Pacific Sheath-Tailed Bat
(*Emballonura semicaudata rotensis*)

5-Year Review
Summary and Evaluation

U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, HI

5-YEAR REVIEW
Species reviewed: Pacific sheath-tailed bat Mariana subspecies
(*Emballonura semicaudata rotensis*)

TABLE OF CONTENTS

1.0 GENERAL INFORMATION 1
1.1 Reviewers (list primary reviewers of species information below) 1
1.2 Methodology used to complete the review:..... 1
1.3 Background:..... 1
2.0 REVIEW ANALYSIS..... 2
2.1 Application of the 1996 Distinct Population Segment (DPS) policy..... 2
2.2 Recovery Criteria..... 3
2.3 Updated Information and Current Species Status..... 4
2.4 Synthesis..... 9
3.0 RESULTS 9
3.1 Recommended Classification: 9
3.2 New Recovery Priority Number (indicate if no change; see Appendix E): 10
3.3 Listing and Reclassification Priority Number, if reclassification is recommended (see Appendix E)..... 10
4.0 RECOMMENDATIONS FOR FUTURE ACTIONS 10
5.0 REFERENCES - 11

5-YEAR REVIEW
Pacific sheath-tailed bat *(Emballonura semicaudata rotensis)*

1.0 GENERAL INFORMATION

1.1 Reviewers:

Ferdinand Galsim, Biologist, Pacific Islands Fish and Wildlife Office (PIFWO)
Jacqueline Flores, Mariana Islands Manager PIFWO
John Vetter, Animal Recovery Coordinator, PIFWO
Megan Laut, Conservation and Restoration Team Manager, PIFWO

Lead Regional or Headquarters Office:
Region 12, Portland Regional Office

Lead Field Office:
Pacific Islands Fish and Wildlife Office, (808) 792–9400

Cooperating Field Office(s): N/A

Cooperating Regional Office(s): N/A

Cooperating Science Center(s) (NMFS only): N/A

1.2 Methodology used to complete the review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office of the U.S. Fish and Wildlife Service (Service) in 2020. The review was based on the final rule listing this species; and other experienced biologists; unpublished survey reports; notes and communications from other qualified biologists; as well as a review of current, available information. The evaluation of Ferdinand Galsim, Biologist, was reviewed by Jacqueline Flores, Mariana Islands Team Manager, Megan Laut, Conservation and Restoration Manager and John Vetter, Animal Recovery Coordinator.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2015. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews for 156 Species in Oregon, Washington, Hawaii, Palau, Guam, and the Northern Mariana Islands. Federal Register 83(88): 20088–20092, May 7, 2018.

1.3.2 Listing history

Original Listing
FR notice: USFWS. 2015. Endangered and Threatened Wildlife and Plants; Endangered Status for 16 Species and Threatened for 7 Species in Micronesia. Federal Register 80 (190): 59424-59497**.**
Date listed: November 2, 2015
Entity listed: *Emballonura semicaudata rotensis*, subspecies
Classification: Endangered

Revised Listing, if applicable
FR notice: N/A
Date listed: N/A
Entity listed: N/A
Classification: N/A

1.3.3 Associated rulemakings: N/A

1.3.4 Review History:
This is the first 5-year review for *Emballonura semicaudata rotensis.* Critical habitat was not designated for this species. The draft recovery plan for this species is in preparation.

1.3.5 Species' Recovery Priority Number at start of this 5-year review: 6

1.3.6 Current Recovery Plan or Outline
The recovery plan is currently being drafted.

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate?

__X__ ***Yes***
_____ ***No***

2.1.2 Is the species under review listed as a DPS?

____ ***Yes***
__X__ ***No***

2.1.3 Was the DPS listed prior to 1996?

____ ***Yes***
__X__ ***No***

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

____ ***Yes***
____ ***No***

2.1.3.2 Does the DPS listing meet the discreteness and significance elements of the 1996 DPS policy?

____ ***Yes***
____ ***No***.

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?

____ ***Yes***
__X__ ***No***

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

____ ***Yes***
__*X*__ ***No***,.

A recovery plan for Pacific sheath-tailed bat and the other 22 species listed in 2015 (FR 80 (190): 59424-59497) is currently being developed and is expected to be completed in FY 2020.

2.2.2 Adequacy of recovery criteria.

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat? N/A

____ ***Yes***.
____ ***No***

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? N/A

____ ***Yes***
____ ***No***

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information

N/A

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:
All subspecies of the Pacific sheath-tailed bat are nocturnal and appear to be cave-dependent, roosting during the day in a wide range of cave types, including overhanging cliffs, crevices, lava tubes, and limestone caves (Grant 1993, p. 51; Grant et al. 1994, pp. 134–135; Hutson et al. 2001, p. 139; Palmeirim et al. 2005, p. 28). The Mariana subspecies forages almost entirely in forests (native and nonnative) near their roosting caves (Esselstyn et al. 2004, p. 307). The Pacific sheath-tailed bats consume a diverse array of small-sized (0.078–0.314 in (2–8 mm)) insects, including ants, bees, and wasps (Hymenoptera), moths (Lepidoptera), and beetles (Coleoptera), as their primary prey (O'Shea and Valdez 2009, pp. 63–65; Valdez *et al.* 2011, pp. 301–307). Other subspecies of Pacific sheath-tailed bats (*E.s. palauensis*) routinely travel distances exceeding 5 km to reach foraging sites in Palau (Wiles et al., 1997).

Pacific sheath-tailed bats were observed to roost "singly (or as lone adults next to lone young), spaced about 5–30 cm apart on the ceiling and upper walls of the [cave] dome, ventral surfaces appressed to the rock surface with heads facing downwards, with spacing intermediate between regular and random patterns" (Wiles et al. 2011, p. 303). Although they prefer large caves (Wiles et al. 2009, p. 15 in O'Shea and Valdez 2009), they may also be found in smaller caves, especially where there may be less disturbance (mostly from goats or humans). The roosting pattern of *rotensis* with a main cave containing the majority of individuals and a few bats in several caves around this location is consistent with behavioral observations from the *semicaudata* subspecies in Fiji (Scanlon et al. 2013, Waldien 2019, in litt.). Observations in Fiji and American Samoa (Scanlon et al. 2014, p. 456; Palmeirim et al. 2005, pp. 55– 62) found large aggregations (100s to 1000s) in a single "main" cave and a few individuals (1s to 10s) often scattered in several caves close to this location.

Currently, subspecies *rotensis* is known only from the island of Aguiguan, also known as Goat Island (Engbring *et al.* 1986, p. 8). The limestone cave ecosystem on Aguiguan has a constant temperature, high relative humidity, and no major air movement (O'Shea and Valdez 2009, pp. 77–78).

The bats generation length (the average age of parents of the current cohort, reflecting the turnover rate of breeding individuals in a population) is believed to be 2.5 years (Pacifici et al. 2013). A field investigation of the Aguiguan

population of the Mariana subspecies several lines of evidence to infer an annual litter size of one pup per female in late summer (Wiles et al. 2011, p. 303).

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Fossil evidence shows the Mariana subspecies was once common on both Guam and Rota, and somewhat less common on the island of Tinian (Steadman 1999, p. 321; Wiles and Worthington 2002, pp. 1–3; Wiles *et al.* 2011, p. 299). Currently, this subspecies population is only found in the island of Aguiguan. When the Mariana subspecies was listed in 2015 as Endangered, there were estimated 359 to 466 individuals from several roosting colonies (Wiles and Worthington 2002, p. 15; Wiles 2007, pers. comm.; O'Shea and Valdez 2009, pp. 2–3; Wiles *et al.* 2011, p. 299; Oyler-McCance *et al.* 2013, p. 1,030).

Liske-Clark et al. (2018) conducted a follow-up survey in 2016. Due to bad weather, complicated logistics, and the count method used (a single night exit count at each cave), the authors reported a minimum abundance rather than a range. Liske-Clark et al. reported a minimum population size of 323 bats at East Black Noddy Cave, which seems to be the key roost for the species, similar earlier estimates by Wiles et al. (2011), who reported a range of 308–382 for emergence counts of bats at this location. In 2008, Guano cave was occupied by between 43 and 64 bats, but none were detected in 2016. At least one bat was reported at Crevice Cave in 2016, but authors hypothesized the bats used it as a temporary or night roost, and bats were not detected there every night of the survey (Liske-Clark et al. 2018).

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

Three subspecies of sheath-tailed bat – *rotensis* (Marianas)*, palauensis* (Palau), and *semicaudata* (South Pacific) – have been found to have notable genetic differences (Oyler-McCance et al. 2013, p. 1030), and species experts suggest that they would likely be classified as individual species if the genetics work was more complete (G. Wiles 2019, in litt). Oyler-McCance et al. (2013) found no genetic variation when they examined 12 *rotensis* individuals. As the population has contracted down to one island, the subspecies has undoubtedly lost genetic and phenotypic diversity putting it at risk of eventual extinction (Shaffer 1981, p. 131; Lacy 2000, pp. 40, 44–46).

2.3.1.4 Taxonomic classification or changes in nomenclature:

Four subspecies of Pacific sheath-tailed bats are currently recognized: *Emballonura semicaudata rotensis,* endemic to the Mariana Islands (referred here

as the Mariana subspecies); *E. s. sulcata* in Chuuk and Pohnpei (Pohnpei subspecies); *E. s. palauensis* in Palau (Palau subspecies); and *E. s. semicaudata* in American and Independent Samoa, Tonga, Fiji, and Vanuatu (South Pacific subspecies) (Koopman 1997, pp. 358–360; Oyler- McCance et al. 2013, pp. 1,030–1,036).

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.).

The Pacific sheath-tailed bat was once common and widespread in Polynesia, eastern Melanesia, and Micronesia and is the only insectivorous bat recorded from a large part of this area (Hutson et al. 2001, p. 138). Since its listing as Endangered in 2015, the Pacific sheath-tailed bat subspecies in the Marianas remains extant only on the island of Aguiguan.

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

The island of Aguiguan is a small 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). While currently uninhabitated, it was once inhabited by the Chamorro people (Russell 1998, pp. 90–91). Although the forest habitat in Aguiguan appears to be relatively healthy, the majority of the sheath-tailed bat's historical habitats in the Marianas (Guam, Rota, Saipan, Tinian, and possibly Maug) have been and are affected by deforestation and other habitat modification. On Aguiguan, threats do exist (e.g. feral goats, nonnative plants, and typhoons) that can significantly decrease the suitability of its habitat.

2.3.1.7 Other:

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

Roost and cave disturbance
Roost disturbance is a well-known problem for many cave-dwelling species (Palmeirim et al. 2005, p. 3). Based on observations, Mariana swiftlets (*Aerodramus vanikorensis bartschi*) often share roosting caves with the bats, where smooth rock overhangs in tall caverns provide nesting surfaces safe from rats, cats, and other predators (Tarburton 2011, p. 38). Feral goats have been observed entering caves on Aguiguan Island for shelter, which has been documented to disrupt colonies of the Mariana swiftlet and is believed to disrupt

roosting bats as well (Wiles and Worthington 2002, p. 17; Cruz et al. 2008, p. 243; Scanlon 2015b, in litt.). However, the extent of disturbance is unknown (Scanlon 2015b, in litt.).

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 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). Roosts often facilitate complex social interactions, offer protection from inclement weather, help bats conserve energy, and minimize predation risk (Kunz and Lumsden 2003, p. 3); therefore, disturbance at caves and flushing from roosts may cause bats to incur elevated energetic costs, other physiological stress, and potentially increased risk of predation while in flight. Researchers found that if caves that were otherwise suitable for bats were occupied by goats, there were no bats present in the caves (Guam Division of Aquatic and Wildlife Resources 1995, p. 95). Roost disturbance at caves accessible to humans and animals (e.g. feral goats) will likely continue to be a threat into the future.

Overgrazing by feral ungulates
In areas of known populations of the Pacific sheath-tailed bat in Fiji and the Mariana Islands, overgrazing of the forest understory by goats resulted in little or no recruitment of canopy tree species (Gorresen et al. 2009, p. 339; Palmeirim et al. 2005, p. 46). Palmeirim et al. (2005, p. 46) predicted that continued overgrazing would result in the demise of the forests that serve as important foraging sites for the Pacific sheath-tailed bat. During a 2003 field survey, the Mariana subspecies was seen foraging in the forest understory to within 1 m of the ground, with some activity at tree-top level and above the forest canopy (Esselstyn et al. 2004), indicating understory composition may play an important part of the forest habitat for the species.

Deforestation
The arrival of humans in the Mariana archipelago has caused ongoing degradation to the native forests resulting in the conversion of primary forest to secondary, monoculture, and nonnative forests (Willsey et al. 2019). Historic agriculture, development, warfare, and tropical cyclones are the main causes of deforestation in the habitat of the Pacific sheath-tailed bat (Wiles and Worthington 2002, p. 18). For example, the arrival of Europeans in the 16th century in the Marianas caused widespread damage to the forests through clearing and the introduction of nonnative animals, particularly ungulates that continue to overgraze of the forests. This lack of recruitment caused by overgrazing of native plants may have likely affected foraging habits and available food for the Pacific sheath-tailed bat.

The loss of plant diversity associated with the conversion of native forests to agriculture and other uses usually results in a corresponding reduction in the

diversity and number of flying insects (Hespenheide 1975, pp. 84, 96; Waugh and Hails 1983, p. 212; Tarburton 2002, p. 107). Based on the preference of the Mariana subspecies for foraging in forested habitats near their roost caves, Wiles et al. (2011, p. 307) assert that past deforestation in the Mariana archipelago was likely a principal factor in limiting the current population to the island of Aguiguan, which has relatively healthy native forest.

Pesticides
Pesticides are known to adversely affect bat and insectivorous bird populations, either by secondary poisoning upon consumption of contaminated insects or by reducing the availability of prey (Hutson et al. 2001, p. 138; Mickleburgh et al. 2002, p. 19). In American Samoa and Samoa, current levels of pesticide use are likely lower than several decades ago when, particularly during the years in which taro was grown on large scales for export (1975–1985), use coincided and is considered a primary cause of the decline of bats in both places (Tarburton 2002, p. 107, Scanlon 2019, in litt.). Between the 1940s and 1970s, pesticides such as dichlorodiphenyltrichloroethane (DDT) and malathion were once applied excessively in the Northern Marianas, particularly Guam, Saipan, and Tinian, which may have negatively impacted the Pacific sheath-tailed bat (Baker 1946; Jenkins 1983), and likely contributed to declines and loss of Pacific sheath-tailed bat (Wiles and Worthington 2002, p. 17).

Typhoons
High winds, waves, strong storm surges, high rainfall, and flooding associated with tropical storms, particularly severe typhoons (with sustained winds of at least 150 mi per hour or 65 m per second) can cause direct mortality to the Pacific sheath-tailed bat, particularly the extremely low abundance of remaining bat populations in the small and isolated island of Aguiguan (Harrington 2019). Indirectly, the bat's inability to forage during extended periods of high wind or rain can lead to starvation (Tarburton 2002, p. 107). In addition, strong typhoons can destruction and modification of their foraging habitat.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes: Not considered a threat to this species.

2.3.2.3 Disease or predation:
Rats
Rats (*Rattus spp*.) are known to prey on non-volant bats (young that have not developed the ability to fly) at roosting sites and can be a major threat to colonies (Wiles et al. 2011, p. 306). Of several nonnative rats found on islands in the Pacific, black rats (*R. rattus*) likely pose the greatest threat to Pacific sheath-tailed bats because of their excellent climbing abilities (Palmeirim 2015, in litt.). The remaining roost sites of the sheath-tailed bat on Aguiguan appear to be those that are inaccessible to rodents (Wiles and Worthington 2002, p. 18; Berger et al. 2005, p. 144).

Cats
Domestic and feral cats (*Felis catus*) can capture low-flying bats and cats have been documented to wait for bats as they emerge from caves and capture them in flight (Tuttle 1977 in Palmeirim et al. 2005, p. 33; Ransome 1990 in Palmeirim et al. 2005, p. 33; Woods et al. 2003, pp. 178, 188). Feral cats are not currently present on Aguiguan, may have contributed to the bat's extirpation from other islands in the Mariana Island chain.

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Existing regulations under CNMI law **(**(§ 85–30.1–330), (*e.g.,* prohibitions of hunting, fishing, collecting, killing, commercial activity, destruction of habitats or artifacts, and camping) to protect wildlife conservation areas (CNMI–DLNR–Rota 2015, in litt.). These regulations are designed to protect native species, including rare species at risk from competition and predation by nonnative, and in some cases native, species. However, the magnitude and intensity of threats, high costs, and the lack of funding and human resources hinder the ability of regulator actions to fully enforce these regulations ((CNMI–DLNR–Rota 2015, in litt.). Nonetheless, greater enforcement of local laws would provide additional benefit to listed species such as the Pacific sheath-tailed bat.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Analysis from early surveys has suggested that the invasive shrub *Lantana camara* may be tied to the decline of the Pacific sheath-tailed bat as it contributed to the loss of native limestone forest (Welch et al. 2016). Liske-Clark et al. (2018) observed that the Mariana subspecies appeared to avoid *L. camara* fields for foraging but was found foraging in areas heavily impacted by feral goat browsing in the understory.

2.4 Synthesis

Currently, the *rotensis* subspecies of the Pacific sheath-tailed bat is extant only on the island of Aguiguan in the Marianas, where the population remains in the low hundreds of individuals. The species has disappeared from the rest of its range in the chain likely due to habitat destruction and degradation, pesticides overuse, roost disturbance, predation from nonnative animals, and stochastic events, like typhoons. Due to its small population, very limited occurrence, and unmanaged threats on Aguiguan, the subspecies continues to meet the definition of endangered throughout its range.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened

____ Uplist to Endangered

____ **Delist** (Indicate reasons for delisting per 50 CFR 424.11):

__X__ **No change is needed**

3.2 New Recovery Priority Number*:*

Brief Rationale:

3.3 Listing and Reclassification Priority Number

Reclassification (from Threatened to Endangered) Priority Number: ____
Reclassification (from Endangered to Threatened) Priority Number: ____
Delisting (regardless of current classification) Priority Number: ____

Brief Rationale:

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- A project has recently been funded by CNMI Department of Land and Natural Resources, Division of Fish and Wildlife to enable surveys of the Pacific sheath-tailed bat's roosting habitat on Aguiguan, with hopes to eventually translocate bats to the island of Rota (J. Guilbert and T. Willsey, 2019. in litt). With surveys to commence in 2020, the goal of this project is to provide population status, genetics, life history, and breeding information about the bats on Aguiguan, and assess caves on Rota for their translocation potential. This project would improve the viability of the species and its ability to return to a metapopulation equilibrium with populations on more than one island.

- Another project to commence in 2020 is the U.S. Fish and Wildlife Service's plan to control Lantana scrub to encourage forest growth (T. Willsey, 2019, in litt.), particularly areas of land dominated by monocultures. The removal of this invasive plant will help the forest recover from excessive goat browsing and create more foraging habitat for bats on Aguiguan.

- Abate the threats of predation by monitor lizards or rats to the Pacific sheath-tailed bat. In addition, complete eradication of goats may be necessary (T. Willsey, 2019, pers. comm).

- Habitat degradation and loss - Control and monitor land clearing and prevent wildfires to preserve the native forest habitat for this species. Reforest using native flora.

- Conduct a more complete genetic testing to confirm if the Pacific sheath-tailed bat be classified as individual species.

- Prevent cave disturbance from feral goats or human (frequent hunting trips to the island) by fencing the cave entrance (Liske-Clark et al. 2018).

5.0 REFERENCES -

Baker, R. H. 1946. Some effects of the war on the wildlife of Micronesia. Transactions of the North American Wildlife Conference 11:205–213.

Berger, G.M., J. Gourley, and G. Schroer. 2005. Comprehensive wildlife conservation strategy for the CNMI. CNMI Department of Land and Natural Resources (DLNR) Division of Fish and Wildlife (DFW), Saipan. 358 pp.

Bonaccorso, F. & Allison, A. 2008. *Emballonura semicaudata*. The IUCN Red List of Threatened Species. Version 2015.1. <www.iucnredlist.org>. Downloaded on 22 June 2015.

Esselstyn, J.A., G.J. Wiles, and A. Amar. 2004. Habitat use of the Pacific sheath-tailed bat (Emballonura semicaudata) on Aguiguan, Mariana Islands. Acta Chiropterologica 6: 303–308.

Flannery, T.F. 1995. Mammals of the South-West Pacific and Moluccan Islands. Reed Books and Cornell University. Ithaca, NY, USA. 426 pp.

Grant, G.S. 1993. Sheath-tailed bats—Tutuila's rarest mammal. Pp. 51–52 in American Samoa: Natural History and Conservation Topics, Vol. 1. Biological Report Series, Report No. 42, Department of Marine and Wildlife Resources, American Samoa.

Grant, G.S., Banack, S.A. and Trail, P. 1994. Decline of the sheath-tailed bat Emballonura semicaudata (Chiroptera: Emballonuridae) on American Samoa. Micronesica, 27, 133–137.

Gorresen P.M., Bonnacorso F.J., and C.A. Pinzari. 2009. Habitat occupancy and detection of the Pacific sheath-tailed bat (*Emballonura semicaudata*) on Aguiguan, Commonwealth of the Northern Mariana Islands. Acta Chiropterologica 11(2): 331–342.

Harrington, C. L., B. K. Pang, M. Richardson, and F. Amidon. 2019. Physical Geography of the Mariana Archipelago. Encyclopedia of the World's Biomes. https://doi.org/10.1016/B978-0-12-409548-9.11948-7

Hutson, A.M., Mickleburgh, S.P. and Racey, P.A. 2001. Microchiropteran Bats—Global Status Survey and Conservation Action Plan. IUCN/SSC Chiroptera Specialist Group, Gland, Switzerland and Cambridge, U.K.

Jenkins, J. M. 1983. The native forest birds of Guam. Ornithological Monographs 31:1–61.

Lemke, T.O. 1986. Distribution and status of the sheath-tailed bat (Emballonura semicaudata) in the Mariana Islands. Journal of Mammalogy, 67: 743–746.

Liske-Clark, J., Chagnon, B., Mullin, S., and Eichelberger B. 2018. Wildlife and vegetation surveys, Aguiguan 2016 (Technical Report #18). Saipan, MP: CNMI Division of Fish and Wildlife.

Nowak, R.M. 1994. Sac-winged bats, sheath-tailed bats, and ghost bats; and Old World sheath-tailed bats. In Walker's Bats of the World, The Johns Hopkins University Press, Baltimore and London. Pp. 87–88, 90–92.

O'Shea, T.J. and E.W. Valdez. 2009. Assessment for Pacific sheath-tailed bats (*Emballonura semicaudata rotensis*) on Aguiguan, Commonwealth of the Northern Mariana Islands. USGS Administrative Report to the US Fish and Wildlife Service, Fort Collins. 113 pp.

Oyler-McCance, S.J., Valdez, E.W., O'Shea, T.J., and J.F. Fike. 2013. Genetic characterization of the Pacific sheath-tailed bat (Emballonura semicaudata rotensis) using mitochondrial DNA sequence data. J. Mammology 94: 1030–1036.

Pacifici, M., Santini, L., Di Marco, M., Baisero, D., Francucci, L., Grottolo Marasini, G., Visconti, P. and Rondinini, C. 2013. Generation length for mammals. Nature Conservation 5: 87–94.

Palmeirim, J. M., Champion, A., Naikatini, A., Niukula, J., Tuiwawa, M., Fisher, M., Yabaki-Gounder, M., Qalovaki, S. and Dunn, T. 2005. Distribution, status, and conservation of bats in the Fiji islands. The University of the South Pacific, Fauna and Flora International, Universidade de Lisboa.

Tarburton, M. K. 2002. Demise of the Polynesian sheath-tailed bat *Emballonura semicaudata* in Samoa. Micronesia 34: 105–108.

Uyehara, K. and G. Wiles. 2009. Bats of the U.S. Pacific Islands. USDA-NRCS Pacific Islands Area, Biology Technical Note No. 20. 28 pp. + appendices.

Walker, E.P. and J.L. Paradiso. 1983. Order Chiroptera. In Walker's Mammals of the World 4th Edition, Vol. I, Nowak, R.M. and J.L. Paradiso (eds.), The Johns Hopkins University Press, Baltimore and London. Pp. 168–211.

Welch, J. N., Fordyce, J. A., & Simberloff, D. S. (2016). Indirect impacts of invaders: A case study of the Pacific sheath-tailed bat (*Emballonura semicaudata rotensis*). *Biological Conservation, 201*, 146-151. doi:10.1016/j.biocon.2016.07.004.

Wiles, G.J., Engbring, J., and D. Otobed. 1997. Abundance, biology, and human exploitation of bats in the Palau Islands. J. Zool., Lond. 241: 203–227.

Wiles, G.J. and D.J. Worthington. 2002. A population assessment of Pacific sheath-tailed bats (*Emballonura semicaudata*) on Aguiguan, Mariana Islands. Prepared for the U.S. Fish and Wildlife Service, Pacific Islands Office, Honolulu. 32 pp.

Willsey, Tyler and Kwon, James and Reeves, M. and Amidon, Fred and Miller, Stephen. 2019. Mariana Islands Forest. 10.1016/B978-0-12-409548-9.12012-3.

Woods, M., McDonald, R.A., and S. Harris. 2003. Predation of wildlife by domestic cats Felis catus in Great Britain. Mammal. Rev. 33: 174–188.

U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW of *Emballonura semicaudata rotensis*/Pacific sheath-tailed bat

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: N/A

Review Conducted By: Ferdinand Galsim, Biologist, Pacific Islands Fish and Wildlife Office (PIFWO)
Jacqueline Flores, Mariana Islands Manager PIFWO
John Vetter, Animal Recovery Coordinator, PIFWO
Megan Laut, Conservation and Restoration Team Manager, PIFWO

FIELD OFFICE APPROVAL:

MEGAN LAUT Digitally signed by MEGAN LAUT
Date: 2020.09.28 13:04:02 -10'00'
_____ Date _____

for **Field Supervisor, Fish and Wildlife Service**