,130 ha) in the early 1990s, but researchers believe that overgrazing by introduced ungulates may preclude the long-term viability of that population (Rodda 2002, p. 3; Fritts and Rodda 1993, p. 1). The catch rate (number of lizards captured per hour) quadrupled on Sarigan in a survey conducted in 2007, after eradication of feral ungulates from the island in 1998 (Vogt 2007, p. 5–5; Kessler 2011, p. 322). Its current status on Aguiguan, Guguan, Pagan, and Asuncion is unknown.

Slevin's skink measures 3 in (77 mm) from snout to cloaca vent (the opening for reproductive and excretory ducts), although length can vary slightly (Vogt and Williams 2004, p. 65). Fossil remains indicate its prehistoric size was much larger, up to 4.3 in (110 mm) in length (Rodda 2010, p. 3). Slevin's skink is darkly colored, from olive to brown, with darker flecks in a checkerboard pattern, and a light orange to bright yellow underside (Vogt and Williams 2004, p. 65). Their skin tends to be shiny, and is very durable and tough. Juveniles may appear cream-colored (Vogt and Williams 2004, p. 65; Rodda 2010, p. 3).

Slevin's skink is a fast-moving, alert, insectivorous lizard, typically found on the ground or at ground level, and active during the day. Based on both older and more recent observations, the species occurs in the forest ecosystem, with most individuals observed on the forest floor using leaf litter as cover (Brown and Falanruw 1972, p. 110; GDAWR 2006, p. 107; Cruz et al. 2000, p. 21; Lardner 2013, in litt.). Occasionally, individuals were observed in low hollows of tree trunks (Brown and Falanruw 1972, p. 110). It is a social species, seen often in the company of other individuals, including other nonnative skink species (Vogt and Williams 2004, pp. 59, 65). The females carry their eggs internally and give birth to live young (Brown 1991, pp. 14–15). Other specific life-history or habitat requirements of Slevin's skink are not well documented (Rodda 2002, p. 3).

Slevin's skink was most numerous in the Mariana Islands during prehistoric times, before the introduction of other competing lizards and predators, and loss of native forest (Vogt and Williams 2004, p. 65; Berger et al. 2005, p. 175). After World War II, Slevin's skink had notably vanished from the larger southern Mariana Islands (Fritts and Rodda 1993, p. 4), which suggests the species may be sensitive to habitat destruction or changes in land use practices (Fritts and Rodda 1993, p. 4; Berger et al. 2005, p. 174). Slevin's skink had not been recorded on Guam since 1945 or on Cocos Island since the early 1990s (Rodda and Fritts 1992, p. 171; Campbell 2011, in litt.), until a specimen was captured on Cocos Island in January of 2011 (Campbell 2011, pers. comm.). Over half the island is developed for a hotel, and it is a tourist destination (Fritts and Rodda 1993, p. 2). Only about 25 ac (10 ha) of suitable habitat is available on Cocos Island, and it is periodically overwashed during typhoons (Fritts and Rodda 1993, pp. 2, 5). The northern islands of its known occurrence provide less than 19,843 ac (8,030 ha) of land area, not all of which is suitable habitat. Slevin's skink is no longer found on the larger southern islands of Guam, Rota, and Tinian, which combined, provide the largest land area, 179,892 ac (72,800 ha). This species no longer occurs in 90 percent of its historical range.

In summary, once widespread, the remaining known populations of Slevin's skink are made up of a few individuals on Cocos Island, and occurrences of undetermined numbers of individuals on Alamagan and Sarigan. Populations of Slevin's skink are decreasing from initial numbers observed on Cocos Island, Alamagan, Pagan, and Asuncion, and it has not been reobserved on Guam, Rota, Tinian, and Aguiguan; the species has been lost from 90 percent of its former range. The remaining populations of Slevin's skink are at risk, due to continued habitat loss and destruction from agriculture, urban development, nonnative animals, and typhoons. Predation by rats, monitor lizards, and possible predation by the brown tree snake (if the snake is introduced to other islands), also contribute to the decline of Slevin's skink.

Mariana Eight-Spot Butterfly

The Mariana eight-spot butterfly (*Hypolimnas octocula marianensis*), a butterfly in the Nymphalidae family, is known solely from the islands of Guam and Saipan, in the forest ecosystem (Schreiner and Nafus 1996, p. 2; Schreiner and Nafus 1997, p. 26). It may be extirpated from Saipan (Schreiner and Nafus 1997, p. 26). This subspecies was originally described by Butler and is recognized as a distinct taxon in Swezey (1942, p. 35), the most recent and accepted taxonomy for this species. Like most nymphalid butterflies, orange and black are the two primary colors exhibited by this subspecies. The males are smaller than the females by at least a third or more in size. Males are predominantly black with an orange stripe running vertically on each wing. The stripe on the hindwings exhibits small black dots in a vertical row. Overall, the females appear more orange in color than the males, and black bands across the apical (top) margins of both pair of wings are exhibited. Along the inner margin of these black bands, large white spots are exhibited across the entire length of the wings (Schreiner and Nafus 1997, pp. 15, 26–27). The caterpillar larva of this species is black in color with red spikes and a black head, differentiating it from similar-appearing caterpillars including *Hypolimnas bolina, H. anomala,* and *Pipturus* spp. (Schreiner and Nafus 1996, p. 10; Schreiner and Nafus 1997, p. 26).

The larvae of this butterfly feed on two native plants, *Procris pedunculata* (no common name), and *Elatostema calcareum* (tapun ayuyu) (Schreiner and Nafus, 1996, p. 1). Both of these forest herbs (family Urticaceae) are found only on karst substrate within the forest ecosystem, draped over boulders and small cliffs, presumably out of reach of browsing ungulates (Schreiner and Nafus 1996, p. 1; Rubinoff 2013, in litt.). When adult butterflies were observed, they were always in proximity to the host plants (Rubinoff 2011, in litt.; Rubinoff 2013, p. 1). Both of the host plant species are rare in their range, and both plants are believed to be susceptible to feral ungulate grazing based upon anecdotal observations indicating they occur only in the extremely rugged limestone karst terrain believed to be avoided by most

ungulates (Rubinoff 2013, in litt.). The two host plants have been recorded on the islands of Guam, Rota, Saipan, and Tinian (Schreiner and Nafus 1996, p. 2; Schreiner and Nafus 1997, p. 26; Harrington et al. 2012, in litt.; Rubinoff and Haines 2012, in litt.; Rubinoff, in litt. 2013). However, despite recent surveys (2011–2013) on Rota, Tinian, and Saipan, the Mariana eight-spot butterfly is currently known only from the island of Guam (Schreiner and Nafus 1996, p. 2; Schreiner and Nafus 1997, p. 26; Rubinoff and Haines 2012, in litt.; Rubinoff 2013, in litt. 2013). There are 11 known populations of the Mariana eight-spot butterfly on Guam (Schreiner and Nafus 1996, p. 2; Schreiner and Nafus 1997, p. 26; Rubinoff and Haines 2012, in litt.; Rubinoff 2011, in litt.; Rubinoff 2013, in litt.). Several areas were found that supported host plants on Saipan in 1995; however, no individuals of the Mariana eight-spot butterfly were seen, and it may be extirpated on Saipan (Schreiner and Nafus 1997, p. 26).

In summary, the Mariana eight-spot butterfly has been lost from one of the two islands where it formerly occurred. This butterfly is dependent upon two relatively rare host species, both of which are susceptible to the effects of ungulate grazing. The Mariana eight-spot butterfly is vulnerable to the impacts of continued habitat loss and destruction from agriculture, urban development, nonnative animals and plants, and typhoons. Herbivory of its host plants by nonnative animals, combined with direct predation by ants and parasitic wasps, contribute to the decline of the Mariana eight-spot butterfly.

Mariana Wandering Butterfly

The Mariana wandering butterfly (*Vagrans egistina*), is endemic to the islands of Guam and Rota in the Mariana archipelago, in the forest ecosystem. This butterfly was originally named *Issoria egistina* (Swezey 1942, p. 35). In 1934, Hemming published the genus *Vagrans* as a replacement name for the genus *Issoria.* Schriener and Nafus (1997) recognize this species as *Vagrans egistina,* which is the most recent and accepted taxonomy.

Like most nymphalid butterflies, the Mariana wandering butterfly is primarily orange and black in coloration. This species is largely black in appearance with a prominent orange irregular pattern extending from the forewings to the hindwings. Obvious stripes or rows of spots are lacking (Schreiner and Nafus 1997, plate 9). The caterpillar larva life stage of this species is brown in color with black-colored spikes (Schreiner and Nafus 1996, p. 10).

The Mariana wandering butterflies are known to be good fliers, and in earlier times, probably existed as a series of meta-populations (Harrison et al. 1988, p. 360), with considerable movement and interbreeding between local and stable populations and continued colonization and extinction in disparate localities. The larvae of this butterfly feed on the plant species *Maytenus thompsonii* (luluhut) in the Celastraceae family, which is endemic to the Mariana Islands (Swezey 1942, p. 35; Schreiner and Nafus 1996, p. 1). The host plant *M. thompsonii* is known to occur within the forest ecosystem on Guam, Rota, Saipan, and Tinian (Vogt and Williams 2004, p. 121).

Historically, the Mariana wandering butterfly was originally collected and described from the island of Guam where it was considered to be rare, but widespread (Swezey 1942, p. 35). The species has not been observed on Guam since 1979, where it was last collected in Agana. Currently, it is considered likely extirpated from Guam (Schreiner and Nafus 1996, pp. 1–2; Rubinoff 2013, in litt.). The Mariana wandering butterfly was first collected on Rota in the 1980s (Schreiner and Nafus 1996, p. 10). During several 1995 surveys on Rota, it was recorded at only one location among six different sites surveyed (Schreiner and Nafus 1996, pp. 1–2). From June through October 2008, extensive surveys for the Mariana wandering butterfly were conducted on the island of Tinian under the direction of the Service. While several *Maytenus thompsonii* host plant population sites were identified in limestone forest habitat, no life stages of the Mariana wandering butterfly were observed (Hawley in litt., 2009, pp. 1–9).

Although considered extirpated from Guam, whether the Mariana wandering butterfly continues to exist on Rota is unknown, as is its possible occurrence on other islands where its host plants are found. Several years of seasonal surveys are needed to determine the status of this species, but we do know that if it persists, it is likely in very low numbers as it has not been observed in many years. Any remaining populations of the Mariana wandering butterfly continue to be at risk from ongoing habitat loss and destruction by rats and typhoons. Herbivory of its host plant by nonnative animals, combined with direct predation by ants and parasitic wasps, contribute to the decline of the Mariana wandering butterfly.

Rota Blue Damselfly

The Rota blue damselfly (*Ischnura luta*) is a small damselfly endemic to the island of Rota and found within the stream ecosystem. Grouped together with dragonflies in the order Odonata, damselflies fall within the suborder Zygoptera. The Rota blue damselfly belongs to the family Coenagrionidae, and it is the only known damselfly species endemic to the Mariana Islands. This species was first described in 2000 (Polhemus et al. 2000, pp. 1–2) based upon specimens collected in 1996. The species is relatively small in size, with males measuring 1.3 in (34 mm) in body length, with forewings and hindwings 0.7 in (18 mm) and 0.67 in (17 mm) in length, respectively. Both sexes are predominantly blue in color, particularly the thorax and portions of the male's abdomen are brilliant, iridescent blue. Both sexes have a yellow and black head with some yellow coloration on the abdomen. Females of this species may be distinguished by their slightly smaller size and somewhat paler blue body color (Polhemus et al. 2000, pp. 1–8).

Resembling slender dragonflies, damselflies are readily distinguished by their trait of folding their wings parallel to the body while at rest rather than holding them out perpendicular to the body. The general biology of narrow-winged damselflies includes territorial males that guard areas of habitat where females will lay eggs (Moore 1983a, p. 89; Polhemus and Asquith 1996, pp. 2–7). During copulation, and often while the female lays eggs, the male grasps the female behind the head with terminal abdominal appendages to guard the female against rival males; thus males and females are frequently seen flying in tandem. Adult damselflies are predaceous and feed on small flying insects such as midges and other flies.

The immature larval life stages (naiads) of the vast majority of damselfly species are aquatic, breathe through flattened abdominal gills, and are predaceous, feeding on small aquatic invertebrates or fish (Williams 1936, p. 303). Females lay eggs in submerged aquatic vegetation or in mats of moss or algae on submerged rocks, and hatching occurs in about 10 days (Williams 1936, pp. 303, 306, 318; Evenhuis et al. 1995, p. 18). Naiads may take up to 4 months to mature (Williams 1936, p. 309), after which they crawl out of the water onto rocks or vegetation to molt into winged adults, typically remaining close to the aquatic habitat from which they emerged. Adults have only been observed in association with the single perennial stream on Rota; therefore, we

believe the larval stage of the Rota blue damselfly is aquatic.

The Rota blue damselfly was only first discovered in April 1996, when a few individuals were observed and one male and one female specimen were collected outside the Talakhaya Water Cave (also known as Sonson Water Cave) located below the Sabana plateau (Polhemus et al. 2000, pp. 1–8; Camacho et al. 1997, p. 4). The size of the population at the time of discovery was estimated to be small and limited to the stream area near the mouth of the cave. The primary source of the stream is springwater emerging at the limestone-basalt interface below the highly permeable limestone of the Sabana plateau (Polhemus et al. 2000, pp. 1–8; Keel et al. 2011, p. 1). This spring water also serves as the main source of fresh water supply for the population of Rota (Polhemus et al. 2000, pp. 1–8; Keel et al. 2011, p. 1). A concrete collection structure with associated piping has been built into and surrounding the entrance of the water cave. This catchment system and a smaller, adjacent catchment deliver approximately 2.7 to 3.8 million liters-per-day (0.7 to 1 million gallons) of water to Rota's municipal system (Keel et al. 2011, pp. 29–30) (see ''Stream Ecosystem,'' above, and *Factor E. Other Natural or Manmade Factors Affecting Their Continued Existence,* ''Water Extraction,'' below, for further discussion).

Eighteen years elapsed between the original discovery of the species in 1996 and the next known survey for the Rota blue damselfly. In January 2014, two male specimens were observed flying above a portion of the stream located at approximately 770 ft (235 m) in elevation, and below the Talakhaya (Sonson) Water Cave (Richardson 2014, in litt.). No specimens were observed immediately in the vicinity of the water cave entrance, and no fish were observed in the stream immediately below the cave entrance (Richardson 2014, in litt.), a notable observation because many damselfly species endemic to Pacific islands are known to be susceptible to predation by nonnative fish species that eat the naiad life stage of the damselfly. Predation by nonnative fish is a serious threat to the Hawaiian *Megalagrion* damselfly naiads (Englund 1999, pp. 235–236). Eggs laid in vegetation or on rocks in streams hatch in about 10 days and develop into naiads. Naiads take approximately 4 months to mature before emerging from the water (Williams 1936, pp. 303, 306, 309, 318).

Fish predation has been an important factor in the evolution of behavior in damselfly naiads in continental systems (Johnson 1991, p. 8), and damselflies in the wider-ranging *Ishnura* (as opposed to the Hawaiian *Megalagrion*) may have developed avoidance behaviors (Polhemus 2014, pers. comm.). On a survey of the stream (Okgok River, also known as Babao) fed by the Talakhaya (Sonson) Water Cave, the presence of four native fish species was noted: The eel *Anguilla marmorata,* the mountain gobies *Stiphodon elegans* and *Sicyopus leprurus,* and the flagtail, or mountain bass, *Kuhlia rupestris* (Camacho et al. 1997, p. 8). Densities of these native fish were low, especially in areas above the waterfall. Gobies can maneuver in areas of rapidly flowing water by using ventral fins that are modified to form a sucking disk (Ego 1956, in litt.). The flagtails were only abundant in the lower reach of the stream. Freshwater gobies in Hawaii are primarily browsers and bottom feeders, often eating algae off rocks and boulders, with midges and worms being their primary food items (Ego 1956, in litt.; Kido et al. 1993, p. 47). It can only be speculated that the Rota blue damselfly may have adapted its behavior to avoid the benthic feeding habits of native fish species. The release of aquarium fish into streams and rivers of Guam is well documented, but currently, no nonnative fish have been found in the Rota stream (Tibbatts 2014, in litt.).

The Rota blue damselfly appears to be extremely limited in range and researchers remain perplexed by its absence from other Mariana Islands (Polhemus et al. 2000, p. 8). Particularly striking is the fact that it has never been collected on Guam, despite the islands' larger size and presence of over 100 rivers and streams. The Rota blue damselfly's population site is afforded some protection from human impact by its remote and relatively inaccessible location; however, a reduction or removal of stream flow due to increased interception for municipal usage, and from lower water quantities resulting from the effects of climate change, could eliminate the only known population of the species (See ''Stream Ecosystem,'' above, and *Factor E. Other Natural or Manmade Factors Affecting Their Continued Existence,* below, for further discussion). Introduction of nonnative fish into the stream could also impact or eliminate the Rota blue damselfly naiads, leading to its extirpation. In addition, low numbers of individuals result in loss of vigor and genetic representation and contribute to the decline of the Rota blue damselfly.

Humped Tree Snail

The humped tree snail (*Partula gibba;* akaleha), in the Partulidae family, is endemic to the forest ecosystem on the Mariana Islands of Guam, Rota, Aguiguan, Saipan, Tinian, Anatahan, Sarigan, Alamagan, and Pagan. The humped tree snail was first collected on Guam in 1819 by Quoy and Gaimard during the Freycinet Uranie expedition of 1817–1819 and was once considered the most abundant tree snail on Guam (Crampton 1925, pp. 8, 25, 60). Currently, the humped tree snail is known from the islands of Guam (Hopper and Smith 1992, p. 81; Smith et al. 2009, pp. 10, 12, 16), Rota (Smith 1995, p. 1; Bauman 1996, pp. 15, 18), Saipan (Hadfield 2010, pp. 20–21), Sarigan (Hadfield 2010, p. 21) Alamagan (Bourquin 2002, p. 30), and Pagan (Hadfield 2010, pp. 8–14), in the forest ecosystem. The humped tree snail may occur on Aguiguan, but was not located on a survey by Smith in 2006 (Smith 2013, p. 14). It is believed that this species is no longer extant on Tinian due to loss of habitat to agriculture and the introduction of nonnative snails (Smith 2013, p. 24), and that it is no longer extant on Anatahan due to volcanic activity in 2003 and 2005 (Kessler 2011, pp. 321, 323).

The shell of the humped tree snail can be left- or right-coiling, conic-ovate, translucent, and engraved longitudinally with equal lines. The color ranges from white to brown, and has a pointed apex colored rose-red, with a milky white suture. Adult snails are from 0.6 to 0.7 in (14 to 18 mm) long, and 0.4 to 0.6 in (10 to 14 mm) wide, with 4 ½ whorls, the last of which is the largest (Pilsbry 1909–1910 in Crampton 1925, p. 60; Smith et al. 2009, p. 2). In general, partulid snails reproduce in less than 1 year, at which time they can produce up to 18 young each year, and may live up to 5 years. The humped tree snail is oviviparous (gives birth to live young). They are generally nocturnal, live on bushes or trees, and feed primarily on dead or decaying plant material.

The humped tree snail occurs in cool, shaded forest habitat as observed by Crampton and others (Crampton 1925, pp. 31, 61; Cowie 1992, pp. 175–176) with high humidity and reduced air movement that prevents excessive water loss. Crampton (1925, pp. 31, 61) described the habitat requirements of the partulid trees snails as having ''sufficiently high and dense growth to provide shade, to conserve moisture, and to effect the production of a rich humus. Hence the limits to the areas occupied by Partulae are set by the more

ultimate ecological conditions which determine the distribution of suitable vegetation.'' Crampton further notes that the Mariana Islands partulid tree snails live on subcanopy vegetation and are not found in high canopy. There are no known natural predators of these snails, although many of these partulid species are currently preyed on by alien invertebrates such as flatworms and slugs (Cowie 1992, p. 175).

Following is a brief historical overview of the humped tree snail in the Mariana archipelago. Crampton (1925, pp. 8, 25, 60) first observed the humped tree snail on Guam, in at least 39 sites, totaling more than 3,000 individuals. In 1989, Hopper and Smith (1992, p. 81) resurveyed 34 of Crampton's 39 sites and did not locate any live individuals; however, they discovered individuals at a new site not noted by Crampton. Populations on Guam have since declined from hundreds to fewer than 50 individuals (Smith et al. 2009, p. 11). Bauman surveyed Rota and reported finding live humped tree snails at 5 out of 25 former sites (Bauman 1996, pp. 15, 18). The largest of these populations may have totaled as many as 1,000 snails. However, this population was located along the main road of Rota and was subsequently cleared for development (Miller 2007, pers. comm.). Four other populations on Rota in 2007 were small and totaled fewer than 600 individuals.

The humped tree snail was discovered on Aguiguan in 1952, in six colonies (biologists often refer to snail populations as ''colonies'') (Kondo 1970, pp. 75, 81). In 1992, two separate surveys reported snails were observed at four locations on Aguiguan (Craig and Chandran 1992; Smith 1995), but by 2008, no live snails were found on this island (Smith 2013, p. 14). Crampton (1925) was unable to visit Tinian, although he states that Partulae were known from that island (1925, p. 6). Smith reported finding only very old shells on two surveys (2006 and 2008) of Tinian (Smith 2013, p. 6). On Saipan, Crampton collected almost 7,000 humped tree snails in 1925 (Crampton 1925, p. 62). By 1991, Smith and Hopper (1994, p. 11) could not find any live snails at 12 sites visited on the island; however, 2 small populations were later discovered, one in 2002, in the central forest area, and another in a mangrove wetland in 2010 (Bourquin 2002, in litt.; Hadfield 2010, pp. 20–21).

In 1994, Kurozumi reported approximately 20 individuals from Anatahan; however, these were possibly extirpated due to violently destructive volcanic eruptions between 2003 and 2005 (Kessler 2011). Kurozumi also reported the humped tree snails from Sarigan in 1994, and the population appears to be increasing as a result of the removal of ungulates. A survey of Sarigan in 2006 found the healthiest population in native forest at an elevation of approximately 1,300 ft (400 m) (Smith 2006 in Martin et al. 2008, p. 8–1). The species was first reported on Alamagan by Kondo in 1949, with over 50 individuals collected from wet forest (Easley 1970, p. 87). The populations seem to have declined on Alamagan by over 70 percent for individuals and approximately 27 percent for populations since that time (Kurozumi 1994). The humped tree snail was first reported from Pagan by Kondo in 1949 (Easley 1970, p. 87). Populations persist on Pagan although the same decline is seen here as for Alamagan (Kurozumi 1994).

In summary, populations of the humped tree snail are rapidly decreasing from initial numbers observed, and with continued habitat loss and predation by nonnative species, are at risk, with the possible exception of those on Sarigan, as ungulates have been removed from that island (see ''Conservation Efforts To Reduce Habitat Destruction, Modification, or Curtailment of Its Range,'' below). However, predation by rats remains a threat to the humped tree snail on Sarigan (Kessler 2011, p. 320).

Recent data also suggest that the individuals identified as humped tree snails on Rota may be a different species (Hadfield 2010, pp. 20–21). Because these recent findings have not been published, and data on population numbers and number of individuals has not been determined, we are still treating the humped tree snail as a single species.

Langford's Tree Snail

Langford's tree snail (*Partula langfordi;* akaleha), in the Partulidae family, is endemic to the forest ecosystem of the island of Aguiguan. Langford's tree snail was first collected and described by Kondo while working on biological control agents in the early 1950s (Kondo 1970, 18 pp.). Kondo's taxonomic work is the most recent and accepted taxonomy for this species. This tree snail has not been observed in the wild since 1992, when one live individual was observed on the northwest terrace of the island (Berger et al. 2005, p. 154). Surveys conducted in 2006 and 2008 revealed only old shells of dead *P. langfordi* (Smith 2013, p. 14).

Langford's tree snail has a dextral (to the right or clockwise from the opening of the shell at the lower right, as opposed to sinistral, to the left, or counterclockwise) shell, described by Kondo (1970, pp. 75–77) as being ovate-conic and moderately thin. The holotype of this species has a length of 0.6 in (14 mm), a diameter of 0.4 in (9 mm), and an aperture length of 0.3 in (8 mm). It has a spire of five whorls that are slightly convex, with an obtuse apex. Its aperture is oblong-ovate with the white mouth projections thickened and expanded. It is buff colored superimposed by maroon.

Although much less studied than related partulid snails from the Mariana Islands, the biology of Langford's tree snail is believed to be the same. See ''Humped tree snail (*Partula gibba*),'' above, for details.

Historically, Langford's tree snail is known only from the island of Aguiguan. In the 1970 survey of Aguiguan, it was noted that Langford's tree snail was collected from an area where it occurred sympatrically with the humped tree snail (Easely 1970, p. 89). The mixed populations were not uniformly distributed, but occurred in small colonies with large unoccupied areas between the colonies. In five of the sites, the Langford's tree snail outnumbered the humped tree snail and it appeared that humped tree snails were more numerous and dominant in the western portion of the site while Langford's tree snails were dominant in the eastern portion of the site (Kondo 1970, p. 81). Three other colonies of Langford's tree snail were collected, two on the north coast and one on the west end of Aguiguan (Kondo 1970, p. 81). A total of 464 adults were collected from 7 sites (Kondo 1970, p. 81). In 1985, five adult Langford's tree snails were collected from the west end of the island (Smith 1995). The last survey in which the species was detected in the wild was conducted in 1992, and one live snail was observed on the northwest terrace of the island (Smith 1995). Surveys of Aguiguan in 2006 and 2008 failed to locate any live Langford's tree snails (Smith 2013, p. 14).

In 1993, the University of Nottingham in England had six young and four adult Langford's tree snails in captivity. By 1994, two adult snails remained. Unfortunately, at the end of 1994, the last two Langford's tree snails died (Pearce-Kelly et al. 1995).

The 2005 Comprehensive Wildlife Conservation Strategy for CNMI (Division of Fish and Wildlife) (Berger et al. 2005) states that ''all Partulid snails are selected as a species of special conservation need'' (p. 153), and that ''[Crampton] found as many as 31 snails on the underside of a single leaf of caladium'' (p. 155) (demonstrating that it would be easy to miss a large number

of snails if that one particular leaf were missed during a survey). This strategy outlines conservation actions for Langford's tree snail, including more numerous and intensive surveys, removal of goats from Aguiguan island, control of nonnative species, and reforestation with native plants (pp. 158–159). Given that so few surveys have been conducted on Aguiguan, and only previously surveyed sites were ever revisited, it is likely Langford's tree snail may be found.

Guam Tree Snail

The Guam tree snail (*Partula radiolata;* akaleha), in the Partulidae family, is endemic to the forest ecosystem of Guam. The Guam tree snail was first collected by Quoy and Gaimard during the French *Astrolabe* expedition of 1828 and was initially named *Bulimus* (*Partula*) *radiolatus* by Pfeiffer in 1846, which he changed to *Partula radiolata* in 1849 (Crampton 1925, p. 34). Crampton's 1925 taxonomic work is the most recent and accepted taxonomy for this species.

The shell of the Guam tree snail is pale straw-colored with darker streaks and brown lines, and has impressed spiral lines. Adult length is 0.5 to 0.7 in (13 to 18.5 mm), and width is 0.3 to 0.5 in (8 to 12 mm), with five slightly convex whorls (Pilsbry 1909–1910 in Crampton 1925, p. 35; Smith et al. 2008 in Kerr 2013, p. 10). The biology of the Guam tree snail is very similar to that of the humped tree snail (see ''Humped tree snail (*Partula gibba*),'' above, for further description). The Guam tree snail prefers the same cool, shaded forest habitat as the humped tree snail and Langford's tree snail, described above.

Historically, suitable habitat for the Guam tree snail was widely available prior to World War II, and included strand vegetation, forested river borders, and lowland and highland forests (Crampton 1925, pp. 36–37), and Crampton found ''it occurs almost everywhere on the island where suitable vegetation exists,'' although historical population numbers are unknown. Crampton (1925, pp. 38–40) found the Guam tree snail at 37 of 39 sites surveyed on Guam and collected a total of 2,278 individuals. The actual population sizes were probably considerably larger since the purpose of Crampton's collections was to evaluate geographic differences in shell patterns and not to assess population size. In 1989, Hopper and Smith (1992, p. 78) resurveyed 34 of Crampton's 39 sites on Guam and an additional 13 new sites. They observed that 9 of the original 34 sites resurveyed supported these snails; however, the Crampton site identified as having the largest remaining population of the Guam tree snail (estimated at greater than 500 snails) had been completely eliminated by the combined effects of land clearing for a residential development and a subsequent series of typhoons in 1990, 1991, and 1992 (Smith 1995).

Of the 13 new sites surveyed by Hopper and Smith in 1989, 7 supported populations of the Guam tree snail. One of these populations was eliminated by wildfires that burned into ravine forest occupied by the snails in 1991 and 1992 (Smith and Hopper 1994). Further surveys by Smith (1995) revealed five new populations of the Guam tree snail. According to Smith, by 1995, there were 20 sites that still supported small populations of the Guam tree snail. Snails were moved from 1 of these 20 sites to a new location due to the development of a golf course (Smith 1995). In 2003 an additional small colony (fewer than 100 snails) was found on the U.S. Naval Base (Smith 2006, pers. comm.). A smaller colony (20 to 25 snails) was found in 2004 along the Lonfit River (Smith 2006, pers. comm.). Additionally, surveys on the Guam Naval Magazine located another new population, with shells of tree snails in abundance on the ground at all locations (Miller 2006, pers. comm.; JGPO–NavFac 2014 apps, pp. 27, 59). Further surveys of lands leased by the Navy in 2009 indicated a decline in densities of tree snails by about half, which was attributed to a loss of native understory (Smith et al. 2009, pp. 13–14). In 2011, a survey of Andersen AFB revealed a single colony of Guam tree snail (Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP) Appendices 2012, p. 15).

Populations of the Guam tree snail continue to decline, from first observations of thousands of individuals by Crampton, down to 20 colonies or fewer today. Continued loss of habitat due to development and removal of native plants by ungulates contributes to this loss.

Fragile Tree Snail

The fragile tree snail (*Samoana fragilis;* akaleha), in the Partulidae family, is known from the forest ecosystems of Guam and Rota. This species was first described as *Partula fragilis* by Férussac in 1821 (Crampton 1925, p. 30). It is the only species representing the genus of *Samoana* in the Mariana Islands. The fragile tree snail was first collected on Guam in 1819 by Quoy and Gaimard during the Freycinet Uranie expedition of 1817 to 1819 (Crampton 1925, p. 30). Crampton's 1925 taxonomic work for this species is the most recent and accepted taxonomy for this species.

The conical shell of the fragile tree snail is 0.5 to 0.6 in (12 to 16 mm) long, 0.4 to 0.5 in (10 to 12 mm) wide, and is formed by four whorls that spiral to the right. The common name is derived from the thin, semi-transparent nature of the shell. The shell has delicate spiral striations intersected by transverse growth striations. The background color is buff, tinted by narrow darker marks and whitish banding that are derived from the internal organs of the animal that are visible through the shell (Mollendorff 1894 in Crampton 1925, p. 31). The biology and habitat for this partulid tree snail are the same as those described for the three partulid species described above (see the ''Humped tree snail (*Partula gibba*),'' above).

Historically, the fragile tree snail was known from 13 populations on Guam and 1 population on Rota (Crampton 1925, p. 30; Kondo 1970, pp. 86–87). Easely (1970, p. 86) documented the 1959 discovery of the fragile tree snail on Rota by R.P. Owen. The same area had been surveyed just 7 years earlier by Benavente and Kondo, in 1952, but the fragile tree snail was not observed (Easley 1970, p. 87). In 1989, Hopper and Smith (1992, p. 78) resurveyed Crampton's original sites plus 13 more, all on Guam. At that time, they found fragile tree snails at only six sites. The most recent surveys on Guam for the fragile tree snail were conducted in 2008 and 2011. Currently, two colonies are known on Guam (Smith et al., 2009, pp. 7, 13). The original site where this species was found on Rota was converted to agricultural fields and no living snails were found there in 1995; however, in 1996, a new colony was found on Rota in a different location (Bauman 1996, pp. 18, 21).

We lack quantitative estimates for the fragile tree snail (Bauman 1996, p. 21), but Crampton (1925, p. 30) originally described this species as rare and low in numbers. Available data indicates the number of known colonies has declined between 1925 and present, from approximately 14 colonies to only 3 colonies.

In summary, populations of the fragile tree snail are decreasing from initial numbers observed on Guam and Rota, and are at risk, due to continued habitat loss and destruction from agriculture, urban development, nonnative animals and plants, and typhoons. Trade of shells by collectors, combined with direct predation by rats and flatworms, also contribute to the decline of the fragile tree snail. Low numbers of

individuals contribute to population declines through loss of vigor and genetic representation.

Summary of Biological Status and Threats Affecting the 23 Species Proposed for Listing as Endangered or Threatened Species

Section 4 of the Act (16 U.S.C. 1533) and its implementing regulations (50 CFR part 424) set forth the procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. A species may be determined to be an endangered or threatened species due to one or more of the five factors described in section 4(a)(1) of the Act: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination. Each of these factors is discussed below.

In considering what factors might constitute threats to a species, we must look beyond the exposure of the species to a particular factor to evaluate whether the species may respond to that factor in a way that causes actual impacts to the species. If there is exposure to a factor and the species responds negatively, the factor may be a threat and, during the status review, we attempt to determine how significant a threat it is. The threat is significant if it drives, or contributes to, the risk of extinction of the species such that the species warrants listing as an endangered or threatened species as these terms are defined in the Act. However, the identification of factors that could impact a species negatively may not be sufficient to warrant listing the species under the Act. The information must include evidence sufficient to show that these factors are operative threats that act on the species to the point that the species meets the definition of endangered or threatened under the Act.

If we determine that the level of threat posed to a species by one or more of the five listing factors is such that the species meets the definition of either endangered or threatened under section 3 of the Act, that species may then be proposed for listing as an endangered or threatened species. The Act defines an endangered species as ''in danger of extinction throughout all or a significant portion of its range,'' and a threatened species as ''likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.'' The threats to each of the individual 23 species proposed for listing in this document are summarized in Table 3, and discussed in detail below. Since there are 15 islands in the Mariana Islands, Table 4 (below) is provided as a supplement to Table 3, to allow the reader to better understand the presence of nonnative species addressed in this proposed rule that negatively impact the 23 species on an island-by-island basis.

TABLE 3—SUMMARY OF PRIMARY THREATS IDENTIFIED FOR EACH OF THE 23 MARIANA ISLANDS SPECIES

Species	Ecosystem	Factor A						Factor B	Factor C			Factor D	Factor E
		Development, military training, urbanization	Non-native animals	Non-native plants	Fire	Typhoons	Climate change	Over-utilization	Predation and herbivory by ungulates	Predation and herbivory by NN vertebrates	Predation and herbivory by NN invertebrates	Inadequate existing regulatory mechanisms	Species-specific
PLANTS													
Bulbophyllum guamense	FR	X	R, BTS	X	X	X	X				S	X	
Cycas micronesica	FR	X	R, P, B, D, BTS	X	X	X	X		P, D		CAS	X	ORD
Dendrobium guamense	FR	X	R, BTS	X	X	X	X				S	X	
Eugenia bryanii	FR	X	R, D, BTS	X		X	X		D			X	
Hedyotis megalantha	SV	X	R, P, BTS	X	X	X	X					X	REC
Heritiera longipetiolata	FR	X	R, P, B, D, C, BTS	X		X	X		P, D			X	ORD
Maesa walkeri	FR	X	R, P, B, D, BTS	X	X	X	X					X	LN
Nervilia jacksoniae	FR	X	P, B, D, R, BTS	X	X	X	X				S	X	
Phyllanthus saffordii	SV	X	R, P, BTS	X	X	X	X					X	REC
Psychotria malaspinae	FR	X	R, P, B, D, BTS	X		X	X		P, D			X	LN
Solanum guamense	FR	X	R, P, D, BTS	X		X	X		P, D			X	LN
Tabernae-montana rotensis	FR	X	R, P, B, D, BTS	X	X	X	X					X	V
Tinospora homosepala	FR		R, BTS	X		X	X					X	LN
Tuberolabium guamense	FR	X	R, BTS	X	X	X	X				S	X	LN
ANIMALS													
Pacific sheath-tailed bat (*Emballonura semicaudata rotensis*)	FR, CA	X	R, G			X	X			R, BTS, ML		X	
Slevin's skink (*Emoia slevini*)	FR	X	R, G, P, C			X	X			R, BTS, ML		X	
Mariana eight spot butterfly (*Hypolimnas octocula mariannensis*)	FR	X	R, P, B, D, BTS	X		X	X				A, W	X	
Mariana wandering butterfly (*Vagrans egistina*)	FR		R			X	X				A, W	X	
Rota blue damselfly (*Ischnura luta*)	ST	X		X		X	X					X	LN, WE
Humped tree snail (*Partula gibba*)	FR	X	R, G, P, B, C, D, BTS	X	X	X	X	X		R	F	X	
Langford's tree snail (*Partula langfordi*)	FR	X	R, G	X		X	X	X		R	F	X	LN
Guam tree snail (*Partula radiolata*)	FR	X	R, P, B, D, BTS	X	X	X	X	X			F	X	LN
Fragile tree snail (*Samoana fragilis*)	FR	X	R, P, B, D, BTS	X		X	X	X		R	F	X	LN

Factor A = Habitat modification; Factor B = Overutilization; Factor C = Disease or predation; Factor D = Inadequacy of regulatory mechanisms; Factor E = Other Species-specific threats; FR = Forest; SV = Savanna; ST = Stream; CA = Cave; R = Rats; P = Pigs; B = Water buffalo; D = Deer; C = Cattle; G = Goats; S = Slugs; CAS = Scale; ML = Monitor lizard; A = Ants; W = Parasitic wasps; F = Manokwar flatworm; BTS = Brown tree snake; REC = Recreational vehicles; ORD = Ordinance; LN = Limited numbers; WE = Water extraction; V = Vandalism.

TABLE 4—NONNATIVE ANIMAL SPECIES THAT NEGATIVELY IMPACT THE 23 MARIANA ISLANDS SPECIES OR THEIR HABITAT, BY ISLAND

Island	Pigs	Goats	Cattle	Water Buffalo	Deer	Rats	Monitor Lizard	Brown Tree Snake	Insects and Worms	Species Proposed for Listing that are Subject to Threats Posed by One or More Nonnative Animal Species on These Islands (see Table 3, above)	
										Plants	Animals
Guam	X			X	X	X	*X	X	A, W, F, S, CAS.	*Bulbophyllum guamense*, *Cycas micronesica*, *Dendrobium guamense*, *Eugenia bryanii*, *Hedyotis megalantha*, *Heritiera longipetiolata*, *Maesa walkeri*, *Nervilia jacksoniae*, *Phyllanthus saffordii*, *Psychotria malaspinae*, *Solanum guamense*, *Tabernaemontana rotensis*, *Tinospora homosepala*, *Tuberolabium guamense*.	Slevin's skink (on Cocos Island), Mariana eight-spot butterfly, Mariana wandering butterfly, Guam tree snail, Humped tree snail.
Rota					X	X	*X		A, W, F, S, CAS.	*Bulbophyllum guamense*, *Cycas micronesica*, *Dendrobium guamense*, *Maesa walkeri*, *Nervilia jacksoniae*, *Tabernaemontana rotensis*, *Tuberolabium guamense*.	Mariana wandering butterfly, Rota blue damselfly, Humped tree snail, Fragile tree snail.
Aguiguan		X				X	*X		F		Pacific sheath-tailed bat, Humped tree snail, Langford's tree snail.
Tinian			X			X	*X		F	*Heritiera longipetiolata*.	
Saipan						X	*X	**X	A, W, F, S	*Dendrobium guamense*, *Heritiera longipetiolata*.	Mariana eight-spot butterfly, Humped tree snail.
Farallon de Medinilla.						X					
Anatahan						X	*X				Humped tree snail.
Sarigan						X	*X		F		Slevin's skink, Humped tree snail.
Guguan						X			F		Slevin's skink.
Alamagan	X	X	X			X	*X		F		Slevin's skink, Humped tree snail.
Pagan	X	X	X			X	*X		F		Slevin's skink, Humped tree snail.
Agrihan	X	X				X	*X				
Asuncion						X					Slevin's skink.
Maug						X					
Uracas						X					

A = Ants
W = Parasitic wasp
F = Manokwar flatworm
S = Slugs
CAS = Scale
*Animals only
**Confirmed sightings of BTS have occurred on Saipan; however no established populations have been documented.

Methodology

Scientific research directed toward each of the species proposed for listing is limited because of their rarity and the challenging logistics associated with conducting field work in the Mariana Islands (i.e., areas are typically remote, difficult to access and work in, and expensive to survey in a comprehensive manner). However, there is information available on many of the threats that act on Mariana Island ecosystems, and, for some ecosystems, these threats are well studied and understood. Each of the native species that occur in the Mariana Islands ecosystems suffers from exposure to these threats to differing degrees, because each species that depends upon a shared ecosystem requires many of the same physical and biological features and the successful functioning of their specific ecosystem to survive. Therefore, for the purposes of this proposed rule, our assumption is that the threats that act at the ecosystem level also act on each of the species that depend upon those ecosystems. In addition, in some cases we have identified species-specific threats—threats that affect a particular species or subset of species within a shared ecosystem—such as predation of tree snails by nonnative invertebrates. The species discussed in this proposed rule, which are dependent on the native ecosystems that are affected by these threats, have in turn shown declines in either number of individuals, number of occurrences, or changes in species abundance and species composition. These declines can reasonably be attributed directly or indirectly to the threats discussed below (by indirectly, we mean that where there are threats to the ecosystem that negatively affect the ecosystem, the species in that ecosystem that depend upon it for survival are negatively affected as well).

The following constitutes a list of ecosystem-scale threats that affect the species proposed for listing in the four described ecosystems on the Mariana Islands:

(1) Foraging and trampling of native plants by feral pigs (*Sus scrofa*), goats (*Capra hircus*), cattle (*Bos taurus*), water buffalo (*Bubalus bubalis*), and Philippine deer (*Cervus mariannus*), which can result in severe erosion of watersheds (Cuddihy and Stone 1990, p. 63; Berger et al. 2005, pp. 42, 44, 138, 156–157; CNMI–SWARS 2010, pp. 9–10; Kessler 2011, pp. 320–324). Foraging and trampling events destabilize soils that support native plant communities, bury or damage native plants, and have adverse effects on water quality due to runoff over exposed soils (Cuddihy and Stone 1990, p. 63; Berger et al. 2005, pp. 42, 44, 138, 156–157; CNMI–SWARS 2010, pp. 9–10; Kessler 2011, p. 323).

(2) Ungulate destruction of seeds and seedlings of native plant species through foraging and trampling facilitates the conversion of disturbed areas from native to nonnative vegetative communities (Cuddihy and Stone 1990, p. 65).

(3) Disturbance of soils by feral pigs from rooting can create fertile seedbeds for alien plants, some of them spread by ingestion and excretion by pigs (Cuddihy and Stone 1990, p. 65; Kessler 2011, pp. 320, 323).

(4) Increased nutrient availability as a result of pigs rooting in nitrogen-poor soils, which facilitates establishment of alien weeds. Introduced vertebrates are known to enhance the germination of alien plants through seed scarification in digestive tracts or through rooting and fertilization with feces of potential seedbeds (Stone 1985, p. 253). In addition, alien weeds are more adapted to nutrient-rich soils than native plants (Cuddihy and Stone 1990, p. 65), and rooting activity creates open areas in forests, allowing alien species to completely replace native stands.

(5) Rodent damage to plant propagules, seedlings, or native trees, which changes forest composition and structure (Cuddihy and Stone 1990, p. 67).

(6) Feeding or defoliation of native plants by nonnative insects, which can reduce geographic ranges of some species, because the damage caused by these insects weakens the plants, making them more susceptible to disease or other predators and herbivores (Cuddihy and Stone 1990, p. 71).

(7) Nonnative insect predation on native insects, which affects native plant species by preventing pollination and seed set and dispersal, and can directly kill native insects (Cuddihy and Stone 1990, p. 71).

(8) Nonnative animal (rat, snakes, and monitor lizard) predation on native birds, tree snails, bats, and skinks, causes island extirpations or extinctions, in addition to altering seed dispersal of native plants (Cuddihy and Stone 1990, pp. 72–73).

Each of the above threats is discussed in more detail below, and summarized above in Table 3. The most-often cited effects of nonnative plants on native plant species are competition and displacement. Competition may be for water, light, or nutrients, or it may involve allelopathy (chemical inhibition of growth of other plants). Alien plants may displace native species of plants by preventing their reproduction, usually by shading and taking up available sites for seedling establishment. Alien plant invasions may also alter entire ecosystems by forming monotypic stands, changing fire characteristics of native communities, altering soil-water regimes, changing nutrient cycling, or encouraging other nonnative organisms (Smith 1989, p. 62; Vitousek et al. 1987, pp. 224–227).

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Habitat Destruction and Modification by Development, Military Training, and Urbanization

The consequences of past land use practices, such as agricultural or urban development, have resulted in little or no native vegetation remaining throughout the inhabited islands of the Mariana archipelago, largely impacting the forest, savanna, stream, and cave ecosystems (Steadman 1990, pp. 207–215; Steadman 1995, pp. 1123–1131; Fritts and Rodda 1998, pp. 119–120; Critical Ecosystem Partnership Fund 2007, pp. i–viii, 1–127). Areas once used for agriculture by the Chamorro are now being converted into residential areas, left fallow, or are being burned by hunters to attract deer (GDAWR 2006, p. 30; Boland 2014, in litt.). Guam's projected population increase by 2040 to 230,000 is an increase of almost 70 percent from that in 2010 (World Population Review 2014, in litt.). CNMI's current population of a little over 51,000 is a decrease from that in 2010, due to collapse of the local garment industry (Eugenio 2009, in litt.). Although the final numbers are not yet known, the planned military relocation to Guam and Tinian will add a large number of Marines and their dependents to the local population, with a concurrent introduction of support staff and development of infrastructure, and increased use of resources such as water (Berger et al. 2005, p. 347; JGPO–NavFac, Pacific 2010a, p. ES–1).

The military buildup on Guam was originally valued in excess of $10 billion (2.5 times the size of the current Guam economy), and was planned to take place over 4 years (Guam Economic Development Authority 2011, p. 58). The scope of the relocation of personnel has decreased since this estimate in 2011, but will still greatly affect infrastructure and resource needs (JGPO-NavFac, Pacific 2014, p. ES 3.1). The currently preferred alternative sites on Guam for relocation of personnel and for live-fire training include Naval Computer and Telecommunications

Station Finegayan, Andersen South, Orote Point, Pati Point, Navy Barrigada, and Naval Magazine areas, where, in total, 18 of the 23 species or their habitat are known to occur (13 of the 14 plants: *Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Eugenia bryanii, Hedyotis megalantha, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordi, Psychotria malaspinae, Solanum guamense, Tabernaemontana rotensis,* and *Tuberolabium guamense;* and 5 of the 9 animals: the Mariana eight-spot butterfly, the Mariana wandering butterfly, the Guam tree snail, the humped tree snail, and the fragile tree snail), and additionally includes the host plants *Procris pendunculata* and *Elatostema calcareum* for the Mariana eight-spot butterfly and the host plant *Maytenus thompsonii* for the Mariana wandering butterfly.

The inhabited island of Tinian and the uninhabited island of Pagan are planned to be used for military training with live-fire weapons and presence of military personnel. The northern two-thirds of Tinian are leased by DOD, and the development of these lands and effects from live-fire training will directly impact the trees *Heritiera longipetiolata* (on Tinian) and *Cycas micronesica* (on Pagan) and their habitat in the forest ecosystem. Pagan is currently occupied by Slevin's skink and the humped tree snail, and is historical habitat of *Bulbophyllum guamense,* all of which will be negatively impacted by direct destruction by live-fire weapons or possible wildfires caused by them and by trampling and destruction by military personnel.

Rota's land is under transition from public to private ownership, and the flat or lower-sloped areas comprising 66 percent of the island is expected to be privately owned (National Park Service 2005 in National Oceanic and Atmospheric Administration (NOAA) 2012, p. 273). Rota already has 7 hotels, and tourism is the island's principal economic industry. If Rota's large central forested areas are developed, only the remaining cliffs or steep slopes would contain undisturbed native forest (National Park Service 2005 in NOAA 2012, p. 273). Continued development on Rota will cause an increase of water use, and will impact the Talakhaya Springs and the streams fed by the springs. Specifically, dewatering of the streams on Rota could lead to elimination of the only known population of the Rota blue damselfly (see ''Water Extraction,'' below). Additionally, development around and within forested areas on Rota will also directly impact the forest habitat and individuals of *Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Maesa walkeri, Nervilia jacksoniae, Tabernaemontana rotensis,* and *Tuberolabium guamense;* and the habitat and host plants of the Mariana wandering butterfly, and the humped tree snail and fragile tree snail.

Other urban development (primarily involving housing development) will further impact the ecosystems that support native species. On Guam, a housing development is proposed for the Sigua highlands, where two of the plant species proposed for listing as endangered (*Hedyotis megalantha* and *Phyllanthus saffordii*) are known to occur (Kelman 2013, in litt.). In addition, the island of Aguiguan is proposed to be developed as an ecotourism resort (Eugenio 2013, in litt.). If developed, this ecotourism resort will negatively impact the forest and cave ecosystems that support three of the animals proposed for listing as endangered (the Pacific sheath-tailed bat, the humped tree snail, and Langford's tree snail), by causing destruction of the forest ecosystem (and associated food sources for the Pacific sheath-tailed bat) for development of tourist facilities for transportation and accommodation, by associated introduction of nonnative predators and herbivores, and by causing direct disturbance by visitation of caves.

The total land area for all of the northern islands (within these species' current and historical range) is only 62 mi^2 (160 km^2), and 44 mi^2 (114 km^2) of this land area is on islands with volcanic activity, which could impact the species and their habitat. The larger land area on the southern islands (332 mi^2 (857 km^2)), within these species' current and historical range, is undergoing increased human use, as described above.

In summary, development, military training, urbanization (GDAWR 2006, p. 69), and the associated destruction or degradation of habitat through loss of forest and savanna areas, disturbance of caves, and dewatering of streams, are serious threats to 13 of the 14 plants (*Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Eugenia bryanii, Hedyotis megalantha, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordii, Psychotria malaspinae, Solanum guamense, Tabernaemontana rotensis,* and *Tuberolabium guamense*), and to 8 of the 9 animals (the Pacific sheath-tailed bat, Slevin's skink, the Mariana eight-spot butterfly, the Rota blue damselfly, the Guam tree snail, the humped tree snail, Langford's tree snail, and the fragile tree snail) that are dependent on these ecosystems. We do not have sufficient information specific to 2 of the 23 species, *Tinospora homosepala* and the Mariana wandering butterfly, that would lead us to conclude that habitat loss as a result of development, military training, or urbanization is a threat to these species. For a more thorough discussion of previous occupations and current U.S. military activities, see ''Historical and Ongoing Human Impact,'' above.

Habitat Destruction and Modification by Nonnative Animals

Animal species introduced by humans, either intentionally or accidentally, are responsible for some of the greatest negative impacts to the four Mariana Islands ecosystems described here (Stone 1970, pp. 14, 32; Intoh 1986 in Conry 1988, p. 26; Fritts and Rodda 1998, p. 130). Although there are numerous reports of myriad introduced animal species that have negatively impacted the four described Mariana Islands ecosystems, ranging from ungulates to insects (including such diverse animals as the musk shrew (*Suncus murinus*), dogs (*Canis lupis familiaris*), cats, and black drongoes (birds; *Dicrurus macroercus*)), we have focused our efforts here on the negative impacts of those species that impose the greatest harmful effects on the four ecosystems (see Table 3). In addition, we address the compounding effects on these ecosystems that arise when the pressure of two or more individual negative impacts is greater than the sum of their parts (i.e., synergistic effects). Below we discuss the negative impacts of various nonnative animals, including feral pigs, goats, cattle, and water buffalo, as well as Philippine deer, rats, and the brown tree snake (BTS) (*Boiga irregularis*), which impose the greatest adverse impacts on one or more of the 4 described Mariana Islands ecosystems (forest, savanna, stream, and cave) that support the 23 species proposed for listing here (Stone 1970, pp. 14, 32; Intoh 1986 in Conry 1988, p. 26; Fritts and Rodda 1998, pp. 130–133; Berger et al. 2005, pp. 42, 44, 138, 156–157; CNMI–SWARS 2010, pp. 7, 24). Because most of the islands in the Mariana archipelago are small (Guam being the largest), the negative impacts associated with a destructive nonnative animal species affect the entire island. The mild climate of the islands, combined with the lack of competitors or predators, has led to the successful establishment of large populations of these introduced animals, to the detriment of the native Mariana Island species and ecosystems.

These effects are discussed in more detail, below.

Habitat Destruction and Modification by Introduced Ungulates

Like most oceanic islands, the Mariana Islands, and greater Micronesia, did not support indigenous populations of terrestrial mammalian herbivores prior to human colonization (Wiles et al. 1999, p. 194). Although agriculture and land use by the Chamorro clearly altered the landscape and composition of native biota in the Mariana Islands, starting over 3,500 years ago (Perry and Morton 1999, p. 126; Steadman 1995, pp. 1,126–1,127), impacts to the native species and ecosystems of the Marianas accelerated following the arrival of Magellan in the 1500s (Pregill 1998, p. 66; Perry and Morton 1999, pp. 126–127). The Spanish and subsequent explorers intentionally introduced pigs, cattle, goats, water buffalo, and Philippine deer to serve as food sources (Fosberg 1960, p. 54; Conry 1988, pp. 26–28). The isolation of the Mariana Islands allowed plant species to evolve without defenses to browsing and grazing animals, such as secondary metabolites and spines, making them highly susceptible to herbivory (Bowen and Van Vuren 1997, p. 1,249; Wiles et al. 1999, p. 194). Introduced mammals have profoundly influenced many insular ecosystems around the globe through alteration of the physical environment, culminating in the decline and loss of native biota (Stone 1970, pp. 14, 32; Scowcroft and Giffin 1983 in Wiles et al. 1999, p. 194; Stone 1985, pp. 251, 253–263; Campbell and Donlan 2004, pp. 1,363, 1,365), including the Mariana Islands ecosystems (Conry 1988, pp. 27–28; Mueller-Dombois and Fosberg 1998, pp. 250–252, 264; Berger et al. 2005, pp. 42, 44, 138, 156–157; CNMI–SWARS 2010, pp. 7, 24).

The presence of alien mammals is considered one of the primary factors underlying the alteration and degradation of native plant communities and habitats on the Mariana Islands. The destruction or degradation of habitat due to nonnative ungulates, including pigs, goats, cattle, water buffalo, and deer, is currently a threat to 17 of the proposed species in 2 of the 4 ecosystems (forest and savanna) on 7 of the 15 Mariana Islands (Guam, Rota, Aguiguan, Tinian, Alamagan, Pagan, and Agrihan). Habitat degradation or destruction by ungulates is a threat to 10 of the 14 plant species (*Cycas micronesica, Eugenia bryanii, Hedyotis megalantha, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordii, Psychotria malaspinae, Solanum guamense,* and *Tabernaemontana rotensis*), and 7 of the 9 animal species (the Pacific sheath-tailed bat, Slevin's skink, the Mariana eight-spot butterfly, the Guam tree snail, the humped tree snail, Langford's tree snail, and the fragile tree snail) proposed for listing (Table 3) (Stone 1970, pp. 14, 32; Perlman and Wood 1994, pp. 135–136.; Fritts and Rodda 1998, pp. 130–133; Mueller-Dombois and Fosberg 1998, p. 250; Perry and Morton 1999, pp. 126–127; Wiles and Johnson 2004, p. 586; Vogt and Williams 2004, pp. 82–89; Berger et al. 2005, pp. 42, 44, 138, 156–157; CNMI–SWARS 2010, pp. 7, 24; Pratt 2011, pp. 2, 36; Cook 2012, in litt.; Rogers 2012, in litt.; Rubinoff and Haines 2012, in litt.; Gawel 2014, in litt.; Marler 2014, in litt.). The three epiphytic orchids (*Bulbophyllum guamense, Dendrobium guamense,* and *Tuberolabium guamense*), the vine *Tinospora homosepala,* the Mariana wandering butterfly and its host plant *Maytenus thompsonii,* and the Rota blue damselfly are not reported to be vulnerable to habitat modification and destruction caused by nonnative ungulates.

Pigs—The destruction or degradation of habitat due to nonnative feral pigs is currently a threat in 2 (forest and savanna) of the 4 Mariana Islands ecosystems and their associated species on 4 of the 15 islands (Guam, Alamagan, Pagan, and Agrihan) (Berger et al. 2005, pp. 37–38, 40–44, 51, 95, 114; CNMI–SWARS 2010, p. 15; Kessler 2011, pp. 320, 323; Pratt 2011, pp. 2, 36). Pigs are present on other islands in the archipelago not noted above (i.e., Rota, Saipan, and Tinian); however, they are present in very low numbers, primarily on farms and, therefore, not considered a threat on these islands at this time.

Feral pigs are known to cause deleterious impacts to ecosystem processes and functions throughout their worldwide distribution (Aplet et al. 1991, p. 56; Anderson and Stone 1993, p. 201; Campbell and Long 2009, p. 2,319). Feral pigs are extremely destructive and have both direct and indirect impacts on native plant communities. While rooting in the earth in search of invertebrates and plant material, pigs directly impact native plants by disturbing and destroying vegetative cover, and trampling plants and seedlings. It has been estimated that at a conservative rooting rate of 2 square yards (yd^2) (1.7 m^2) per minute, with only 4 hours of foraging a day, a single pig could disturb over 1,600 yd^2 (1,340 m^2) (or approximately 0.3 ac, or 0.1 ha) of groundcover per week (Anderson et al. 2007, in litt.).

Pigs may also reduce or eliminate plant regeneration by damaging or eating seeds and seedlings (further discussion of predation by nonnative ungulates is provided under *Factor C. Disease and Predation,* below). Pigs are a major vector for the establishment and spread of competing invasive, nonnative plant species by dispersing plant seeds on their hooves and fur, and in their feces (Diong 1982, pp. 169–170, 196–197), which also serves to fertilize disturbed soil (Siemann et al. 2009, p. 547). In addition, pig rooting and wallowing contributes to erosion by clearing vegetation and creating large areas of disturbed soil, especially on slopes (Smith 1985, pp. 190, 192, 196, 200, 204, 230–231; Stone 1985, pp. 254–255, 262–264; Tomich 1986, pp. 120–126; Cuddihy and Stone 1990, pp. 64–65; Aplet et al. 1991, p. 56; Loope et al. 1991, pp. 18–19; Gagne and Cuddihy 1999, p. 52; Nogueira-Filho et al. 2009, p. 3,681; CNMI–SWARS 2010, p. 15; Dunkell et al. 2011, pp. 175–177; Kessler 2011, pp. 320, 323). Erosion, resulting from rooting and trampling by pigs, impacts native plant communities by contributing to watershed degradation and alteration of plant nutrient status, as well as causing direct damage to individual plants from landslides (Berger et al. 2005, pp. 42–44; Vitousek et al. 2009, pp. 3074–3086; Chan-Halbrendt et al. 2010, p. 251; Kessler 2011, pp. 320–324).

In the Hawaiian Islands, pigs have been described as the most pervasive and disruptive nonnative influence on the unique native forests, and are widely recognized as one of the greatest current threats to Hawaii's forest ecosystems (Aplet et al. 1991, p. 56; Anderson and Stone 1993, p. 195). The negative impacts from pig rooting and wallowing described above negatively affect 2 of the 4 described ecosystems (forest and savanna), and 14 of the 23 species proposed for listing as endangered or threatened (9 plants: *Cycas micronesica, Hedyotis megalantha, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordii, Psychotria malaspinae, Solanum guamense,* and *Tabernaemontana rotensis;* and 5 animals: Slevin's skink, the Mariana eight-spot butterfly, and the Guam tree snail, the humped tree snail, and the fragile tree snail) (Conry 1988, pp. 27–28; Vogt and Williams 2004, p. 88; Berger et al. 2005, pp. 37–38, 40–44, 51, 95, 114; CNMI–SWARS 2010, p. 15; SWCA 2010, p. 38; Kessler 2011, pp. 320, 323; Pratt 2011, pp. 2, 36; Harrington et al. 2012, in litt.).

Goats—Habitat destruction or degradation of habitat due to nonnative feral goats is currently a threat to three of the species proposed for listing in

two (forest and cave) of the four Mariana Islands ecosystems, on the islands of Aguiguan, Alamagan, Pagan, and Agrihan (Berger et al. 2005, pp. 36, 38, 40, 42–47; CNMI–SWARS 2010, p. 15; Kessler 2011, pp. 320–323; Pratt 2011, pp. 2, 36). Goats are presumably present on other islands (e.g., Guam and Saipan, and possibly Rota), but these individuals are primarily on farms and, therefore, are not considered a threat at this time (Kremer 2013, in litt.). Three of the 23 species proposed for listing as endangered or threatened species in this rule (the Pacific sheath-tailed bat, the humped tree snail, and Langford's tree snail), within the forest and cave ecosystems on the above-mentioned islands, are negatively affected by feral goats.

The feral goat population on Aguiguan increased from a handful of animals in 1992 to more than 1,000 in 2002, which led to the general destruction of the forest ecosystem due to lack of regeneration of native plants and almost complete loss of understory plants, leaving only two native plants that are unpalatable, *Cynometra ramiflora* and *Guamia mariannae* (Cruz et al. 2008, p. 243; Wiles and Worthington 2002, p. 7). In addition, feral goats on Aguiguan have been observed entering caves for shelter, which disrupts the endangered Mariana swiftlet colonies and is believed to disturb the Pacific sheath-tailed bat (Cruz et al. 2008, p. 243; Wiles and Worthington 2002, p. 17). Researchers found that if caves suitable for bats were occupied by goats, there were no bats present in the caves (GDAWR 1995, p. 95). Goats are widely recognized to have almost limitless ranges, and are able to access, and forage in, extremely rugged terrain (Clarke and Cuddihy 1980, pp. C–19, C–20; Culliney 1988, p. 336; Cuddihy and Stone 1990, p. 64).

Goats have completely eliminated some plant species from islands (Mueller-Dombois and Fosberg 1998, p. 250; Atkinson and Atkinson 2000, p. 21). On Alamagan and Pagan, goat browsing negatively impacts the habitat that supports the humped tree snail in the forest ecosystem by altering the essential microclimate, leading to increased desiccation and disruption of plant decay processes (Mueller-Dombois and Fosberg 1998, p. 250). On Agrihan, goats have destroyed much of the shrubs that make up the subcanopy, and the herbs in the understory (Ohba 1994, p. 19). In addition, goats eat the seeds and seedlings of one of the dominant Micronesian (Mariana Islands and Palau) endemic canopy species, *Elaeocarpus joga,* preventing its regeneration (Ohba 1994, p. 19; Ritter and Naugle 1999, pp. 275–281). None of the 23 species addressed in this proposed rule are known to currently occur on Agrihan; however, this island may be involved in future recovery efforts for 1 or more of the 23 species, and 2 other listed species, the Mariana fruit bat and the Micronesian megapode, occur there.

Cattle—Habitat destruction or degradation of habitat by feral cattle is currently a threat to two species addressed in this proposed rule (the humped tree snail and the plant *Heritiera longipetiolata*) in the forest ecosystem on the islands of Tinian, Alamagan, and Pagan (Berger et al. 2005, pp. 114, 218; Kessler 2011, p. 320) Cattle grazing damages the native vegetation and contributes to loss of native plant species, and also alters the essential microclimate leading to increased desiccation and disruption of plant decay processes necessary to support the humped tree snail, which currently occurs on the islands of Alamagan and Pagan (Mueller-Dombois and Fosberg 1998, p. 261; Pratt 2011, pp. 2, 36; Hadfield 2010, 23 pp.; Berger et al. 2005, pp. 114, 218). Feral cattle eat native vegetation, trample roots and seedlings, cause erosion, create disturbed areas into which alien plants invade, and spread seeds of alien plants in their feces and on their bodies. The forest in areas grazed by cattle degrades to grassland pasture, and plant cover is reduced for many years following removal of cattle from an area. Feral cattle also roam Tinian and are reported to negatively affect habitat across the island by grazing, trampling plants, and exposing soil, thereby changing the microclimate and composition of vegetation. This has led to deleterious effects on 1 (*Heritiera longipetiolata*) of the 23 species proposed for listing as an endangered species in this rule and its forest habitat. The Pacific sheath-tailed bat, and the plants *Dendrobium guamense, Solanum guamense,* and *Tuberolabium guamense,* occurred historically on Tinian.

Water buffalo—Several herds of Asiatic water buffalo or carabao roam southern Guam and the Naval Magazine area, and cause damage to the forest and savanna ecosystems that support 10 of the 23 species proposed for listing as endangered or threatened species (6 plants: *Cycas micronesica, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Psychotria malaspinae,* and *Tabernaemontana rotensis;* 4 animals: the Mariana eight-spot butterfly, the Guam tree snail, the humped tree snail, and the fragile tree snail) (Conry 1988, pp. 27–28; Harrington et al. 2012, in litt.). Water buffalo create mud wallows and trample vegetation (Conry 1988, p. 27). Wallowing pools can cover as much as 0.3 ac (0.1 ha) and reach a depth of 3 ft (1.0 m) (Conry 1988, p. 27), and trampling denudes land cover, leaving erosion scars and slumping (Conry 1988, pp. 27–28). Water buffalo negatively impact the Mariana eight-spot butterfly by damaging the habitat that supports its two host plants (*Procris pendunculata* and *Elatostema calcareum*). Although four additional species (the three epiphytic orchids (*Bulbophyllum guamense, Dendrobium guamense,* and *Tuberolabium guamense*), and the Mariana wandering butterfly and its host plant *Maytenus thompsonii*) may occur on the Naval Magazine, these four species are not as vulnerable to the negative impacts associated with water buffalo.

Deer—Habitat destruction or degradation due to Philippine deer is currently a threat to 13 of the proposed species found in 2 of the 4 described Mariana Island ecosystems (forest and savanna) on the islands of Guam and Rota (Wiles et al. 1999, pp. 198–200). Philippine deer have caused extensive damage resulting in changes in the forest structure, including erosion, grazing to the point of clearing the entire herbaceous understory, consumption of seeds and seedlings preventing regeneration of native plants and the spread of invasive plant species, and other physical damage (e.g., trunk rubbing) (Schreiner 1997, pp. 179–180; Wiles et al. 1999, pp. 193–215; Berger et al. 2005, pp. 36, 45–46, 100; CNMI–SWARS 2010, p. 24; JGPO–NavFac, Pacific 2010b, pp. 3–33; SWCA 2011, pp. 35, 42; Harrington et al. 2012, in litt.). At least 34 native plant species in the forest ecosystem have been documented as known food of the deer on the islands of Guam and Rota, including: (1) genera of 5 plant species addressed in this proposed rule (*Cycas* spp. (e.g., *C. micronesica*), *Eugenia* spp. (e.g., *E. bryanii*), *Heritiera* spp. (e.g., *H. longipetiolata*), *Psychotria* spp. (e.g., *P. malaspinae*), and *Solanum* spp. (e.g, *S. guamense*); and genera of the 2 host plants *Procris* spp. and *Elatostema* spp. that support the Mariana eight-spot butterfly; (2) several keystone ecosystem species: *Artocarpus mariannensis* (dokdok, seeded bread fruit), *Discocalyx megacarpa* (otot), *Merrilliodendron megacarpum* (faniok), *Piper* spp., *Pipturus argenteus,* and *Premna obtusifolia* (false elder); and (3) the listed species *Serianthes nelsonii* (Wiles et al. 1999, pp. 198–200, 203; Rubinoff and Haines 2012, in litt.). Philippine deer degrade the habitats that support 12 of the 23 species proposed for listing

as endangered or threatened species here, in the forest and savanna ecosystems on the islands of Guam and Rota (8 plants: *Cycas micronesica, Eugenia bryanii, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Psychotria malaspinae, Solanum guamense,* and *Tabernaemontana rotensis;* and 4 animals: the Mariana eight-spot butterfly (including the two host plants *Procris pendunculata* and *Elatostema calcareum*), the Guam tree snail, the humped tree snail, the fragile tree snail).

In summary, the habitats for 17 of the 23 species within all 4 ecosystems (forest, savanna, stream, and cave) identified in this rule are exposed to ongoing destruction and modification by feral ungulates (pigs, goats, cattle, and water buffalo), and Philippine deer (10 plants: *Cycas micronesica, Eugenia bryanii, Hedyotis megalantha, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordii, Psychotria malaspinae, Solanum guamense,* and *Tabernaemontana rotensis;* and 7 animals: the Pacific sheath-tailed bat, Slevin's skink, the Mariana eight-spot butterfly (and its 2 host plants *Procris pendunculata* and *Elatostema calcareum*), the Guam tree snail, the humped tree snail, Langford's tree snail, and the fragile tree snail). The effects of these nonnative animals include (1) the destruction of vegetative cover and the required microclimate of the 4 tree snails; (2) trampling of plants and seedlings and direct consumption of native vegetation and the 10 plants and the host plants for the 2 butterflies; (3) altering the native ecosystems that provide habitat for the 10 plants and 7 animals by soil disturbance leading to erosion and sedimentation; (4) dispersal of alien plant seeds on hooves and coats and in feces, which contributes to invasion and alteration of ecosystems required by the 10 plants and 7 animals; (5) alteration of soil nitrogen availability, and creation of open areas conducive to further invasion of native ecosystems by nonnative pest plant species; and (6) alteration of food availability for the Pacific sheath-tailed bat by destruction of native forest and the associated insect prey. All of these impacts lead to the subsequent conversion of a plant community dominated by native species to one dominated by nonnative species (see ''Habitat Destruction and Modification by Nonnative Plants,'' below). In addition, because these nonnative animals inhabit terrain that is often steep and rugged (Cuddihy and Stone 1990, pp. 64–65; Berger et al. 2005, pp. 36–38, 40–47, 51, 95, 100, 114, 218), foraging and trampling contribute to severe erosion of watersheds. Nonnative ungulates would thus pose a potential threat to the Rota blue damselfly's stream habitat, if these ungulates were allowed to roam freely on Rota (Dunkell et al. 2011, p. 192).

Habitat Destruction and Modification by Introduced Small Vertebrates

Rats—Three rat species are found in the Mariana Islands: (1) the Polynesian rat (*Rattus exulans*), the only rat found in prehistoric fossil records; (2) the Norway rat (*R. norvegicus*); and (3) a putative new southeast Asian *Rattus* line, originally thought to be *R. diardii* (synonymous with *R. tanezumi*) (Pages et al. 2010, p. 200; Pages et al. 2013, pp. 1019–1020; Kuroda 1938 in Wiewel et al. 2009, p. 208; Wiewel et al. 2009, pp. 210, 214–216). One or more of these rat species are present on all 15 Mariana Islands (Wiewel et al. 2009, pp. 205–222; Kessler 2011, p. 320). Rats are a threat to the forest and savanna ecosystems that support the 22 of the 23 species proposed for listing as endangered or threatened in this proposed rule (all 14 plant species and 8 of 9 animal species—all except the Rota blue damselfly in the stream ecosystem) by affecting regeneration of native vegetation, thereby destroying or eliminating the associated flora and fauna of these ecosystems.

Rats are recognized as one of the most destructive invasive vertebrates, causing significant ecological, as well as economic, and health impacts (Atkinson and Atkinson 2000, pp. 23–24; Cuddihy and Stone 1990, pp. 68–69). Rats impact native plants by eating fleshy fruits, seeds, flowers, stems, leaves, roots, and other plant parts (Atkinson and Atkinson 2000, p. 23), and can seriously affect plant regeneration. A New Zealand study of rats in native forests has demonstrated that, over time, differential regeneration of plants, as a consequence of rat predation, may alter the species composition of forested areas (Cuddihy and Stone 1990, p. 69). Rats have caused declines or even the complete elimination of island plant species (Campbell and Atkinson 1999, in Atkinson and Atkinson 2000, p. 24). Plants with fleshy fruits are particularly susceptible to rat predation (Stone 1985, p. 264; Cuddihy and Stone 1990, pp. 67–69).

Rats also impact the faunal composition of ecosystems by predation or competition with native amphibian, avian, invertebrate, mammalian, and reptilian species, often resulting in population declines or even extirpations; disruption of island trophic systems including nutrient cycling; and by the creation of novel vectors and reservoirs for diseases and parasites (Pickering and Norris 1996 in Wiewel et al. 2009, p. 205; Chanteau et al. 1998 in Wiewel et al. 2009, p. 205; Fukami et al. 2006, pp. 1,302–1,303; Towns et al. 2006, pp. 876–877; Wiewel et al. 2009, p. 205).

Rats are less numerous on Guam compared to Rota, Saipan, and Tinian, due to the presence of the BTS (see ''Brown Tree Snake,'' below) (Wiewel et al. 2009, p. 210). An inverse relationship has been observed between rat density and the density of the BTS, as rats are a food source for the BTS and, therefore, contribute toward its persistence (Rodda and Savidge 2007, p. 315; Wiewel et al. 2009, p. 218). Rodda et al. (1991, in CNMI DFW 2005, p. 175) suggests that rats negatively impact native reptile populations, such as Slevin's skink, by aggressively competing for habitat. Several restoration studies have shown rapid increases in skink populations after removal of rats (Towns et al. 2001, pp. 6, 9).

Brown tree snake—The brown tree snake (BTS), native to coastal eastern Australia and north through Papua New Guinea and Melanesia, was accidentally introduced to Guam shortly after World War II (Rodda and Savidge 2007, p. 307). This arboreal, nocturnal snake was first observed near the Fena Reservoir in the Santa Rita area, and now occupies all ecosystems on Guam (Rodda and Savidge 2007, p. 314). There are reported sightings of the BTS on Saipan; however, there are no known established populations on Saipan at this time (Campbell 2014, pers. comm.; Phillips 2014, pers. comm.). The BTS is believed responsible for the extirpation of 13 of Guam's 22 native bird species (including all but 1 of its native forest bird species), and for contributing to the elimination of the Mariana fruit bat, the Pacific sheath-tailed bat, and Slevin's skink populations from the island (Rodda and Savidge 2007, p. 307).

The loss or severe reduction of so many bird species and other small native animal species on Guam has ecosystem-wide impacts, since many of these bird and small animal species were responsible for seed dispersal and pollination of native plants (Perry and Morton 1999, p. 137; Rodda and Savidge 2007, p. 311; Rogers 2008, in litt.). Some report that the BTS has eliminated virtually all native seed dispersers (Fritts and Rodda 1998, p. 129). Field studies have demonstrated that seed dispersal of selected native plant species (*Aglaia mariannensis, Elaeocarpa joga,* and *Premna obtusifolia*) has declined on Guam as

compared to neighboring islands (Rota, Saipan, and Tinian), due to BTS predation on native birds and other small native vertebrate species (Ritter and Naugle 1999, pp. 275–281; Rogers 2008, in litt.; Rogers 2009, in litt.). Almost three quarters of the native tree species on Guam were once dependent on birds to eat their fruits and disperse their seeds (Rogers 2009, in litt.). Detailed studies on the native tree *P. obtusifolia* show that seeds handled by birds are twice as likely to germinate than seeds that fall off the tree and land directly below on the forest floor (by either simply nicking the seed and dropping it, or fully digesting the outer seed coat and excreting it in feces) (Rogers 2009, in litt.). An impact at one trophic level (elimination of seed dispersers) has cascading effects on other trophic levels, and can affect ecosystem stability (Perry and Morton 1999, p. 137).

The brown tree snake's elimination of native plant seed dispersers is an indirect threat that adversely affects 2 of the 4 described ecosystems (forest and savanna), and the habitat of 18 of the 23 species proposed for listing as endangered or threatened (all 14 plant species and 4 of the 9 animal species, including the Mariana eight-spot butterfly, the Guam tree snail, the humped tree snail, and the fragile tree snail).

Habitat Destruction and Modification by Nonnative Plants

Native vegetation on the Mariana Islands has undergone extreme alteration because of past and present land management practices, including ranching, the deliberate introduction of nonnative plants and animals, agricultural development, military actions, and war (Ohba 1994, pp. 17, 28, 54–69; Mueller-Dombois and Fosberg 1998, p. 242; Berger et al. 2005, pp. 45, 105, 110, 218, 347, 350; CNMI–SWARS 2010, pp. 7, 9, 13, 16). Some nonnative plants were brought to the Mariana Islands by various groups of people, including the Chamorro, for food or cultural reasons.

The native flora of the Mariana Islands (plant species that were present before humans arrived) consisted of no more than 500 taxa, 10 percent of which were endemic (species that occur only in the Mariana Islands). Over 100 plant taxa have been introduced from elsewhere, and at least one third of these have become pests (i.e., injurious plants) (Stone 1970, pp. 18–21; Mueller-Dombois and Fosberg 1998, pp. 242–243, 249, 262–263; Costion and Lorence 2012, pp. 51–100). Of these approximately 30 nonnative pest plant species, at least 9 have altered the habitat of 20 of the 23 species proposed for listing as endangered or threatened species (only 3 of the animal species, the Pacific sheath-tailed bat, the Slevin's skink, and the Mariana wandering butterfly, are not directly impacted by nonnative plants (see Table 3)).

Nonnative plants degrade native habitat in the Mariana Islands by: (1) Modifying the availability of light through alterations of the canopy structure; (2) altering soil-water regimes; (3) modifying nutrient cycling; (4) altering the fire regime affecting native plant communities (e.g., successive fires that burn farther and farther into native habitat, destroying native plants and removing habitat for native species by altering microclimatic conditions to favor alien species); and (5) ultimately converting native-dominated plant communities to nonnative plant communities (Smith 1985, pp. 217–218; Cuddihy and Stone, 1990, p. 74; Matson 1990, p. 245; D'Antonio and Vitousek 1992, p. 73; Ohba 1994, pp. 17, 28, 54–69; Vitousek et al. 1997, pp. 6–9; Mueller-Dombois and Fosberg 1998, pp. 242–243, 249, 262–263; Berger et al. 2005, pp. 45, 105, 110, 218, 347, 350; CNMI–SWARS 2010, pp. 7, 9, 13, 16).

The following list provides a brief description of the nonnative plants that impose the greatest negative impacts to forest, savanna, and stream ecosystems and the proposed species that depend on these ecosystems (all 14 of the plant species and 6 of the animal species, including the Mariana eight-spot butterfly, Rota blue damselfly, humped tree snail, Langford's tree snail, Guam tree snail, and fragile tree snail).

- *Antigonon leptopus* (chain of hearts, Mexican creeper, coral vine), a perennial vine native to Mexico, has become widespread throughout the Mariana Islands. This species is a fast-growing, climbing vine that can reach up to 25 ft (8 m) in length, and smothers all native plants in its path (University of Florida Center for Aquatic and Invasive Plants (UF) 2014, in litt.). The fact that this species can tolerate poor soil and a wide range of light conditions makes this species a very successful invasive plant (UF 2013, in litt.).
- *Coccinia grandis* (ivy or scarlet gourd), native throughout Africa and Asia, is an aggressive noxious pantropical weedy vine that forms dense blankets that smother vegetation, and currently proliferates on Guam and Saipan (Space and Falanruw 1999, pp. 3, 9–10). This species is considered the most invasive and serious threat to forest health by the CNMI DFW (CNMI–SWARS 2010, p. 15). Currently, *C. grandis* covers nearly 80 percent of Saipan (CNMI–SWARS 2010, p. 15).
- *Chromaeolena odorata* (Siam weed, bitterbrush, masigsig), native to Central and South America, is an herbaceous perennial that forms dense tangled bushes up to 6 ft (2 m) in height, but can grow up to 20 ft (6 m) as a climber on other plants (Invasive Species Specialist Group—Global Invasive Species Database (ISSG–GISD) 2006, in litt.). This species can grow in a wide range of soils and vegetation types, giving it an advantage over native plants (ISSG–GISD 2006, in litt.). Dense stands of *C. odorata* prevent the establishment of native plant species due to competition and allelopathic (growth inhibition) effects (ISSG–GISD 2006, in litt.).
- *Lantana camara* (lantana), a malodorous, branched shrub up to 10 ft (3 m) tall, was brought to the Mariana Islands as an ornamental plant. Lantana is aggressive, thorny, and forms thickets, crowding out and preventing the establishment of native plants (Davis et al. 1992, p. 412; Wagner et al. 1999, p. 1,320).
- *Leucana leucocephala* (tangentangen, koa haole), a shrub native to the neotropics, is a nitrogen-fixer and an aggressive competitor that often forms the dominant element of the vegetation (Geesink et al. 1999, pp. 679–680).
- *Paspalum conjugatum* (Hilo grass, sour grass) is a perennial grass that occurs in wet habitats and forms a dense ground cover. Its small, hairy seeds are easily transported on humans and animals, or are carried by the wind through native forests, where it establishes and displaces native vegetation (Pace et al. 2000, p. 23; Motooka *et al.* 2003; Pacific Islands Ecosystems at Risk 2008).
- *Pennisetum* species are aggressive colonizers that outcompete most native species by forming widespread, dense, thick mats. *Pennisetum setaceum* (fountain grass) has been introduced to Guam (Space and Falanruw 1999, pp. 3, 5). Fountain grass occurs in dry, open places; barren lava flows; and cinder fields, is fire-adapted, and burns swiftly and hot, causing extensive damage to the surrounding habitat (O'Connor 1999, p. 1,581). On Hawaii Island, fountain grass is estimated to cover hundreds of thousands of acres and has the ability to become the dominant component in dry, open places in the Mariana Islands (O'Connor 1999, p. 1,578; Fox 2011, in litt.). *Pennisetum purpureum* and *P. polystachyon* have been introduced to Guam and Saipan (Space and Falanruw 1999, pp. 3, 5). *Pennisetum purpureum* (Napier grass, elephant grass) is a vigorous grass that produces razor-sharp

leaves and forms thick clumps up to 13 ft (4 m) that resemble bamboo (Plantwise 2014, in litt.). Tall, dense thickets of *P. purpureum* outcompete and smother native plants, and can dominate fire-adapted grassland communities (Holm et al. 1979, in Plantwise 2014, in litt.). Similarly, dense thickets of *Pennisetum polystachyon* (mission grass) alter the fire regime and outcompete and smother native plants (University of Queensland 2011, in litt.).

- *Triphasia trifolia* (limeberry, limoncito), a shade-tolerant woody shrub native to southeast Asia, Malaysia, and the Christmas Islands, is an aggressive plant that forms dense, spiny thickets in the forest understory that smother native plant species and outcompete them for light and water (CABI 2014–*Invasive Species Compendium Online Database*).
- *Vitex parviflora* (small leaved vitex; molave tree, agalondi), a medium-sized tree up to 35 ft (10 m) native to Indonesia, Malaysia, and the Philippines, often forms monotypic stands, and can spread by seeds and pieces of roots and stems. *Vitex parviflora* forms thickets that outcompete, prevent recruitment of, and exclude native plants (Guaminsects 2005, in litt.). *Vitex parviflora* has greatly altered native habitats on Guam (SWCA 2010, pp. 36, 67), and is one of the most dominant trees on the island (WERI–IREI 2014b, in litt.).

Habitat Destruction and Modification by Fire

Fire is a human-exacerbated threat to native species and native ecosystems throughout the Mariana Islands, particularly on the island of Guam. Wildfires plague forest and savanna areas on Guam every dry season despite the island's humid climate, with at least 80 percent of wildfires resulting from arson (JGPO–NavFac, Pacific 2010b, p. 1–9). Deer hunters on Guam and Rota frequently create fires in order to lure deer to new growth for easier hunting (Kremer 2014, in litt.; Boland 2014, in litt.). It is not uncommon for these fires to become wildfires that spread across large expanses of the savanna ecosystem as well as into the adjacent forest ecosystem. Between 1979 and 2001, more than 750 fires were reported annually on Guam, burning over 155 mi^2 (401 km^2) during this time period (JGPO–NavFac, Pacific 2010b, pp. 1–8). Six of these 750 fires burned over 1,000 ac (405 hectares (ha)) (JGPO–NavFac, Pacific 2010b, pp. 1–8). On the island of Rota on the Sabana, hunters often set fires, which burn into adjacent native forest. Fire can destroy dormant seeds of native species as well as plants themselves, even in steep or inaccessible areas. Successive fires that burn farther and farther into native habitat destroy native plants and remove habitat for native species by altering microclimate conditions to those favorable to alien plants. Alien plant species most likely to be spread as a consequence of fire are those that produce a high fuel load, are adapted to survive and regenerate after fire, and establish rapidly in newly burned areas.

Grasses (particularly those that produce mats of dry material or retain a mass of standing dead leaves) that invade native forests and shrublands provide fuels that allow fire to burn areas that would not otherwise easily burn (Fujioka and Fujii 1980 in Cuddihy and Stone 1990, p. 93; D'Antonio and Vitousek 1992, pp. 70, 73–74; Tunison et al. 2002, p. 122). Native woody plants may recover from fire to some degree, but fire shifts the competitive balance toward alien species (National Park Service 1989 in Cuddihy and Stone 1990, p. 93). Another factor that contributes to wildfires on Guam, and other Mariana Islands with nonnative ungulates, includes land clearing for pasturage and ranching, which results in fire-prone areas of nonnative grasses and shrubs (Stone 1970, p. 32; CNMI–SWARS 2010, pp. 7, 20). Further, the danger of fire increases following intense typhoons, due to large fuel accumulation (Donnelly 2010, p. 6). Wildfire is a threat to nine plant species (*Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Hedyotis megalantha, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordii, Tabernaemontana rotensis,* and *Tuberolabium guamense*) and two animal species (the Guam tree snail (Guam) and the humped tree snail (Guam and Rota)), because individuals of these species occur in the savanna ecosystem or the forest ecosystem adjacent to the savanna ecosystem, on southern Guam (i.e., Cetti Watershed area) and on the Rota Sabana, where fires are common (Grimm 2012, in litt.; Gutierrez 2012, in litt.; Gutierrez 2013, in litt.).

Habitat Destruction and Modification by Typhoons

The Mariana Islands lie in the western North Pacific basin, which is the world's most prolific typhoon basin, with an annual average of 26 named tropical cyclones between 1951 and 2010, depending on the database used (Keener et al. 2012, p. 50). Typhoons are seasonal, occurring more often in the summer, and tend to be more intense during El Niño years (Gualdi et al. 2008, pp. 5,205, 5,208, 5,226). The North Pacific basin has been relatively calm the past decade; however, between 2002 and 2005, three typhoons (Typhoon Chataan (2002), Typhoon Tingting (2004), and Typhoon Nabi (2005)) and two super typhoons (Super Typhoon Pongsona (2002) and Super Typhoon Chaba (2004)) struck the Mariana Islands (Federal Emergency Management Agency (FEMA) 2014, in litt.). In the previous 20 years (between 1976 and 1997), only eight typhoons reached the island chain that caused damage warranting FEMA assistance (FEMA 2014, in litt.).

Typhoons may cause destruction of native vegetation and open the native canopy, thus modifying the availability of light, and creating disturbed areas conducive to invasion by nonnative pest species and nonnative plant species that compete for space, water, and nutrients, and alter basic water and nutrient cycling processes. This process leads to decreased growth and reproduction for all 14 plant species proposed for listing as endangered or threatened (see Table 3, above), and for the host plants (*Procris pendunculata, Elatostema calcareum,* and *Maytenus thompsonii*) for the 2 butterfly species addressed in this proposed rule (Perlman 1992, 9 pp.; Kitayama and Mueller-Dombois 1995, p. 671). Additionally, typhoons initiate a large pulse in the accumulation of debris and often trigger landslides with large debris flows (Lugo 2008, pp. 368, 372), as well as induce defoliation and wind-thrown trees, which can create conditions favorable to wildfires or which can result in the direct damage or destruction of individuals of the 14 plant species addressed in this proposed rule. Further, typhoon frequency globally may decrease; however, there may be some regional increases (e.g., in the western north Pacific), with an increase in the frequency of higher intensity events due to climate change (Emanuel et al. 2008, p. 361).

Typhoons constitute a threat to the nine animal species proposed for listing as endangered species in this rule, because the associated high winds may dislodge larvae, juveniles, or adult individuals from their host plants, caves, or streams, thereby increasing the likelihood of mortality caused by lack of essential nutrients for proper development; increase their exposure to predators (e.g., rats, BTS, monitor lizards, ants) (see *Factor C. Disease and Predation,* below); destroy host plants; open up the canopy and alter the microclimate; or cause direct physical damage. Damage by subsequent typhoons could further decrease the remaining native plant-dominated

habitat areas, and the associated food resources, that support the nine animal species. For plant and animal species that persist only in low numbers and restricted ranges, such as the 23 Mariana Islands species addressed here, natural disasters, such as typhoons, can be particularly devastating (Mitchell et al. 2005, p. 4–3).

Habitat Destruction and Modification by Climate Change

Our analyses under the Act include consideration of ongoing and projected changes in climate. The terms ''climate'' and ''climate change'' are defined by the Intergovernmental Panel on Climate Change (IPCC). ''Climate'' refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (Le Treut et al. 2007, p. 96). The term ''climate change'' thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (Le Treut et al. 2007, p. 104). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18).

Climate change will be a particular challenge for the conservation of biodiversity because the introduction and interaction of additional stressors may push species beyond their ability to survive (Lovejoy 2005, pp. 325–326). The synergistic implications of climate change and habitat fragmentation are the most threatening facet of climate change for biodiversity (Hannah et al. 2005, p. 4). The magnitude and intensity of the impacts of global climate change and increasing temperatures on native Mariana Island ecosystems are unknown. Currently, there are no climate change studies that address impacts to the specific Mariana Island ecosystems discussed here or any of the 23 individual species proposed for listing as endangered or threatened species that are associated with these ecosystems. There are, however, climate change studies that address potential changes in the tropical Pacific on a broader scale.

Based on the best available information, climate change impacts could lead to the loss of native species that comprise the communities in which the 23 species occur (Pounds et al. 1999, pp. 611–612; Still et al. 1999, p. 610; Benning et al. 2002, pp. 14,246–14,248; Allen et al. 2010, pp. 668–669; Sturrock et al. 2011, p. 144; Towsend et al. 2011, pp. 14–15; Warren 2011, pp. 165–166). In addition, weather regime changes (droughts, floods, typhoons) will likely result from increased annual average temperatures related to more frequent El Niño episodes as hypothesized for other Pacific Island chains (Giambelluca et al. 1991, p. iii). Future changes in precipitation and the forecast of those changes are highly uncertain because they depend, in part, on how the El Niño-La Niña weather cycle (a disruption of the ocean atmospheric system in the tropical Pacific having important global consequences for weather and climate) might change (State of Hawaii 1998, pp. 2–10). The 23 species proposed for listing as endangered or threatened species may be especially vulnerable to extinction due to anticipated environmental changes that may result from global climate change, due to their small population size and highly restricted ranges. Environmental changes that may affect these species are expected to include habitat loss or alteration and changes in disturbance regimes (e.g., storms and typhoons).

Climate Change and Ambient Temperature—The range of global surface warming since 1979 is 0.16 °C to 0.18 °C per decade (Trenberth et al. 2007, p. 237). Globally, the annual number of warm nights increased by about 25 days since 1951, with the greatest increase since the mid 1970s (Alexander et al. 2006, pp. 7–8). The bulk of the increase in mean temperature is related to a larger increase in minimum temperatures compared to the increase in maximum temperatures (Giambelluca et al. 2008, p. 1). Globally averaged, 2012 ranked as the eighth or ninth warmest year since records began in the mid- to late 1800s (Lander and Guard 2013, p. S–11).

To date, climate change indicators specific to the Mariana Islands have not been published; however, data collected on climate change indicators from the Pacific Region, (e.g., the Hawaiian Islands) show that, overall, the daily temperature range is decreasing, resulting in a warmer environment, especially at higher elevations and at night. Predicted changes associated with increases in temperature include, but are not limited to, a shift in vegetation zones upslope, shifts in animal species' ranges, changes in mean precipitation with unpredictable effects on local environments, increased occurrence of drought cycles, and increases in the intensity and number of hurricanes (i.e., typhoons) (Loope and Giambelluca 1998, pp. 514–515; Emanuel et al. 2008, p. 365; U.S. Global Change Research Program (US–GCRP) 2009, pp. 145–149, 153; Keener et al. 2010, pp. 25–28; Finucane et al. 2012, pp. 23–26; Keener et al. 2012, pp. 47–51). It is reasonable to extrapolate these predictions to the Mariana Islands as climate in this area is strongly influenced by the phase of ENSO (Lander and Guard 2013, pp. S192–S194). In addition, weather regime changes (e.g., droughts, floods, and typhoons) will likely result from increased annual average temperatures related to more frequent El Niño episodes in the Mariana Islands (Keener et al. 2012, pp. 35–37, 47–51), and elsewhere in the Pacific (Giambelluca et al. 1991, p. iii). However, despite considerable progress made by expert scientists toward understanding the impacts of climate change on many of the processes that contribute to El Niño variability, it is not possible to say whether or not El Niño activity will be affected by climate change (Collins et al. 2010, p. 391).

Globally, the increasing ambient temperature is creating a plethora of anticipated and unanticipated environmental changes such as melting ice caps, decline in annual snow mass, sea-level rise, ocean acidification, increase in storm frequency and intensity (e.g., hurricanes, typhoons, cyclones, and tornadoes), and altered precipitation patterns that contribute to regional increases in floods, heat waves, drought, and wildfires that also displace species and alter or destroy natural ecosystems (Pounds et al. 1999, p. 611; IPCC AR4 2007, p. 48; Marshall et al. 2008, p. 273; US–GCRP 2009, pp. 81–83; Allen et al. 2010, p. 669). These environmental changes are predicted to alter species migration patterns, lifecycles, and ecosystem processes such as nutrient cycles, water availability, and decomposition (IPCC AR4 2007, p. 48; Pounds et al. 1999, pp. 611–612; Sturrock et al. 2011, p. 144; Townsend et al. 2011, pp. 14–15; Warren 2011, pp. 221–226). The species extinction rate is predicted to increase congruent with ambient temperature increase (US–GCRP 2009, pp. 81–82). In the Mariana Islands, these environmental changes associated with a rise in ambient temperature can directly impact (by loss of individuals) and indirectly impact (by loss of habitat or food and sites for reproduction) the 23 species proposed for listing as endangered or threatened species in this

rule, and the ecosystems that support them, as discussed above.

Climate Change and Precipitation—As global surface temperature rises, the evaporation of water vapor increases, resulting in higher concentrations of water vapor in the atmosphere, further resulting in altered global precipitation patterns (U.S. National Science and Technology Council (US–NSTC) 2008, pp. 60–61; US–GCRP 2009, pp. 145–146). While annual global precipitation has increased over the last 100 years, the combined effect of increases in evaporation and evapotranspiration is causing land surface drying in some regions leading to a greater incidence and severity of drought (US–NSTC 2008, pp. 60–61; US–GCRP 2009, pp. 145–146). Over the past 100 years, most of the Pacific has experienced an annual decline in precipitation; however, the western North Pacific (e.g., western Micronesia, including the Mariana Islands) has experienced a slight increase (up to 14 percent on some islands) (US–NSTC 2008, p. 63; Keener et al. 2010, pp. 53–54). Increases in rain are associated with alterations in faunal breeding systems and increases in disease prevalence, flooding, and erosion (Easterling et al. 2000, p. 2073; Harvell et al. 2002, pp. 2,159 − 2,161; Nearing et al. 2004, pp. 48 − 49). It should be noted that although the western North Pacific typically experiences large amounts of rainfall annually, drought is a serious concern throughout Micronesia due to limited storage capacity and small groundwater supplies (Keener et al. 2012, pp. 49, 58, 119). Future changes in precipitation in the Mariana Islands are uncertain because they depend, in part, on how the El Niño-La Niña weather cycle might change (State of Hawaii 1998, pp. 2–10). Long periods of decline in annual precipitation result in a reduction in moisture availability, loss of wet forest, an increase in drought frequency, and a self-perpetuating cycle of invasion by nonnative plants, increasing fire-cycles, and increasing erosion. These impacts may negatively affect the 23 species proposed for listing as endangered or threatened species in this rule, and the ecosystems that support them.

Climate Change and Typhoons—A typhoon (as a tropical cyclone is referred to in the Northwest Pacific ocean) is the generic term for a medium- to large-scale, low-pressure storm system over tropical or subtropical waters with organized convection (i.e., thunderstorm activity) and definite cyclonic surface wind circulation (counterclockwise direction in the Northern Hemisphere) (Holland 1993, p. 7, NOAA 2011, in litt.). In the north Pacific Ocean, west of the International Date Line, once a typhoon reaches an intensity of winds of at least 150 mi per hour (65 m per second), it is classified as a super typhoon (Neumann 1993, pp. 1–2; NOAA 2011, in litt.). Climate modeling has projected changes in typhoon frequency and intensity due to global warming over the next 100 to 200 years (Emanuel et al. 2008, p. 360, Figure 8; Yu et al. 2010, pp. 1,355–1,356, 1,369–1,370); however, there are no certain climate model predictions for a change in the duration of the Pacific tropical cyclone storm season (which generally runs from May through November) (Collins et al. 2010, p. 396). The high winds and strong storm surges associated with typhoons, particularly super typhoons, have periodically caused great damage to the vegetation of the Mariana Islands. The strong winds can injure or cause death to the 9 animal species and the 14 plant species addressed in this proposed rule, and negatively impact the ecosystems that support them (see ''Habitat Destruction and Modification by Typhoons,'' above).

Climate Change and Sea-Level Rise—On a global scale, sea level is rising as a result of thermal expansion of warming ocean water; the melting of ice sheets, glaciers, and ice caps; and the addition of water from terrestrial systems (Climate Institute 2011, in litt.). Sea level rose at an average rate of 0.1 in (3.1 mm) per year between 1961 and 2003 (IPCC AR4 2007, p. 30), with a predicted increase in 2100 of 1.6 to 4.6 ft (0.5 to 1.4 m) above the 1990 level (Rahmstorf 2007, p. 368). Seven of the 23 species (5 plants: *Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Heritiera longipetiolata,* and *Nervilia jacksoniae;* and 2 animals: the humped tree snail and the Mariana eight-spot butterfly (indirectly through impacts to its 2 host plants (*Procris pendunculata* and *Elatostema calcareum*)) have individuals that occur close to the coast in the adjacent forest ecosystem at or near sea level and may be negatively impacted by sea-level rise and coastal inundation due to climate change; however, there is no specific data available on how sea-level rise and coastal inundation will impact these species.

In summary, increased variability of ambient temperature, precipitation, typhoons, and sea-level rise and inundation would provide additional stresses on the 4 ecosystems and each of the 23 associated species because they are highly vulnerable to disturbance and related invasion of nonnative species. The risk of extinction as a result of such factors increases when a species' range is restricted, its habitat decreases, and its population numbers decline (IPCC 2007, pp. 8–11). In addition, these 23 species may be at a greater risk of extinction due to the loss of redundancy and resiliency created by their limited ranges, restricted habitat requirements, small population sizes, or low numbers of individuals. Therefore, we would expect these 23 species to be particularly vulnerable to projected environmental impacts that may result from changes in climate and subsequent impacts to their habitats (Loope and Giambelluca 1998, pp. 504–505; Pounds et al. 1999, pp. 611–612; Still et al. 1999, p. 610; Benning et al. 2002, pp. 14,246–14,248; Giambelluca and Luke 2007, pp. 13–15). Based on the above information, changes in environmental conditions that result from climate change are likely to negatively impact the 23 species proposed for listing as endangered or threatened species in this rule, and we do not anticipate a reduction in this potential threat in the near future.

Conservation Efforts To Reduce Habitat Destruction, Modification, or Curtailment of Its Range

There are no approved Habitat Conservation Plans, Candidate Conservation Agreements, or Strategic Habitat Areas that specifically address these 23 species and threats to their habitat.

In 2012, the Guam Plant Extinction Prevention Program (GPEPP) was formed to address conservation concerns for a select group of native Mariana Islands plant species, including three of the plant species addressed in this proposed rule: *Heritiera longipetiolata, Maesa walkeri,* and *Psychotria malaspinae.* GPEPP is a partnership between the University of Guam (UOG), multiple Federal agencies (FWS, DOD, and USDA), Hawaii State Department of Land and Natural Resources, and the Hawaii Plant Extinction Prevention Program (Hawaii PEPP). The goal of GPEPP is to prevent the extinction of native Mariana Islands plant species that have fewer than 200 individuals remaining in the wild on the island of Guam (GPEPP 2014, in litt.). The group currently has funding limitations, so is focusing their efforts on tree species. The program's main objectives are to monitor, collect, survey, manage, and reintroduce native plant species in the Mariana Islands. They plan to work with conservation partners to protect wild populations and preserve genetic material (GPEPP 2014, in litt.).

A conservation project on Rota, administered through the Water and

Environmental Research Institute of the Western Pacific at the University of Guam, is aimed to analyze the island's hydrology, with the ultimate goal of protection of the Sabana Watershed and Talakhaya Springs (Keel et al. 2007, pp. 5, 22–23). Erosion control, revegetation, and water source preservation conducted as part of this project may provide protection to 9 of the 23 species in this proposed rule that currently or historically occurred on the southern side of the central plateau of Rota (6 plants: *Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Maesa walkeri, Nervilia jacksoniae, Tuberolabium guamense;* 3 animals: the Mariana wandering butterfly, the Rota blue damselfly, and the humped tree snail).

A FWS Biological Opinion (1998) recommended that the Navy fund conservation and recovery projects in the Mariana Islands to improve habitat and population sizes of the federally listed Micronesian megapode as mitigation for bombing activities on Farallon de Medinilla. This resulted in the removal of ungulates from Sarigan, which has improved native habitat that supports two species in this proposed rule, the humped tree snail and Slevin's skink, by decreasing the impacts of trampling and browsing on native plants. Sarigan may serve as a location for recovery of Slevin's skink and the humped tree snail.

Since 1993, the USDA–Wildlife Services' Brown Tree Snake Program in Guam has been working to prevent the inadvertent spread of the snake to other locations, and to reduce negative impacts by the brown tree snake on economic and ecological resources. Experimentation with toxicant drops to control the brown tree snake is ongoing. The USDA–Wildlife Services is the lead agency for this work, in cooperation with the USDA–National Wildlife Research Center, the U.S. Geological Survey, FWS, and DOD. Results of the toxicant drops are currently under review (Phillips 2014, in litt.).

Area 50, a 59-ac (24-ha) enclosure on Andersen AFB, containing a relictual patch of limestone forest, was created to exclude ungulates and the brown tree snake (Hess and Pratt 2006, p. 2). This enclosure was maintained for ecosystem and species experimental research. Several individuals of the tree *Tabernaemontana rotensis* occur within the enclosure and would benefit from protection from predators and habitat disturbance (Hess and Pratt 2006, p. 7); however, researchers found the enclosure in a state of neglect, and invaded by nonnative plant species and pigs, with only 20 ac (8 ha) of undisturbed primary forest remaining by 2006 (Hess and Pratt 2006, p. 24). We are unaware of any efforts to continue maintenance of this enclosure since that time.

Rota's Department of Fish and Wildlife constructed exclosures for two occurrences of *Tabernaemontana rotensis* in the Sabana Conservation Area, but only one exclosure remains, as the other burned in a fire (Hess and Pratt 2006, p. 33; 65 FR 35029, June 1, 2000).

The Micronesian Challenge is an organization with the goal of preserving at least 30 percent of near-shore marine resources and 20 percent of the terrestrial resources across Micronesia by 2020 (Micronesian Challenge 2011, in litt.). The CNMI government is already attempting to meet this goal by planning to designate conservation lands within native forest (CNMI–SWARS 2010, p. 30). The Micronesian Challenge organization has partnered with many national and international environmental organizations (e.g., Federated States of Micronesia, The Republic of the Marshall Islands, The Nature Conservancy, and the New York Botanical Gardens), and focuses on conservation outreach to native Micronesians and visitors (Micronesian Challenge 2011, in litt.).

Summary of Habitat Destruction and Modification

The threats to the habitats of each of the 23 Mariana Islands species are occurring throughout the entire range of each of the species, except where noted above, with consequent deleterious effects on individuals and populations of these species. These threats include land conversion by agriculture and urbanization, habitat destruction and modification by nonnative animals and plants, fire, natural disasters, environmental changes resulting from climate change, and compounded impacts due to the interaction of these threats. While the conservation measures described above address some threats to the 23 species, due to the pervasive and expansive nature of the threats resulting in habitat degradation, these measures are insufficient to eliminate these threats to any of the 23 species addressed in this proposed rule.

Development and urbanization represents a serious and ongoing threat to all 23 species because they cause permanent loss and degradation of habitat. The effects from ungulates are ongoing because ungulates currently occur in all 4 ecosystems that support the 23 species in this proposed rule. The threat of habitat destruction and modification posed by introduced ungulates is serious, because they cause: (1) Trampling and grazing that directly impacts plants, including 10 of the 14 plant species addressed in this rule, and impacts the 2 host plants used by the Mariana eight-spot butterfly for shelter, foraging, and reproduction; (2) increased soil disturbance, leading to mechanical damage to individuals of 10 of the 14 plant species, and also the host plants for the Mariana eight-spot butterfly; (3) creation of open, disturbed areas conducive to weedy plant invasion and establishment of alien plants from dispersed fruits and seeds, which results over time in the conversion of a community dominated by native vegetation to one dominated by nonnative vegetation; and (4) increased erosion, leading to destabilization of soils that support native plant communities, elimination of herbaceous understory vegetation, and creation of disturbed areas into which nonnative plants invade. The BTS and rats both negatively impact the four ecosystems by eating native animals that native plants rely on to disperse seeds, limiting the regenerative capacity of the native forest. These threats are expected to continue or increase without ungulate control or eradication.

Nonnative plants represent a serious and ongoing threat to 20 of the 23 species addressed in this proposed rule (all 14 plant species, the Mariana eight-spot butterfly, the Rota blue damselfly, and all 4 tree snails) (see Table 3) through habitat destruction and modification, because they: (1) Adversely impact microhabitat by modifying the availability of light; (2) alter soil-water regimes; (3) modify nutrient-cycling processes; (4) alter fire characteristics of native plant habitat, leading to incursions of fire-tolerant nonnative plant species into native habitat; (5) outcompete, and possibly directly inhibit the growth of, native plant species; and (6) create opportunities for subsequent establishment of nonnative vertebrates and invertebrates. Each of these threats can convert native-dominated plant communities to nonnative plant communities (Cuddihy and Stone 1990, p. 74; Vitousek 1992, pp. 33–36). This conversion has negative impacts on all 14 plant species addressed here, as well as the native plant species upon which the Mariana eight-spot butterfly and the Rota blue damselfly depend for essential life-history needs. For example, nonnative plants that outcompete native plants can destabilize streambanks, exacerbating the potential for landslides and rockfalls, in turn dislodging Rota

blue damselfly eggs and naiads from streams, and also displace or destroy vegetation used for perching by adults, leaving them more susceptible to predation.

The threat from fire to 11 of the 23 species in this proposed rule that depend on the savanna ecosystem and adjacent forest ecosystems (9 plant species: *Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Hedyotis megalantha, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordii, Tabernaemontana rotensis,* and *Tuberolabium guamense;* and 2 animal species: the Guam tree snail and the humped tree snail) (see Table 3, above) is serious and ongoing because fire damages and destroys native vegetation, including dormant seeds, seedlings, and juvenile and adult plants. After a fire, nonnative, invasive plants, particularly fire-tolerant grasses, outcompete native plants and inhibit their regeneration (D'Antonio and Vitousek 1992, pp. 70, 73–74; Tunison et al. 2002, p. 122; Berger et al. 2005, p. 38; CNMI–SWARS 2010, pp. 7, 20; JGPO–NavFac, Pacific 2010b, pp. 4–33). Successive fires that burn farther and farther into native habitat destroy native plants and animals, and remove habitat for native species by altering microclimatic conditions and creating conditions favorable to alien plants. The threat from fire is unpredictable but increasing in frequency in the savanna ecosystem that has been invaded by nonnative fire-prone grasses, and that is subject to abnormally dry to severe drought conditions.

Natural disasters such as typhoons are a threat to native terrestrial habitats on the Mariana Islands in all 4 ecosystems addressed here, and to all 14 plant species identified in this proposed rule, because they result in direct impacts to ecosystems and individual plants by opening the forest canopy, modifying available light, and creating disturbed areas that are conducive to invasion by nonnative pest plants (Asner and Goldstein 1997, p. 148; Harrington et al. 1997, pp. 346–347; Berger et al. 2005, pp. 36, 45, 71, 100, 144; CNMI–SWARS 2010, p. 10; JGPO–NavFac, Pacific 2010b, pp. 1–8). In addition, typhoons are a threat to the nine animal species in this rule because strong winds and intense rainfall can kill individual animals, and can cause direct damage to streams (Polhemus 1993, pp. 86–87). High winds and torrential rains associated with typhoons can also destroy the host plants for the two butterfly species, and can dislodge individual butterflies and their larvae from their host plants and deposit them on the ground where they may be crushed by falling debris or eaten by nonnative wasps and ants. In addition, the high winds can dislodge bats from their caves and cause individual harm or death. The impacts of typhoons can be particularly devastating to the 23 species because, as a result of other threats, they now persist in low numbers or occur in restricted ranges and are therefore less resilient to such disturbances, rendering them highly vulnerable. Furthermore, a particularly destructive super typhoon could potentially drive localized endemic species to extinction in a single event. Typhoons pose an ongoing threat because they are unpredictable and can occur at any time.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Plants

We are not aware of any threats to the 14 plant species that would be attributed to overutilization for commercial, recreational, scientific, or educational purposes.

Animals

We are not aware of any threats to five of the nine animal species (the two Mariana butterflies, Pacific sheath-tailed bat, Slevin's skink, or Rota blue damselfly) addressed in this proposed rule that would be attributed to overutilization for commercial, recreational, scientific, or educational purposes. We do have evidence indicating that collection is a threat to the four tree snail species addressed in this proposed rule, as discussed below.

Tree Snails—Tree snails can be found around the world in tropical and subtropical regions and have been valued as collectibles for centuries. Evidence of tree snail trading among prehistoric Polynesians was discovered by analysis of the multi-archipelagic distribution of the Tahitian endemic *Partula hyalina* and related taxa (Lee et al. 2007, pp. 2,907, 2,910). In their study, Lee et al. (2007, pp. 2,908–2,910) found evidence that *P. hyalina* had been traded as far away as Mangaia in the Southern Cook Islands, a distance of over 500 mi (805 km). The endemic Hawaiian tree snails within the family Achatinellidae were extensively collected for scientific as well as recreational purposes by Europeans in the 18th to early 20th centuries (Hadfield 1986, p. 322). Historically, tree snails were abundant in the Pacific Islands. During the 1800s collectors observed 500 to 2,000 snails per tree, and sometimes collected more than 4,000 snails in several hours (Hadfield 1986, p. 322). Likewise, in the Mariana Islands, Crampton (an early naturalist in the islands) alone took 2,666 adult *Partula gibba* snails from 8 sites on Sapian in just 6 days in 1925 (Crampton 1925, p. 100). Repeated collections of hundreds to thousands of individuals at a time by early collectors may have contributed to decreased population sizes and reduction of reproduction potential due to the removal of potential breeding adults (Hadfield 1986, p. 327).

The collection of tree snails persists to this day, and the market for rare tree snails serves as an incentive to collect them. A search of the Internet (e.g., eBay and Etsy) reveals Web sites that offer snail shells from more than 100 land and sea snail species (along with corals and sand) from around the world, including rare and listed *Achatinella* and *Partulina.* These sites encourage collectors by making statements such as ''These assorted land snail shells from the tropical regions of the world are great for crafters and decorations for tanks'' and refer to shells with colorful names such as ''rainbow shells from Haiti'' (*http://www.shells-of-aquarius.com/snail-shells.html; https://www.etsy.com/uk/search?q=tree+snail*). Concerned citizens alert law enforcement of Internet sales and notify the public about illegal sales through personal web blogs (*http://bioacoustics.blogspot.com/2012/04/endangered-species-on-ebay.html*). Over the past 100 years, Mariana species of partulid tree snail shells have been made into jewelry and purses and sold to tourists (Kerr 2013, p. 3). Based on the history of collection of Pacific island tree snails, the market for Mariana tree snail shells, and the vulnerability of the small populations of the humped tree snail, Langford's tree snail, the Guam tree snail, and the fragile tree snail, we consider collection a threat to the four endemic Mariana tree snail species proposed for listing as endangered species in this rule.

Summary of Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

We have no evidence to suggest that overutilization for commercial, recreational, scientific, or educational purposes poses a threat to any of the 14 plant species, 2 butterflies, Pacific sheath-tailed bat, Slevin's skink, or Rota blue damselfly proposed for listing as endangered or threatened species. We consider the four species of tree snails vulnerable to the impacts of overutilization due to collection for trade or market. Based on the history of collection of Pacific tree snails, the current market for Marianas tree snail

shells and tree snail shells world-wide, and the inherent vulnerability of the small populations of the Guam tree snail, the humped tree snail, Langford's tree snail, and the fragile tree snail to the removal of breeding adults, we consider collection to pose a serious and ongoing threat to these species.

Factor C. Disease and Predation

Disease

We are not aware of any threats to the 23 species addressed in the proposed rule that would be attributable to disease.

Predation and Herbivory

Multiple animal species, ranging from mammals and rodents to reptiles and insects, are reported to impact 17 of the 23 species proposed for listing as endangered or threatened species in this rule by means of predation or herbivory (Table 3). Those species that have the most direct negative impact on the 23 species include: feral pigs, Philippine deer, rats, the brown tree snake, monitor lizards, Cuban slugs (*Veronicella cubensis*); the manokwari flatworm (*Platydemus manokwari*), the cycad aulacaspis scale, ants (*Tapinoma minutum, Technomyrmex albipes, Monomorium floricola,* and *Solenopsis geminata*), and parasitoid wasps (*Telenomus* sp. and *Ooencyrtus* sp.). Data show these nonnative animals have caused a decline of 17 of the 23 species (Intoh 1986 in Conry 1988, p. 26; Fritts and Rodda 1998, pp. 130–133). Although feral goats, cattle, and water buffalo occur on one or more of the Mariana Islands and are recognized to negatively impact the ecosystems in which they occur (see *Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range,* above), we have no direct evidence that goats, cattle, or water buffalo browse specifically on any of the 14 plant species addressed in this proposed rule.

Ungulates

Pigs—Feral pigs are widely recognized to negatively alter ecosystems (see ''Habitat Destruction and Modification by Introduced Ungulates,'' above). In addition, feral pigs have been observed to eat the leaves, fruits, seeds, seedlings, or bark, from 4 of the 14 plant species proposed for listing as endangered or threatened species in this rule (*Cycas micronesica, Heritiera longipetiolata, Psychotria malaspinae,* and *Solanum guamense*) in the forest ecosystem (Perlman and Wood 1994, pp. 135–136; Harrington et al. 2012, in litt.; Rogers 2012, in litt.; Marler 2013, pers. comm.). Similarly, on other Pacific islands (e.g., the Hawaiian Islands), pigs are known to eat and fell plants and remove the bark from a variety of native plant species, including *Clermontia* spp., *Cyanea* spp., *Cyrtandra* spp., *Hedyotis* spp., *Psychotria* spp., and *Scaevola* spp. (Diong 1982, p. 144). In addition, evidence of pigs feeding on *Cycas micronesica* has been observed, hypothesized for the intent to get at grubs (Harrington et al. 2012, in litt.). Pigs also eat standing living stems of plants, thought to be for the same intent (Marler 2013, pers. comm.). Feral pigs have been documented to eat the host plants that support the Mariana eight-spot butterfly (*Procris pendunculata* and *Elatostema calcareum*).

In addition to deer imposing negative impacts on habitat at an ecosystem scale in the Mariana Islands on which they occur (primarily Guam and Rota), deer consume leaves, seeds, fruits, and bark of 5 of the 14 plant species (*Cycas micronesica, Eugenia bryanii* (deer are known to consume all Mariana Islands *Eugenia* spp.), *Heritiera longipetiolata, Psychotria malaspinae,* and *Solanum guamense*), and the 2 host plants for the Mariana eight-spot butterfly (Wiles et al. 1999, pp. 198–200, 203; Rubinoff and Haines 2012, in litt.).

Other Nonnative Vertebrates

Rats

Rat Predation on Tree Snails—Rats (*Rattus* spp.) have been suggested as responsible for the greatest number of animal extinctions on islands throughout the world, including extinctions of various snail species (Towns et al. 2006, p. 88). Rats are known to prey upon Pacific island endemic arboreal snails (Hadfield et al. 1993, p. 621). In the Waianae mountains of Oahu, Meyer and Shiels (2009, p. 344) found shells of the endemic Oahu tree snail (*Achatinella mustelina*) with characteristic rat damage (e.g., damage to the shell opening and cone tip), but noted that, since a high proportion of crushed shells could not reliably be collected in the field, the impact of rat predation on snail populations may be underestimated. Rat predation on tree snails has also been observed on the Hawaiian Islands of Lanai (Hobdy 1993, p. 208; Hadfield 2005, in litt, p. 4), Molokai (Hadfield and Saufler 2009, p. 1,595), and Maui (Hadfield 2006, in litt.). Rat populations on Guam may be limited by predation by the brown tree snake, thereby limiting rat predation on native tree snails. Because rats occur in larger numbers on the Mariana Islands to the north of Guam, rat predation is considered a threat to the three tree snail species addressed in this proposed rule that occur on the other Mariana Islands (the humped tree snail on Rota, Aguiguan, Saipan, Sarigan, Alamagan, and Pagan; the fragile tree snail on Rota; and Langford's tree snail on Aguiguan).

Rat Predation on Bats—Rats may prey on the Pacific sheath-tailed bat, proposed for listing as endangered. Rats are omnivores and are opportunistic feeders. Rats have a widely varied diet consisting of nuts, seeds, grains, vegetables, fruits, insects, worms, snails, eggs, frogs, fish, reptiles, birds, and mammals (Fellers 2000, p. 525; GISD 2014, in litt.). Rats occur on Aguiguan, the only island on which the Pacific sheath-tailed bat is known to roost (Berger et al. 2005, p. 144). Rats are predators on young bats at roosts (that are nonvolant, i.e., have not yet developed the ability to fly) (Wiles et al. 2011, p. 306). The black rat was determined to be the primary factor in reproductive failure for a maternal colony of Townsend's big-eared bat (*Corynorhinus townsendii*) in California (Fellers 2000, pp. 524–525). Many of the roosting sites used by the Pacific sheath-tailed bat on Aguiguan appear to be impassable to rats; however, this may be due to rats limiting the selection of roosting sites because of their foraging and surveillance for prey in caves (Wiles and Worthington 2002, p. 18; Berger et al. 2005, p. 144). Because rats occur on all of the Mariana Islands, the Service considers rats a threat to the Pacific sheath-tailed bat.

Rat Predation on Skinks—Rats are known to prey on a variety of skink species around the globe (Crook 1973 in Towns et al. 2001, p. 3; Whitaker 1973 in Towns et al. 2001, p. 3; McCallum 1986 in Towns et al. 2001, p. 3; Towns et al. 2001, pp. 3–4, 6–8; Towns et al. 2006, pp. 875–877, 883). A New Zealand study showed the cause of the decline of rare reptiles on island reserves became evident through associations with the spread of Pacific rats (*Rattus exulans*) to these island reserves (Crook, 1973; Whitaker, 1973, 1978; and McCallum, 1986 in Towns et al. 2001, p. 3). Other restoration projects in New Zealand have demonstrated the native reptile populations undergo a resurgence following aggressive conservation activities to control predatory mammals, especially rodents (Towns et al. 2001, p. 3). The reptile species showing the most rapid response to removal of rats was the shore skink (*Oligosoma smithi*), with an increase of the capture frequency of shore skinks by up to 3,600 percent over 9 years (Towns 1994, unpub. in Towns et al. 2001, p. 10). Rats occur on all of

the Mariana Islands and are a threat to the Slevin's skink on the islands on which it currently occurs (Cocos Island, Alamagan, and Sarigan), and are a threat on islands where the skink was observed in the 1980s and 1990s (Guguan, Pagan, and Asuncion) but for which their current status is unkown. Once thought to be extirpated from Cocos Island (just offshore of Guam), Slevin's skink was observed on Cocos Island for the first time in more than 20 years following the eradication of rats and monitor lizards (Fisher 2012 pers. comm., in IUCN 2014, in litt.), indicating that predation by these nonnative species has a significant negative effect on skink populations.

Brown Tree Snake (BTS)

The BTS (see ''Habitat Destruction and Modification by Introduced Small Vertebrates,'' above) preys upon a wide variety of animals, and although it is only known to occur on Guam at this time, it is an enormous concern that the BTS will be introduced to other Mariana Islands (The Brown Tree Snake Control Committee 1996, pp. 1, 5). This nocturnal arboreal snake occupies all ecosystems on Guam, and consumes small mammals and lizards, usually in their neonatal state (Rodda and Savidge 2007, pp. 307, 314). The BTS is attributed with the extirpation, or contribution thereof, of 13 of Guam's 22 native bird species. Roosting and nesting birds, eggs, and nestlings are all vulnerable. If the BTS establishes on any other of the Mariana Islands it will impose a wide range of negative impacts, both environmental and economic (Campbell 2014, pers. comm.).

BTS Predation on Bats—The BTS has the potential to prey on fruit bats and the Pacific sheath-tailed bat, as BTS are known to climb in caves and prey on Mariana swiflets. Predation by tree snakes possibly caused losses of sheath-tailed bats in southern Guam in the 1950s and 1960s, but invaded northern Guam too late to have played a role in the bat's extirpation there (Wiles et al. 2011, p. 306). If the BTS should be introduced to Aguiguan, the only island in the Mariana archipelago that currently supports a population of the Pacific sheath-tailed bat, it would negatively affect this population, either by predation or by limiting available cave sites (Rodda and Savidge 2007, p. 307). Additionally, if the BTS is introduced to islands in the Mariana archipelago that historically supported the Pacific sheath-tailed bat (i.e., Guam, Rota, Saipan, Tinian, Anatahan, and Maug), recovery for this species will be difficult, and the Service considers the BTS a potential threat to the Pacific sheath-tailed bat on these islands.

BTS Predation on Skinks—The BTS is known to prey on a wide variety of small vertebrates on Guam, including skinks. Juvenile BTS are known to feed exclusively on lizards (including skinks) (Savidge 1988, in Rodda and Savidge 2007, pp. 314 − 315). In one study, 250 food items were taken from the digestive systems of BTS, and of these, 194 were lizards or lizard eggs (Savidge 1988 cited in Rodda and Fritts 1992, p. 166). If the BTS is introduced to any of the islands that currently (Cocos Island, Alamagan, and Sarigan) or historically (Guam, Rota, Tinian, Aguiguan, Guguan, and Pagan) support the Slevin's skink, it will negatively impact by decreasing populations and the numbers of individuals, and when combined with habitat loss, and other threats, could lead to their extirpation. Additionally, if the BTS is introduced to islands where the Slevin's skink occurred historically (Guam, Rota, Tinian, Aguiguan, Guguan, and Pagan), recovery for this species will be difficult, and the Service considers the BTS a potential threat to the Slevin's skink on these islands.

Monitor Lizard

Monitor Lizard Predation on Bats—The monitor lizard (hilitai, *Varanus indicus*), a carnivorous, terrestrial, arboreal lizard that can grow up to 3 ft (1 m) in length, is present on every island in the Mariana Islands except for Farallon de Medinilla, Guguan, Asuncion, Maug, and Uracas (Vogt and Williams 2004, pp. 76–77). It is unknown when the monitor lizard was introduced to Guam and the Northern Mariana Islands; however, it is known that the presence of this species in the islands predates European contact (Vogt and Williams, p. 77). Monitor lizards typically hunt over large areas and feed frequently on a wide variety of prey including, but not limited to, crabs, snails, snakes, lizards, skinks, fish, rats, squirrels, rabbits, sea turtle eggs, and birds (Losos and Greene 1988, pp. 379, 393; Bennet 1995 in ISSG–GISD 2007, in litt.). In the Mariana Islands, monitor lizards prey on both invertebrates and vertebrates, including large animals like chickens and the endangered Micronesian megapode (Martin et al. 2008 in IUCN 2007, in litt.). Considering their varied diet, which includes small vertebrates, and given the opportunity, predation by monitor lizards is a threat to the Pacific sheath-tailed bat proposed for listing as an endangered species in this rule, in the forest and cave ecosystems (USDA–Natural Resources Conservation Service 2009, p. 8).

Monitor Lizard Predation on Skinks—Monitor lizards are known to prey on all life stages of lizards (eggs, juveniles, and adults) and also other monitor lizards. Therefore, we expect monitor lizards negatively impact the Slevin's skink, also (Rodda and Fritts 1992, pp. 166 − 174; Vogt 2010, in litt.). The specific reasons for the decline of Slevin's skink (currently known from only 3 of the 10 islands where occurrences have been noted) are not known. Rodda et al. (1991) suggest that the combination of introduced species such as rats and shrews and other reptiles negatively impact native reptile populations, including Slevin's skink, by aggressively competing for habitat and food resources, and through predation (see ''Rat Predation on Skinks,'' above) (Rodda et al. 1991 in Berger et al. 2005, pp. 174–175). The monitor lizard is known to have a varied diet (coconut crabs, snails, snakes, lizards, skinks, fish, rats, squirrels, rabbits, sea turtle eggs, and birds.) (Berger et al. 2005, pp. 69–70, 90, 347–348; Losos and Greene 1988, pp. 379, 393; Bennet 1995 in ISSG–GISD 2007, in litt.); therefore, predation of Slevin's skink by monitor lizards is a threat to the Slevin's skink throughout its range in the Mariana Islands.

Nonnative Fish Predation on Damselflies

A survey of the Okgok River (or Okgok Stream, also known as Babao), conducted in 1996, showed that only four fish species (all native species) were present: the eel *Anguila marmorata,* the mountain gobies *Stiphodon elegans* and *Sicyopus leprurus,* and the flagtail or mountain bass, *Kuhlia rupestris.* Other freshwater species observed included a prawn, shrimps, and gastropods (Camacho et al. 1997, pp. 8–9). Densities of these native fish were low, especially in areas above the waterfall. Gobies can maneuver in areas of rapidly flowing water by using ventral fins that are modified to form a sucking disk (Ego 1956, in litt.). Freshwater gobies in Hawaii are primarily browsers and bottom feeders, often eating algae off rocks and boulders, with midges and worms being their primary food items (Ego 1956, in litt.; Kido et al. 1993, p. 47). The flagtails were only abundant in the lower reach of the stream. Researchers speculate that the Rota blue damselfly may have adapted its behavior to avoid the benthic feeding habits of native fish species.

Nonnative fish (*Gambusia* spp.) were introduced to Guam streams for mosquito control. Other nonnative fish from the aquarium trade (e.g., guppies,

swordtails, mollies, betta, oscars, and koi) have been released and documented in Guam streams. Currently, none of these fish are known from the Okgok River (Okgok Stream, Babao) on Rota, but biologists believe that *Gambusia* and guppies would be the most likely species to be introduced (Tibbatts 2014, in litt.). The release of aquarium fish into streams and rivers of Guam is well documented, but currently, no nonnative fish have been found in the Rota stream (Tibbatts 2014, in litt.). Therefore, release of nonnative fish is only a potential threat at this time, as they could impact the Rota blue damselfly by eating the naiad life stage, interrupting its life-cycle, and leading to its extirpation.

Nonnnative Invertebrates

Slug Herbivory on Native Plants—The nonnative Cuban slug (*Veronicella cubensis*) is considered one of the greatest threats to native plant species on Pacific Islands (Robinson and Hollingsworth 2006, p. 2). The Cuban slug is a recent introduction to the Micronesian islands. These terrestrial mollusks are generalist feeders, can attack a wide variety of plants, and switch food preferences if potential food plants change (Robinson and Hollingsworth 2006, p. 2). Slugs feed on the two host plants (*Elatostema calcareum* and *Procris pendunculata*) that support the Mariana eight-spot butterfly, proposed for listing as endangered. The Cuban slug has been known on Rota since 1996, occurs in large numbers, and is currently a pest to agricultural and ornamental crops on the island (Badilles et al. 2010, pp. 2, 4, 8). Some agricultural losses are reported to be as high as 70 percent of the crop (Badilles et al. 2010, p. 7). In addition, these slugs are known to attack orchids, which place all four species of orchids addressed in this proposed rule (*Bulbophyllum guamense, Dendrobium guamense, Nervilia jacksoniae,* and *Tuberolabium guamense*) at risk from slug predation on the islands of Guam and Rota (Badilles et al. 2010, p. 7; Cook 2012, in litt.).

Flatworm Predation on Tree Snails—The extinction of native land snails on several Pacific Islands has been attributed to the terrestrial Manokwari flatworm (*Platydemus manokwari*), native to western New Guinea (Sugiura 2010, p. 1,499). It is believed to occur on most of the southern Mariana Islands, and was first observed on Guam in 1978 (Hopper and Smith 1992, pp. 78, 82–83; Berger et al. 2005, p. 158). It was found to be effective in reducing the abundance of the nonnative African snail (*Achatinella fulica*) by as much as 95 percent (Hopper and Smith 1992, p. 82). This flatworm has also diminished two nonnative predatory snails, the rosy wolf snail (*Euglandina rosea*) and *Gonaxis* spp., both of which were previously considered a threat to the Mariana Islands tree snails (Kerr 2013, p. 5). The Manokwari flatworm, mostly ground-dwelling, has been observed to climb trees and feed on juvenile Partulid snails (Hopper and Smith 1992, p. 82). Due to its widespread occurrence on the southern Mariana Islands, and the risk of unintentional introduction on the southern Mariana Islands, predation by the Manokwari flatworm is considered a threat to all four tree snail species (the Guam tree snail, the humped tree snail, Langford's tree snail, and the fragile tree snail) proposed for listing as endangered species.

Scale Herbivory on Cycas—Cycas micronesica is currently declining on two (Guam and Rota) of the five Micronesian islands on which it occurs due to the presence of a phytophagous (plant-eating) insect, the cycad aulacaspis scale (*Aulacaspis yasumatsui*) (Marler and Lawrence 2012, pp. 238–240; Marler 2012, pers. comm.). The cycad aulacaspis scale, first described in Thailand (Takagi 1977 in Marler and Lawrence 2012, p. 233), was unintentionally introduced into the United States (Florida) a little over 20 years ago (Howard et al. 1999 in Marler and Lawrence 2012, p. 233), from where it spread to other regions. It was introduced to Guam in 2003, possibly via importation of the landscape cycad, *Cycas revoluta* (Marler and Lawrence 2012, p. 233). By 2005, the cycad aulacaspis scale had spread throughout the forests of Guam. Although this scale has infested *C. micronesica* populations on Guam, Rota, and the larger islands of Palau, most of the data has been collected on Guam, where more than 50 percent of the total known *Cycas* individuals occur (Marler 2012, pers. comm.). In 2002, prior to the scale infestation, *C. micronesica* was the most abundant tree species on Guam (Donnegan et al. 2002, p. 16). At an international meeting of the Cycad Specialist Group in Mexico in 2005, the cycad aulacaspis scale was identified as a critical issue for cycad conservation worldwide and was given priority status (IUCN/Species Survival Commission Cycad Specialist Group 2014, in litt.).

The cycad aulacaspis scale attacks every part of the leaf, which subsequently turns white. The leaf then collapses, and with progressive infestation, death of the entire plant can occur in less than 1 year (Marler and Muniappan 2006, pp. 3–4). Field studies conducted on the Ritidian National Wildlife Refuge on Guam by Marler and Lawrence (2012, p. 233) between 2004 and 2011 found that 6 years after the cycad aulacaspis scale was found on the refuge, mortality of *C. micronesica* there had reached 92 percent. The scale first killed all seedlings at their study site, followed by the juveniles, then most of the adult plants. The cycad aulacaspis scale is unusual in that it also infests the roots of its host plant at depths of up to 24 in (60 cm) in the soil (University of Florida 2014, in litt.). Marler and Lawrence (2012, pp. 238, 240) predict that if the predation by cycad aulacaspis scale is unabated, it will cause the extirpation of *C. micronesica* from western Guam by 2019.

Nonnative specialist arthropods like the cycad aulacaspis scale are particularly harmful to native plants when introduced to small insular oceanic islands because the native plants lack the shared evolutionary history with arthropods and have not developed resistance mechanisms (Elton 1958 in Marler and Lawrence 2012, p. 233), and the nonnative arthropods are not constrained by the natural pressures or predators of their native range (Howard et al. 1999, p. 26; Keane and Crawely 2002 in Marler and Lawrence 2012, p. 233). In addition, *C. micronesica* is the sole native host of the cycad aulacaspis scale on Guam, which raises concerns to biologists who predict that the extirpation of *C. micronesica* from Guam will bring about negative cascading ecosystem responses and manifold ecological changes (Marler and Lawrence 2012, p. 233). Because this scale spread to Rota in 2006 (Moore et al. 2006, in litt.), and the larger islands of Palau in 2008 (Marler in Science Daily 2012, in litt.), the same degree of negative impact to *C. micronesica* in these areas is likely to occur. As shown in other case studies worldwide, the scale insects are known to spread rapidly, within a few months, from the site of introduction (University of Florida 2014, in litt.).

Although the scale is present on the larger islands of Palau, it has not yet reached the numerous smaller Rock Islands, where more than 1,000 individuals of *C. micronesica* are estimated to occur. As scales can be wind dispersed, it could be a short amount time for infestation in the Rock Islands, as shown by its rapid spread throughout Florida between 1996 and 1998 (Marler 2014, in litt.; University of Florida 2014, in litt). The Rock Islands are a popular tourist destination, and the scale could also be inadvertently transported on plant material and soils (International Coral Reef Action Network 2014, in litt.). Yap is an

intermediate stop-over point for those traveling between Guam and Palau. *Cycas micronesica* on Yap are also considered at risk as scales can be spread by wind dispersal and on transportation of already infested plant material and soil; and because of the rapidity with which it spreads (ISSG–GISD 2014, in litt.; University of Florida 2014, in litt.). In addition, three other insects (a nonnative butterfly (*Chilades pandava*), a nonnative leaf miner (*Erechthias* sp.), and a native stem borer (*Dihammus marianarum*), opportunistically feed on *C. micronesica* weakened by the cycad aulacaspis scale, compounding its negative impacts (Marler 2013, pp. 1,334–1,336).

Scales, once established, require persistent control efforts (University of Florida 2014, in litt.; Gill 2012, in litt). Within the native range of the scale in southeast Asia, cycads are not affected, as the scale is kept in check by native predators; however, there are no predators of the scale in areas where it is newly introduced (Howard et al. 1999, p. 15). Release of biocontrols has been attempted to abate the scale infestation; however, these were unsuccessful: *Rhyzobius lophanthae* in 2004, which established immediately; *Coccobius fulvus* in 2005, which did not establish; and *Aphytis lignanensis* in 2012, which died in the laboratory prior to release (Moore et al. 2006, in litt.). *Rhyzobius lophanthae* prolonged the survival of many *Cycas* trees during the first 6 years of scale infestation; however, with time, the size difference between the scale and *R. lophanthae* proved to be a problem when it was observed that the scale could find locations on the *Cycas* plant body that the predator (*R. lophanthae*) could not access (Marler and Moore 2010, p. 838). Even with this biocontrol, *Cycas micronesica* populations are still declining and no reproduction has been observed on Guam since 2005 (Moore et al. 2006, in litt.).

Ant Predation on Butterflies—Four species of nonnative ants have been observed to prey upon the Mariana eight-spot butterfly (Schreiner and Nafus 1996, p. 3) and are believed to also negatively impact the Mariana wandering butterfly, the two butterfly species proposed for listing as endangered species in this rule: (1) dwarf pedicel ants (*Tapinoma minutum*); (2) tropical fire ants (*Solenopsis geminata*); (3) white-footed ants (*Technomyrmex albipes*); and (4) bi-colored trailing ants (*Monomorium floricola*). These ants parasitize the butterfly eggs (Schreiner and Nafus 1996, p. 3). Many ant species are known to prey on all immature stages of Lepidoptera and can completely exterminate populations (Zimmerman 1958). In a 1-year study, Schreiner and Nafus (1996, pp. 3–4) found predation by nonnative ants to be one of the primary causes of mortality (over 90 percent) in the Mariana eight-spot butterfly. These four ant species occur on the islands of Guam, Rota, and Saipan, which support the two butterfly species. Biologists observed high mortality of the instar larval stages of the Mariana eight-spot butterfly (Schreiner and Nafus 1996, pp. 2–4), for unknown reasons, but this, compounded with predation of eggs by ants, negatively impacts both the Mariana eight-spot butterfly and the Mariana wandering butterfly.

Parasitic Wasp Predation on Butterflies—Two native parasitoid wasps, *Telenomus sp.* (no common name) and *Ooencyrtus* sp. (no common name), are known to lay their eggs in eggs of native Mariana Islands Lepidoptera species (Mariana eight-spot butterfly (Guam and Saipan) and Mariana wandering butterfly (Guam and Rota) (Schreiner and Nafus 1996, pp. 2–5). These wasps are tiny and likely hitch-hiked with adult female butterflies in order to access freshly laid eggs, as has been observed in related species (Woelke 2008). These wasps negatively impact the Mariana eight-spot and Mariana wandering butterflies because they lay their own eggs within the butterfly eggs, thus preventing caterpillar development. Habitat destruction and loss of host plants, along with continued parasitism, act together to negatively affect populations and individuals of the Mariana eight-spot butterfly and the Mariana wandering butterfly. These parasitoid wasps occur on the three islands (Guam, Rota, and Saipan) that support the Mariana eight-spot butterfly and the Mariana wandering butterfly proposed for listing as endangered species.

Conservation Efforts To Reduce Disease or Predation

Conservation efforts to reduce predation mirror those mentioned under Factor A. *Habitat Destruction, Modification, or Curtailment of Its Range* (see ''Conservation Efforts To Reduce Habitat Destruction, Modification, or Curtailment of Its Range,'' above).

Summary of Disease and Predation

We are unaware of any information that indicates that disease is a threat to any of the 23 species in this proposed rule.

Although conservation measures are in place in some areas where one or more of the 23 Mariana Islands species occurs, information does not indicate that they are ameliorating the threat of predation described above. Therefore, we consider predation by nonnative animal species (pigs, deer, rats, brown tree snakes, monitor lizards, slugs, ants, and wasps) to pose an ongoing threat to 17 of 23 species addressed in this proposed rule (see Table 3, above) throughout their ranges for the following reasons:

(1) Observations and reports have documented that pigs and deer browse and trample 5 of the 23 plant species (*Cycas micronesica, Eugenia bryanii, Heritiera longipetiolata, Psychotria malaspinae,* and *Solanum guamense*), and the host plants of the Mariana eight-spot butterfly, addressed in this rule (see Table 3), in addition to studies demonstrating the negative impacts of ungulate browsing and trampling on native plant species of the islands (Spatz and Mueller-Dombois 1973, p. 874; Diong 1982, pp. 160–161; Cuddihy and Stone 1990, p. 67).

(2) Nonnative rats, snakes, and monitor lizards prey upon one or more of the following 6 animal species addressed in this proposed rule: the Pacific sheath-tailed bat, Slevin's skink, and the four tree snails.

(3) Ants and wasps prey upon the eggs and larvae of the two butterflies, the Mariana eight-spot butterfly and Mariana wandering butterfly.

(4) Nonnative slugs cause mechanical damage to plants and destruction of plant parts (branches, fruits, and seeds), including orchids, and are considered a threat to 4 of the 14 plant species in this rule (*Bulbophyllum guamense, Dendrobium guamense, Nervilia jacksoniae,* and *Tuberolabium guamense*).

(5) *Cycas micronesica* is currently preyed upon by the cycad aulacaspis scale on three of the five Micronesian islands (Guam, Rota, and Palau) on which it occurs (Hill et al. 2004, pp. 274 – 298; Marler and Lawrence 2012, p. 233; Marler 2012, pers. comm.). This scale has the ability to severely impact or even extirpate *C. micronesica* throughout its range if not abated.

These threats are serious and ongoing, act in concert with other threats to the species and their habitats, and are expected to continue or increase in magnitude and intensity into the future without effective management actions to control or eradicate them.

Factor D. The Inadequacy of Existing Regulatory Mechanisms

The Mariana Islands encompass two different political entities, the U.S. Territory of Guam and the U.S.

Commonwealth of the Northern Mariana Islands, and issues regarding existing regulatory measures for each entity are discussed in separate paragraphs below.

U.S. Territory of Guam

We are aware of regulatory measures regarding conservation of natural resources established by the Government of Guam (GovGuam). Under Guam Annotated Rules (GAR) Title 9—Animal Regulations (9 GAR—Animal Regulations), there are two divisions: (1) Division 1: Care and Conservation of Animals, and (2) Division 2: Conservation, Hunting and Fishing Regulations (*www.guamcourts.com,* accessed 9 Feb 2014). Division 1 addresses the importation of animals, animal and zoonotic disease control, commercial quarantine regulations, and plant and non-domestic animal quarantine; however, there is no documentation as to what extent this regulation is enforced. Division 2 Chapter 63 covers fish, game, forestry, and conservation. Article 2 (sections 63201 through 63208) describe authorities under the Endangered Species Act of Guam (Act). This Article vests regulatory power in the Guam Department of Agriculture. The Act prohibits, with respect to any threatened or endangered species of plants or wildlife of Guam and the United States: (1) Import or export of any such species to or from Guam and its territory; (2) take of any such species within Guam and its territory; (3) possession, processing, selling or offering for sale, delivery, carrying, transport, or shipping, by any means whatsoever, any such species; provided that any person who has in his possession such plants or wildlife at the time this provision is enacted into law may retain, process, or otherwise dispose of those plants or wildlife already in his possession, and (4) violation of any regulation or rule pertaining to the conservation, protections, enhancement, or management of any designated threatened or endangered species.

As of 2009 (the currently posted list), Guam DAWR recognizes 6 of the 23 species as endangered (the plant *Heritiera longipetiolata;* 3 of the 4 tree snails (the Guam tree snail, the humped tree snail, and the fragile tree snail), the Pacific sheath-tailed bat, and Slevin's skink). The other 17 species on Guam proposed here for listing are not currently recognized under the Endangered Species Act of Guam, but will be recognized as requiring protection by the Act upon their listing as endangered or threatened. However, this Act does not address the threats imposed upon the 21 species that occur currently or historically on Guam that are ongoing and are expected to increase in magnitude in the near future (Langford's tree snail and the Rota blue damselfly are the only species addressed in this rule with no record of occurrence on Guam). Only three species addressed in this proposed rule currently benefit from conservation actions on Guam, those conducted by the Guam PEPP for *Heritiera longipetiolata, Maesa walkeri,* and *Psychotria malaspinae,* as discussed in ''Conservation Efforts To Reduce Habitat Destruction, Modification, or Curtailment of Its Range,'' above. Under Guam's ESA, the Department of Agriculture is authorized to establish priorities for the conservation and protection of threatened and endangered species and their associated ecosystems, but we are unaware of any documentation of these priorities or actions conducted for protection of the 21 Guam species.

U.S. Commonwealth of the Northern Mariana Islands (CNMI)

The CNMI has multiple regulatory measures in place intended to protect natural resources (*www.cnmilaw.org,* accessed 9 Feb 2014 (CNMI 2014, in litt.)). Six Chapters under Title 85: Department of Land and Natural Resources, encompass the most relevant regulatory measures with respect to the 16 CNMI species addressed in this proposed rule (*www.cnmilaw.org,* accessed 9 Feb 2014). Chapter 85–20 addresses animal quarantine rules and regulations, including domestic animals of all types, and associated port of entry laws. Chapter 95–30 addresses noncommercial fish and wildlife regulations, including the List of Protected Wildlife and Plant Species in the CNMI, which includes 1 of the 23 species addressed in this proposed rule (the plant *Tabernaemontana rotensis*). Chapter 95–30 also covers CNMI conservation areas. Chapter 85–60 covers the Division of Plant Industry, including plant quarantine regulations. Chapter 85–80 covers the Division of Zoning. Chapter 85–90 addresses permits necessary for the clearing and burning of vegetation, and removal of plants or plant products, or soil, from areas designated as diverse forests on public lands. Chapter 85–100 addresses BTS prevention regulations.

All six Chapters under Title 85 mentioned above have a component that is designed to protect native species, including rare species at risk from competition and predation by nonnative, and in some cases native, species. However, these regulations are modestly enforced and are currently inadequate to protect the 16 CNMI species in this proposed rule. Nonnative animals and plants have spread throughout the island chain despite these laws being in place. Greater enforcement of local laws in place may provide additional benefit to the 16 species proposed for listing as endangered or threatened species in this rule that occur in the CNMI (the plants *Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Tabernaemontana rotensis,* and *Tuberolabium guamense;* the humped tree snail, Langford's tree snail, and the fragile tree snail; the two butterflies, the Pacific sheath-tailed bat, Slevin's skink, and the Rota blue damselfly).

U.S. Department of Defense (DOD)

The Sikes Act (16 U.S.C. 670) authorizes the Secretary of Defense to develop cooperative plans with the Secretaries of Agriculture and the Interior for natural resources on public lands. The Sikes Act Improvement Act of 1997 requires DOD installations to prepare Integrated Natural Resource Management Plans (INRMPs) that provide for the conservation and rehabilitation of natural resources on military lands consistent with the use of military installations to ensure the readiness of the Armed Forces.

In June 2013, the Department of the Navy, Joint Region Marianas (JRM), completed an INRMP to address the conservation, protection, and management of fish and wildlife resources on DOD-managed and -controlled areas on Guam, specifically Naval Base Guam and Andersen Air Force Base, including leased lands in the CNMI on Tinian and Farallon de Medinilla. On July 2, 2013, the Navy requested the Service's endorsement of the JRM INRMP. To determine if an INRMP provides a conservation benefit to listed species, the Service must consider: (1) The extent of area and features present; (2) the type and frequency of use of the area by the species; (3) the relevant elements of the INRMP in terms of management objectives, activities covered, and best management practices, and the certainty that the relevant elements will be implemented; and (4) the degree to which the relevant elements of the INRMP will protect the habitat from the types of effects that would be addressed through a destruction-or-adverse-modification analysis. The JRM INRMP is under review by the Service, but at present the Navy is operating under an INRMP that has not yet been approved

by the Service as providing a conservation benefit to the species considered for listing here that are associated with DOD lands or activities.

Summary of the Inadequacy of Existing Regulatory Mechanisms

Both the U.S. Territory of Guam and the U.S. Commonwealth of the Northern Mariana Islands have regulations in place designed to provide protection for their respective natural resources, including native forests, water resources, and the 23 species addressed in this rule; however, enforcement of these regulations is not documented. DOD is partnering with other agencies to prevent inadvertent transport of deleterious species (the brown tree snake) into Guam and the Mariana Islands, and from Guam to other areas; however, the current conservation actions proposed in the 2013 INRMP have not been determined to provide a benefit to the Mariana Islands species considered here, and threats imposed upon the 23 species persist and are expected to increase in magnitude (see Table 3). Examples include continued development and habitat modification, spread and introduction of nonnative plants and animals throughout the islands, fires started by hunters, sales of tree snail shells, and predation and herbivory by nonnative animals.

The capacity of the U.S. Territory of Guam and the U.S. Commonwealth of the Northern Mariana Islands and other Federal and State agencies in the Mariana Islands to mitigate the effects of introduced pests, such as ungulates and weeds, is limited due to the large number of taxa currently causing damage. Resources available to reduce the spread of these species and counter their negative ecological effects are limited. Despite the fact that both GovGuam and the CNMI receive assistance from the USDA, U.S. Department of Homeland Security, and other Federal agencies, the scope of threats remains challenging.

Factor E. Other Natural or Manmade Factors Affecting Their Continued Existence

Other factors that pose threats to some or all of the 23 species include ordnance and live-fire training, water extraction, recreational off-road vehicles, and small numbers of populations and small population sizes. Each threat is discussed in detail below, along with identification of which species are affected by these threats.

Ordnance and Live-Fire Training

Several individuals of the plants *Cycas micronesica* and *Heritiera longipetiolata,* proposed for listing as threatened and endangered species (respectively) in this rule, are located on the Tarague ridgeline near a firing range on Andersen AFB. There is a buffer zone at the end of the range, but not to either side. Ricochet bullets and ordnance have broken branches and made holes through parts of these trees, causing added stress and a possible avenue for disease (Guam DAWR 2013, pers. comm.). Military training is expected to be conducted within 5 Live-Fire Training Ranges (incorporating a Multi-Purpose Machine Gun Range), for 39 weeks out of the year, with 2 night-trainings per week (NavFac Engineering Command Pacific 2014, pp. ES–1, ES–5). Depending on the type of ammunition used, there could be substantial damage to vegetation, or a possible fire started from ordnance use, which could destroy individuals of *Cycas micronesica* and *Heritiera longipetiolata* and their habitat.

Water Extraction

The Rota blue damselfly was only first discovered in April 1996, outside the Talakhaya Water Cave (also known as Sonson Water Cave) located below the Sabana plateau on the island of Rota (see the species' description, above) (Polhemus et al. 2000, pp. 1–8; Camacho et al. 1997, p. 4). The Talakhaya Water Cave, As Onon Spring, and the perennial stream formed from runoff from the springs at the Water Cave support the only known population of the Rota blue damselfly. Rota's municipal water is obtained by gravity flow from these two springs (up to 1.8 Mgal/day) (Keel et al. 2007, pp. 1, 5; Stafford et al. 2002, p. 17). Under ordinary climatic conditions, this area supplies water in excess of demand but ENSO-induced drought conditions can lead to significantly reduced discharge, or may completely dewater the streams (Keel et al. 2007, pp. 3, 6, 19). In 1998, water captured from the springs was inadequate for municipal use, and water rationing was instituted (Keel et al. 2007, p. 6).

As the annual temperature rises resulting from global climate change, other weather regime changes such as increases in droughts, floods, and typhoons will occur (Giambelluca et al. 1991, p. iii). Increasing night temperatures cause a change in mean precipitation, with increased occurrences of drought cycles (Loope and Giambelluca 1998, pp. 514–515; Emanuel et al. 2008, p. 365; U.S. Global Change Research Program (US–GCRP) 2009, pp. 145–149, 153; Keener et al. 2010, pp. 25–28; Finucane et al. 2012, pp. 23–26; Keener et al. 2012, pp. 47–51). The limestone substrate of Rota is porous, with filtration through central Sabana being the sole water source for the few streams on the island and for human use. There are no other ground water supplies on the island, and storage capacity is limited. The Rota blue damselfly is dependent upon any water that escapes the Talakhaya Springs naturally, what is not already removed for human use. The likelihood of dewatering of the Talakhaya Springs is high due to climate change causing increased ENSO conditions, and increased human demand. The ''Public and Agency Participation'' section of the Comprehensive Wildlife Conservation Strategy for the Commonwealth of the Northern Mariana Islands (2005, p. 347) cites ''individuals state that the Department of Public Works has been increasing their water extraction from Rota's spring/stream systems. Historically, this water source flowed year-around, yet now they are essentially dry most of each year'' (see the species description ''Rota blue damselfly,'' and ''Stream Ecosystem,'' above, for further discussion). Water extraction is an ongoing threat to the Rota blue damselfly. The loss of this perennial stream would remove the only known breeding and foraging habitat of the sole known population of the Rota blue damselfly, likely leading to its extinction.

Recreational Vehicles

The savanna areas of Guam are popular for use of recreational vehicles. Damage and destruction caused by these vehicles are a direct threat to the plants *Hedyotis megalantha* and *Phyllanthus saffordii,* proposed for listing as endangered species in this rule, as well as a threat to the savanna habitat that supports these plant species (Guiterrez 2013, in litt.; Guam DAWR 2013, pers. comm.). *Hedyotis megalantha* and *P. saffordii* are particularly at risk, as the only known individuals of these species are scattered on the savanna.

Small Numbers of Individuals and Populations

Species that are endemic to single islands are inherently more vulnerable to extinction than are widespread species, because of the increased risk of genetic bottlenecks, random demographic fluctuations, climate change effects, and localized catastrophes, such as typhoons and disease outbreaks (Pimm et al. 1988, p. 757; Mangel and Tier 1994, p. 607). These problems are further magnified when populations are few and restricted to a very small geographic area, and when the number of individuals in each

population is very small. Species with these population characteristics face an increased likelihood of extinction due to changes in demography, the environment, genetic bottlenecks, or other factors (Gilpin and Soulé 1986, pp. 24–34). Small, isolated populations often exhibit reduced levels of genetic variability, which diminishes the species' capacity to adapt and respond to environmental changes, thereby lessening the probability of long-term persistence (Barrett and Kohn 1991, p. 4; Newman and Pilson 1997, p. 361). Very small, isolated populations are also more susceptible to reduced reproductive vigor due to ineffective pollination (plants), inbreeding depression (plants and animals), and hybridization (plants and insects). The problems associated with small population size and vulnerability to random demographic fluctuations or natural catastrophes are further magnified by synergistic interactions with other threats, such as those discussed above (see *Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range* and *Factor C. Disease or Predation,* above).

Plants—In the 1990s, individuals of *Tabernaemontana rotensis* were vandalized and set on fire (Mehrhoff 2014, in litt.). Because this species is limited in its range, and is vulnerable to any vandalism, we consider vandalism to be a significant threat throughout its range.

The following 5 plant species have a very limited number of individuals (fewer than 50) in the wild: *Maesa walkeri, Psychotria malaspinae, Solanum guamense, Tinospora homosepala,* and *Tuberolabium guamense.* We consider these species highly vulnerable to extinction due to threats associated with small population size or small number of populations because:

- The only known occurrences of *Maesa walkeri, Psychotria malaspinae, Solanum guamense, Tinospora homosepala,* and *Tuberolabium guamense* are threatened either by ungulates, nonnative plants, fire, or a combination of these.
- *Psychotria malaspinae, Solanum guamense,* and *Tuberolabium guamense* are all known from fewer than 10 scattered individuals (Yoshioka 2008, p. 15; Cook 2012, in litt.; CPH 2012f—*Online Herbarium Database;* Harrington et al. 2012, in litt.; Grimm 2013, in litt.; Rogers 2012, in litt.; WCSP 2012d—*Online Herbarium Database*).

Animals—Like most native island biota, the single island endemics Guam tree snail, Langford's tree snail, and Rota blue damselfly are particularly sensitive to disturbances due to low number of individuals, low population numbers, and small geographic ranges. We consider these three species vulnerable to extinction due to the low number of individuals and low number of populations because these species occur on single islands, are declining in number of individuals and range, and are at risk of one or more of the following: predation by nonnative rats, monitor lizards, and flatworms; habitat degradation and destruction by nonnative ungulates; fire; drought; and water extraction (see *Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range* and *Factor C. Disease or Predation,* above).

Conservation Efforts To Reduce Other Natural or Manmade Factors Affecting Its Continued Existence

We are unaware of any conservation actions planned or implemented at this time to abate the threats to the species negatively impacted by water extraction (Rota blue damselfly), recreational vehicles (*Hedyotis megalantha* and *Phyllanthus saffordii*), or low numbers (the plants *Maesa walkeri, Psychotria malaspinae, Solanum guamense, Tinospora homosepala,* and *Tuberolabium guamense;* the Guam tree snail and Langford's tree snail; and the Rota blue damselfly).

Summary of Other Natural or Manmade Factors Affecting Their Continued Existence

We consider the threat from limited numbers of populations and low numbers of individuals (fewer than 50) to be serious and ongoing for 5 plant species addressed in this proposed rule (*Maesa walkeri, Psychotria malaspinae, Solanum guamense, Tinospora homosepala,* and *Tuberolabium guamense*) because: (1) These species may experience reduced reproductive vigor due to ineffective pollination or inbreeding depression; (2) they may experience reduced levels of genetic variability, leading to diminished capacity to adapt and respond to environmental changes, thereby lessening the probability of long-term persistence; and (3) a single catastrophic event (e.g., fire) may result in extirpation of remaining populations and extinction of the species. This threat applies to the entire range of each species.

The threat to the Guam tree snail, Langford's tree snail and Rota blue damselfly from limited numbers of individuals and populations is ongoing and is expected to continue into the future because population numbers of these species are so low that: (1) They may experience reduced reproductive vigor due to inbreeding depression; (2) they may experience reduced levels of genetic variability leading to diminished capacity to adapt and respond to environmental changes, thereby lessening the probability of long-term persistence; (3) a single catastrophic event (e.g., super typhoon) may result in extirpation of remaining populations and extinction of these species; and (4) species with few known locations are less resilient to threats that might otherwise have a relatively minor impact on widely distributed species. For example, an increase in predation of these species that might be absorbed in a widely distributed species could result in a significant decrease in survivorship or reproduction of a species with limited distribution. Additionally, the limited distribution of these species thus magnifies the severity of the impact of the other threats discussed in this proposed rule.

Summary of Factors

The primary factors that pose serious and ongoing threats to 1 or more of the 23 species throughout their ranges in this proposed rule include: Habitat degradation and destruction by development, activities associated with military training and urbanization, nonnative ungulates and plants, rats, fire, typhoons, and climate change, and the interaction of these threats (Factor A); overutilization of tree snails due to collection for trade or market (Factor B); predation by nonnative animal species (ungulates, deer, rats, brown tree snakes, monitor lizards, slugs, flatworms, ants, and wasps) (Factor C); inadequate regulatory mechanisms to address the spread or control of nonnative species (Factor D); and ordnance and live-fire training, water extraction, recreational vehicles, and limited numbers of populations and individuals (Factor E). While we acknowledge the voluntary conservation measures described above may help to ameliorate 1 or more of the threats to the 23 species addressed in this proposed rule, these conservation measures are insufficient to control or eradicate these threats to the point where listing is not warranted.

Proposed Determination

Section 4 of the Act (16 U.S.C. 1533), and its implementing regulations at 50 CFR part 424, set forth the procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, we may list a species based on (A) The present or threatened destruction,

modification, or curtailment of its habitat or range; (B) Overutilization for commercial, recreational, scientific, or educational purposes; (C) Disease or predation; (D) The inadequacy of existing regulatory mechanisms; or (E) Other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination.

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the 23 species proposed for listing as endangered or threatened species in this rule. We find all 23 species face threats that are ongoing and expected to continue into the future throughout their ranges from the present destruction and modification of their habitats from nonnative feral ungulates, rats, and nonnative plants (Factor A). Destruction and modification of habitat by development, military training, and urbanization is a threat to 13 of the 14 plant species (*Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Eugenia bryanii, Hedyotis megalantha, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordii, Psychotria malaspinae, Solanum guamense, Tabernaemontana rotensis,* and *Tuberolabium guamense*) and to 8 of the 9 animal species (the Pacific sheath-tailed bat, Slevin's skink, the Mariana eight-spot butterfly, the Rota blue damselfly, the Guam tree snail, the humped tree snail, Langford's tree snail, and the fragile tree snail). Habitat destruction and modification from fire is a threat to nine of the plant species (*Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Hedyotis megalantha, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordii, Tabernaemontana rotensis,* and *Tuberolabium guamense*) and two tree snails (the Guam tree snail and the humped tree snail). Destruction and modification of habitat from typhoons is a threat to all 23 species. Rising temperatures and other effects of projected climate change may impact all 23 species, but there is limited information on the exact nature of impacts that these species may experience (Factor A).

Overcollection for commercial and recreational purposes poses a threat to all four tree snail species (the Guam tree snail, the humped tree snail, Langford's tree snail, and the fragile tree snail) (Factor B).

Predation or herbivory on 9 of the 14 plant species (*Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Eugenia bryanii, Heritiera longipetiolata, Nervilia jacksoniae, Psychotria malaspinae, Solanum guamense,* and *Tuberolabium guamense*) and 8 of the 9 animals (all except the Rota blue damselfly) by feral pigs, deer, brown tree snakes, rats, monitor lizards, slugs, flatworms, ants, or wasps poses a serious and ongoing threat (Factor C).

The inadequacy of existing regulatory mechanisms (i.e., inadequate protection of habitat and inadequate protection from the introduction of nonnative species) poses a serious and ongoing threat to all 23 species (Factor D).

There are serious and ongoing threats to five plant species (*Maesa walkeri, Psychotria malaspinae, Solanum guamense, Tinospora homosepala,* and *Tuberolabium guamense*), the Guam tree snail, Langford's tree snail, the fragile tree snail, and Rota blue damselfly due to small numbers of populations and individuals; to *Tabernaemontana rotensis* due to vandalism; to *Cycas micronesica* and *Heritiera longipetiolata* from ordnance and live-fire training; to the Rota blue damselfly from water extraction; and to *Hedyotis megalantha* and *Phyllanthus saffordii* from recreational vehicles (Factor E) (see Table 3). These threats are exacerbated by these species' inherent vulnerability to extinction from stochastic events at any time because of their endemism, small numbers of individuals and populations, and restricted habitats.

The Act defines an endangered species as any species that is ''in danger of extinction throughout all or a significant portion of its range'' and a threatened species as any species ''that is likely to become endangered throughout all or a significant portion of its range within the foreseeable future.'' We find that 21 of the 23 Mariana Islands species are presently in danger of extinction throughout their entire range, based on the severity and scope of the ongoing and projected threats described above. These 21 species are: the 12 plants *Bulbophyllum guamense, Dendrobium guamense, Eugenia bryanii, Hedyotis megalantha, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordii, Psychotria malaspinae, Solanum guamense, Tinospora homosepala,* and *Tuberolabium guamense;* and all 9 animals: the Pacific sheath-tailed bat (*Emballonura semicaudata rotensis*), Slevin's skink (*Emoia slevini*), the Mariana eight-spot butterfly (*Hypolimnas octocula mariannensis*), the Mariana wandering butterfly (*Vagrans egistina),* the Rota blue damselfly (*Ischnura luta*), the Guam tree snail (*Partula radiolata*), the humped tree snail (*Partula gibba*), Langford's tree snail (*Partula langfordi*), and the fragile tree snail (*Samoana fragilis*).

We conclude these 21 species are endangered due to the small number of individuals representing the entire species and the limited or concentrated geographic distribution of those remaining individuals or populations, rendering the species in its entirety highly susceptible to extinction as a consequence of these imminent threats. These threats are exacerbated by the loss of redundancy and resiliency of these species, and the continued inadequacy of existing protective regulations. Therefore, on the basis of the best available scientific and commercial information, we have determined that each of these 21 species meets the definition of an endangered species under the Act. We find that threatened species status is not appropriate for these 21 species, as the threats are already occurring rangewide and are not localized, and because the threats are ongoing and expected to continue into the future. In addition, the remaining populations of these species are so small that we cannot conclude they are likely capable of persisting into the foreseeable future in the face of the current threats. We, therefore, propose to list these 21 species as endangered species in accordance with section 3(6) of the Act.

As noted above, the Act defines a threatened species as any species ''that is likely to become endangered throughout all or a significant portion of its range within the foreseeable future.'' We propose to list two plant species as threatened species in accordance with section 3(6) of the Act, *Cycas micronesica* and *Tabernaemontana rotensis. Cycas micronesica* occurs on Guam, Rota, and Pagan in the CNMI, as well as on islands in the nations of Palau and Yap. More than 50 percent of the known individuals occur on Guam and Rota in the CNMI, and are currently impacted by the cycad aulacaspis scale, to the extent that botanists estimate the species could be largely extirpated from these two islands within 5 years, by 2019. The status of the species on Pagan is unknown, although only a small population is known from that island. While the scale has reached the larger islands of Palau, it has not yet reached the Rock Islands of Palau, or Yap, and these islands may afford some temporary protection for the remaining individuals while control methods and biocontrols for the cycad aulacaspis scale are undergoing research. Due to the rapid spread of the scale and associated high mortality, however, populations in Palau and Yap remain

highly vulnerable. Given its relatively greater population size and distribution on multiple islands, some of which have not yet been affected by the cycad aulacaspis scale, we conclude that *Cycas micronesica* is not currently in danger of extinction, thus endangered status is not appropriate. However, given the observed rapid spread of the cycad aulacaspis scale, the likelihood that the scale will soon be transported to areas that are currently unaffected, and the high mortality rate experienced by *Cycas micronesica* upon exposure to the scale, we conclude that *Cycas micronesica* is likely to become in danger of extinction within the foreseeable future. Therefore, on the basis of the best available scientific and commercial information, we propose that this species meets the definition of a threatened species under the Act.

Tabernaemontana rotensis was, until recently, believed to be part of the wider ranging *T. pandacaqui,* until genetic studies showed it to be unique to Guam and Rota. There may be as many as 8,000 individuals on Guam, but only a few on Rota; however, the threats of habitat destruction and modification, fire, typhoons, climate change, and inadequate regulatory mechanisms have a combined impact on all occurrences, to the extent that we believe it is likely to become in danger of extinction within the foreseeable future throughout all of its range. Because *Tabernaemontana rotensis* species still has a relatively large number of individuals, even in the face of current threats, we conclude the species will likely persist into the foreseeable future. As we do not conclude that *Tabernaemontana rotensis* is currently in danger of extinction, endangered status is not appropriate. However, because the species has been reduced to only a few individuals on Rota, and the remaining population on Guam is subject to a suite of ongoing threats as described above, we conclude that *Tabernaemontana rotensis* will become in danger of extinction within the foreseeable future. Therefore, on the basis of the best available scientific and commercial information, we propose that this species meets the definition of a threatened species under the Act.

Under the Act and our implementing regulations, a species may warrant listing if it is endangered or threatened throughout all or a significant portion of its range. Each of the 23 Mariana Islands species proposed for listing in this rule is highly restricted in its range, and the threats occur throughout its range. Therefore, we assessed the status of each species throughout its entire range. In each case, the threats to the survival of these species occur throughout the species' ranges and are not restricted to any particular portion of those ranges. Accordingly, our assessment and proposed determination applies to each species throughout its entire range, and we do not need to further consider the status of each species in a significant portion of their respective ranges.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing results in public awareness, and conservation by Federal, State, and local agencies, private organizations, and individuals. The Act encourages cooperation with the States and territories and requires that recovery actions be carried out for all listed species. The protection required by Federal agencies and the prohibitions against certain activities are discussed, in part, below.

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act requires the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline shortly after a species is listed and preparation of a draft and final recovery plan. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to be used to develop a recovery plan. Revisions of the plan may be done to address continuing or new threats to the species, as new substantive information becomes available. The recovery plan identifies site-specific management actions that set a trigger for review of the five factors that control whether a species remains endangered or may be downlisted or delisted, and methods for monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (composed of species experts, Federal and State agencies, nongovernmental organizations, and stakeholders) are often established to develop recovery plans. When completed, the recovery outline, draft recovery plan, and the final recovery plan will be available on our Web site (*http://www.fws.gov/endangered*), or from our Pacific Islands Fish and Wildlife Office (see **FOR FURTHER INFORMATION CONTACT**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, territories, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (e.g., restoration of native vegetation), research, captive propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. To achieve recovery of these species requires cooperative conservation efforts on all lands.

If these species are listed, funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost share grants for non-Federal landowners, the academic community, and nongovernmental organizations. In addition, pursuant to section 6 of the Act, the State(s) of the U.S. Territory of Guam and the U.S. Commonwealth of the Northern Mariana Islands would be eligible for Federal funds to implement management actions that promote the protection or recovery of the 23 species. Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants.*

Although these species are only proposed for listing under the Act at this time, please let us know if you are interested in participating in recovery efforts for any of these species. Additionally, we invite you to submit any new information on these species whenever it becomes available and any information you may have for recovery planning purposes (see **FOR FURTHER INFORMATION CONTACT**).

Section 7(a) of the Act requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as an endangered or threatened species and with respect to its critical habitat, if any is designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part

402. Section 7(a)(4) of the Act requires Federal agencies to confer with the Service on any action that is likely to jeopardize the continued existence of a species proposed for listing or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species or destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into consultation with the Service.

For the 23 plants and animals proposed for listing as endangered or threatened species in this rule, Federal agency actions that may require consultation as described in the preceding paragraph include, but are not limited to, actions within the jurisdiction of the Natural Resources Conservation Service, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and branches of the DOD. Examples of these types of actions include activities funded or authorized under the Farm Bill Program, Environmental Quality Incentives Program, Ground and Surface Water Conservation Program, Clean Water Act (33 U.S.C. 1251 et seq.), Partners for Fish and Wildlife Program, and DOD activities related to training, facilities construction and maintenance, or other military missions.

The Act and its implementing regulations set forth a series of general prohibitions and exceptions that apply to all endangered and threatened wildlife and plants. The prohibitions, codified at 50 CFR 17.21 for endangered wildlife, and at 17.61 and 17.71 for endangered and threatened plants, respectively, apply. For listed wildlife species, these prohibitions, in part, make it illegal for any person subject to the jurisdiction of the United States to take (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt any of these), import, export, ship in interstate commerce in the course of commercial activity, or sell or offer for sale in interstate or foreign commerce any listed species. Under the Lacey Act (18 U.S.C. 42–43; 16 U.S.C. 3371–3378), it is also illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. Certain exceptions apply to agents of the Service and State conservation agencies.

With respect to endangered plants, prohibitions outlined at 50 CFR 17.61 make it illegal for any person subject to the jurisdiction of the United States to import or export, transport in interstate or foreign commerce in the course of a commercial activity, sell or offer for sale in interstate or foreign commerce, or to remove and reduce to possession any such plant species from areas under Federal jurisdiction. In addition, for endangered plants, the Act prohibits malicious damage or destruction of any such species on any area under Federal jurisdiction, and the removal, cutting, digging up, or damaging or destroying of any such species on any other area in knowing violation of any State law or regulation, or in the course of any violation of a State criminal trespass law. Exceptions to these prohibitions are outlined in 50 CFR 17.62.

With respect to threatened plants, 50 CFR 17.71 provides that all of the provisions in 50 CFR 17.61 shall apply to threatened plants. These provisions make it illegal for any person subject to the jurisdiction of the United States to import or export, transport in interstate or foreign commerce in the course of a commercial activity, sell or offer for sale in interstate or foreign commerce, or to remove and reduce to possession any such plant species from areas under Federal jurisdiction. In addition, the Act prohibits malicious damage or destruction of any such species on any area under Federal jurisdiction, and the removal, cutting, digging up, or damaging or destroying of any such species on any other area in knowing violation of any State law or regulation, or in the course of any violation of a State criminal trespass law. However, there is the following exception for threatened plants. Seeds of cultivated specimens of species treated as threatened shall be exempt from all the provisions of 50 CFR 17.61, provided that a statement that the seeds are of ''cultivated origin'' accompanies the seeds or their container during the course of any activity otherwise subject to these regulations. Exceptions to these prohibitions are outlined in 50 CFR 17.72.

We may issue permits to carry out otherwise prohibited activities involving endangered and threatened wildlife and plant species under certain circumstances. Regulations governing permits are codified at 50 CFR 17.22 for endangered wildlife and at 17.62 and 17.72 for endangered and threatened plants, respectively. With regard to endangered wildlife, a permit must be issued for the following purposes: for scientific purposes, to enhance the propagation or survival of the species, and for incidental take in connection with otherwise lawful activities. With regard to endangered plants, the Service may issue a permit authorizing any activity otherwise prohibited by 50 CFR 17.61 for scientific purposes or for enhancing the propagation or survival of endangered plants. With regard to threatened plants, a permit issued under this section must be for one of the following: scientific purposes, the enhancement of the propagation or survival of threatened species, economic hardship, botanical or horticultural exhibition, educational purposes, or other activities consistent with the purposes and policy of the Act. Requests for copies of the regulations regarding listed species and inquiries about prohibitions and permits may be addressed to U.S. Fish and Wildlife Service, Pacific Region, Ecological Services, Eastside Federal Complex, 911 NE. 11th Avenue, Portland, OR 97232–4181 (telephone 503–231–6131; facsimile 503–231–6243).

Our policy, as published in the **Federal Register** on July 1, 1994 (59 FR 34272), is to identify to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act. The intent of this policy is to increase public awareness of the effect of a proposed listing on proposed and ongoing activities within the range of species proposed for listing. The following activities could potentially result in a violation of section 9 of the Act; this list is not comprehensive:

(1) Unauthorized collecting, handling, possessing, selling, delivering, carrying, or transporting of the 23 species, including import or export across State, Territory or Commonwealth lines and international boundaries, except for properly documented antique specimens of these taxa at least 100 years old, as defined by section 10(h)(1) of the Act;

(2) Introduction of nonnative species that compete with or prey upon the nine animal species, such as the introduction of competing, nonnative plants or animals to the Mariana Islands (U.S. Territory of Guam and U.S. Commonwealth of the Northern Mariana Islands); and

(3) The unauthorized release of biological control agents that attack any life stage of the nine animal species.

(4) Impacts to the nine animal species from destruction of habitat, disturbance from noise (related to military training), and other impacts from military presence.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the Pacific Islands Fish and Wildlife Office (see **FOR FURTHER INFORMATION**

CONTACT). Requests for copies of the regulations concerning listed animals and general inquiries regarding prohibitions and permits may be addressed to the U.S. Fish and Wildlife Service, Pacific Region, Ecological Services, Endangered Species Permits, Eastside Federal Complex, 911 NE. 11th Avenue, Portland, OR 97232–4181 (telephone 503–231–6131; facsimile 503–231–6243).

If made final, Federal listing of the 23 species included in this proposed rule may invoke Commonwealth and Territory listing under CNMI and Guam Endangered Species laws (Title 85: § 85–30.1–101 and 5 GCA § 63205, respectively) and supplement the protection available under other local law. These protections would prohibit take of these species and encourage conservation by both government agencies. Further, the governments would be able to enter into agreements with Federal agencies to administer and manage any area required for the conservation, management, enhancement, or protection of endangered species. Funds for these activities could be made available under section 6 of the Act (Cooperation with the States and Territories). Thus, the Federal protection afforded to these species by listing them as endangered species would be reinforced and supplemented by protection under Territorial and Commonwealth law.

Required Determinations

Clarity of the Rule

We are required by Executive Orders 12866 and 12988 and by the Presidential Memorandum of June 1, 1998, to write all rules in plain language. This means that each rule we publish must:

(1) Be logically organized;

(2) Use the active voice to address readers directly;

(3) Use clear language rather than jargon;

(4) Be divided into short sections and sentences; and

(5) Use lists and tables wherever possible.

If you feel that we have not met these requirements, send us comments by one of the methods listed in **ADDRESSES**. To better help us revise the rule, your comments should be as specific as possible. For example, you should tell us the numbers of the sections or paragraphs that are unclearly written, which sections or sentences are too long, the sections where you feel lists or tables would be useful, etc.

National Environmental Policy Act (42 U.S.C. 4321 et seq.)

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 et seq.), need not be prepared in connection with listing a species as an endangered or threatened species under the Endangered Species Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

References Cited

A complete list of references cited in this rulemaking is available on the Internet at *http://www.regulations.gov* and upon request from the Pacific Islands Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this proposed rule are the staff members of the Pacific Islands Ecological Services Field Office.

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Proposed Regulation Promulgation

Accordingly, we propose to amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as set forth below:

PART 17—[AMENDED]

■ 1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 1531–1544; and 4201–4245; unless otherwise noted.

■ 2. Amend § 17.11(h), the List of Endangered and Threatened Wildlife, as follows:

■ a. By adding an entry for ''Bat, Pacific sheath-tailed'' (*Emballonura semicaudata rotensis*), in alphabetical order under Mammals, to read as set forth below;

■ b. By adding an entry for ''Skink, Slevin's'' (*Emoia slevini*), in alphabetical order under Reptiles, to read as set forth below;

■ c. By adding an entry for ''Butterfly, Mariana eight-spot'' (*Hypolimnas octocula mariannensis*), ''Butterfly, Mariana wandering'' (*Vagrans egistina*), and ''Damselfly, Rota blue'' (*Ischnura luta*), in alphabetical order under Insects, to read as set forth below; and

■ d. By adding an entry for ''Snail, fragile tree'' (*Samoana fragilis*)'', ''Snail, Guam tree'' (*Partula radiolata*), ''Snail, humped tree'' (*Partula gibba*), and ''Snail, Langford's tree'' (*Partula langfordi*), in alphabetical order under Snails, to read as set forth below.

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
MAMMALS							
*	*	*	*	*	*	*	
Bat, Pacific sheath-tailed (Payesyes).	*Emballonura semicaudata rotensis.*	U.S.A. (Guam, Mariana Islands).	Entire	E	.....	NA	NA
*	*	*	*	*	*	*	
REPTILES							
*	*	*	*	*	*	*	
Skink, Slevin's (Guali'ek Halom Tano).	*Emoia slevini*	U.S.A. (Guam, Mariana Islands).	Entire	E	.....	NA	NA

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
*	*	*	*	*	*	*	
INSECTS							
*	*	*	*	*	*	*	
Butterfly, Mariana eight-spot.	*Hypolimnas octocula mariannensis.*	U.S.A. (Guam, Mariana Islands).	Entire	E		NA	NA
Butterfly, Mariana wandering.	*Vagrans egistina*	U.S.A. (Guam, Mariana Islands).	Entire	E		NA	NA
*	*	*	*	*	*	*	
Damselfly, Rota blue	*Ischnura luta*	U.S.A. (Mariana Islands).	Entire	E		NA	NA
*	*	*	*	*	*	*	
SNAILS							
*	*	*	*	*	*	*	
Snail, fragile tree (Akaleha).	*Samoana fragilis*	U.S.A. (Guam, Mariana Islands).	Entire	E		NA	NA
*	*	*	*	*	*	*	
Snail, Guam tree (Akaleha).	*Partula radiolata*	U.S.A. (Guam)	Entire	E		NA	NA
Snail, humped tree (Akaleha).	*Partula gibba*	U.S.A. (Guam, Mariana Islands).	Entire	E		NA	NA
*	*	*	*	*	*	*	
Snail, Langford's tree (Akaleha).	*Partula langfordi*	U.S.A. (Mariana Islands).	Entire	E		NA	NA
*	*	*	*	*	*	*	

* * * * *

■ 3. Amend § 17.12(h), the List of Endangered and Threatened Plants, by adding entries for *Bulbophyllum guamense, Cycas micronesica, Dendrobium guamense, Eugenia bryanii, Hedyotis megalantha, Heritiera longipetiolata, Maesa walkeri, Nervilia jacksoniae, Phyllanthus saffordii, Psychotria malaspinae, Solanum guamense, Tabernaemontana rotensis, Tinospora homosepala,* and *Tuberolabium guamense,* in alphabetical order under Flowering Plants, to read as set forth below.

§ 17.12 Endangered and threatened plants.

* * * * *

(h) * * *

Species		Historic range	Family	Status	When listed	Critical habitat	Special rules
Scientific name	Common name						
FLOWERING PLANTS							
*	*	*	*	*	*	*	
Bulbophyllum guamense.	Cebello halumtano	U.S.A. (Guam, Mariana Islands).	Orchidaceae	E		NA	NA
*	*	*	*	*	*	*	
Cycas micronesica	Fadang	U.S.A. (Guam, Mariana Islands).	Cycadaceae	T		NA	NA
*	*	*	*	*	*	*	
Dendrobium guamense.	None	U.S.A. (Guam, Mariana Islands).	Orchidaceae	E		NA	NA
*	*	*	*	*	*	*	
Eugenia bryanii	None	U.S.A. (Guam)	Myrtaceae	E		NA	NA
*	*	*	*	*	*	*	
Hedyotis megalantha	Paudedo	U.S.A. (Guam)	Rubiaceae	E		NA	NA
*	*	*	*	*	*	*	
Heritiera longipetiolata.	Ufa-halomtano	U.S.A. (Guam, Mariana Islands).	Malvaceae	E		NA	NA

Species		Historic range	Family	Status	When listed	Critical habitat	Special rules
Scientific name	Common name						
*	*	*	*	*	*	*	
Maesa walkeri	None	U.S.A. (Guam, Mariana Islands).	Primulaceae	E		NA	NA
*	*	*	*	*	*	*	
Nervilia jacksoniae	None	U.S.A. (Guam, Mariana Islands).	Orchidaceae	E		NA	NA
*	*	*	*	*	*	*	
Phyllanthus saffordii	None	U.S.A. (Guam)	Phyllanthaceae	E		NA	NA
*	*	*	*	*	*	*	
Psychotria malaspinae.	Aplokating-palaoan	U.S.A. (Guam)	Rubiaceae	E		NA	NA
*	*	*	*	*	*	*	
Solanum guamense	Bereng-henas halomtano.	U.S.A. (Guam, Mariana Islands).	Solanaceae	E		NA	NA
*	*	*	*	*	*	*	
Tabernaemontana rotensis.	None	U.S.A. (Guam, Mariana Islands).	Apocynaceae	T		NA	NA
*	*	*	*	*	*	*	
Tinospora homosepala.	None	U.S.A. (Guam)	Menispermaceae	E		NA	NA
*	*	*	*	*	*	*	
Tuberolabium guamense.		U.S.A. (Guam, Mariana Islands).	Orchidaceae	E		NA	NA
*	*	*	*	*	*	*	

Dated: September 16, 2014.

Daniel M. Ashe,

Director, U.S. Fish and Wildlife Service.

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