

Ostodes strigatus

**5-Year Review
Summary and Evaluation**

**U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
Honolulu, Hawai'i**

5-YEAR REVIEW

Species reviewed: Snail [no common name] (*Ostodes strigatus*)

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5-YEAR REVIEW

Ostodes strigatus

1.0 GENERAL INFORMATION

1.1 Reviewers:

James Breeden, Wildlife Biologist, Pacific Islands Fish and Wildlife Office (PIFWO)
John Vetter, Animal Recovery Coordinator, PIFWO
Megan Laut, Conservation and Restoration Team Manager, PIFWO

Lead Regional or Headquarters Office:

Region 1, Portland Regional Office

Lead Field Office:

Region 12, Pacific Islands Fish and Wildlife Office, Honolulu, HI

Cooperating Field Office:

N/A

Cooperating Regional Office:

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), beginning in June 2021. The review was based on the final rule listing this species; peer-reviewed literature, gray literature (government, academic, business, and industry reports), and expert elicitation. Data gaps were addressed using data available for congeners or otherwise similar species, as well as using basic conservation biology principles and plant and animal biology to identify the needs of individuals, populations, and species. The evaluation completed by James Breeden, Wildlife Biologist, was reviewed by John Vetter, Animal Recovery Coordinator, and Megan Laut, Conservation and Restoration Team Manager.

1.3 Background:

1.3.1 FR Notice citation announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2019. Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Status Reviews for 91 Species in Oregon, Washington, Hawaii, and American Samoa. Federal Register 84(112): 27152–27154, June 11, 2019.

1.3.2 Listing history

Original Listing

FR notice: [USFWS] U.S. Fish and Wildlife Service. 2016. Endangered and Threatened Wildlife and Plants; Endangered Status for Five Species From American Samoa; final rule. Department of the Interior, Federal Register 81 (184): 65466–65508.

Date listed: October 24, 2016

Entity listed: *Ostodes strigatus*

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 *Ostodes strigatus*.

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

5C

1.3.6 Current Recovery Plan or Outline

Name of plan or outline: Draft Recovery Plan for Five Species from American Sāmoa

Date issued: May 17, 2021

Dates of previous revisions, if applicable: N/A

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?

Yes
 No

2.1.2 Is the species under review listed as a DPS?

Yes
 No

2.1.3 Was the DPS listed prior to 1996?

Yes
 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
 No

2.2 Recovery Criteria

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

Yes
 No

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?

Yes
 No

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

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:

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:

Ostodes strigatus is found on the ground in rocky areas under relatively closed canopy with sparse understory plant coverage at elevations below 1,280 feet (ft) (390 meters [m]) (Girardi 1978, p. 224; Miller 1993, pp. 13, 15, 23, 24, 27). Moisture supply is the principal environmental influence on *Ostodes* spp. (Girardi 1978, p. 245).

Ostodes strigatus is a light tan- to cream-colored tropical ground-dwelling snail in the family Poteriidae endemic to the island of Tutuila in American Sāmoa (Girardi 1978, pp. 193, 214; Miller 1993, p. 7). The defining characteristics of species within the family Poteriidae include a pallium cavity (lung-like organ) and an operculum (a shell lid or “trap door” used to close the shell aperture when the snail withdraws inward, most commonly found in marine snails) (Girardi 1978, pp. 214, 222–224; Vaught 1989, p. 16; Barker 2001, pp. 15, 25). *Ostodes strigatus* has a white, turbinate (depressed conical) shell with 4 to 5 whorls and distinctive parallel ridges, reaching a size of 0.3 to 0.4 inch (in) (7 to 11 millimeters [mm]) in height, 0.4 to 0.5 in (9 to 12 mm) in diameter at maturity (Girardi 1978, pp. 222–223; Abbott 1989, p. 43). Its operculum is acutely concave to cone-shaped, with broad, irregular spirals from center to edge (Girardi 1978, pp. 198, 213, 222–224). True radial patterning is seldom found on the upper shell surface, and never on the ventral surface, which is usually entirely smooth (Girardi 1978, p. 223).

Although the biology of the genus *Ostodes* is not well studied and therefore the exact diet is unknown, it is highly probable that *O. strigatus* feeds at least in part on decaying leaf litter and fungus (Girardi 1978, p. 242).

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:

The approximate age at which *Ostodes strigatus* reaches full sexual maturity is unknown (Girardi 1978, p. 194). Once *O. strigatus* reach maturity and can successfully reproduce, it is likely adult snails deposit their eggs into leaf litter where they develop and hatch.

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

No new information.

2.3.1.4 Taxonomic classification or changes in nomenclature:

Ostodes strigatus is a member of the superfamily Cyclophoroidea and the family Poteriidae(= Neocyclotidae) (Cowie 1998, p. 24; Girardi 1978, p. 192; Vaught 1989, p. 16; ITIS 2021).

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.):

Until 1975, *Ostodes strigatus* was considered widespread and common, but has since declined significantly (Miller 1993, p. 15; Cowie 2001, p. 215). In 1992, a survey of nine sites on Tutuila reported several live individuals (and abundant empty shells) from a single site in Maloata Valley on the western end of Tutuila and only shells (no live individuals) at three sites in central Tutuila (Miller 1993, pp. 23–27). At each of the four sites where live *O. strigatus* or empty shells were found, the predatory rosy wolf-snail (*Euglandina rosea*) was common or abundant (Miller 1993, p. 23). In 1998, surveys within the newly established National Park of American Sāmoa (NPAS) on northern Tutuila did not detect any live *O. strigatus* or shells (Cowie and Cook 2001, pp. 143–159); however, Cowie and Cook (1999, p. 24) note that these areas were likely outside the range of *O. strigatus*. We are unaware of any surveys conducted for this species since 1998; however, local field biologists that frequent the forest above Maloata Valley for other biological field work report they have not seen *O. strigatus* (Miles 2015, in litt., entire). Observations of live individuals at a single location on western Tutuila more than 20 years ago suggest that this species has undergone a significant reduction in its range and numbers (Miller 1993, pp. 15, 23–27; Cowie 2001, p. 215). Live individuals or shells of *O. strigatus* have not been reported since 1992, and no systematic surveys have been conducted for this species since the late 1990s (Cowie and Cook 1999, p. 24; Miles 2015, in litt., entire). Currently, the number of extant populations and individuals is unknown (Table 1).

Table 1. Known populations of *Ostodes strigatus* from listing to this 5-year review.

Date	Populations	Individuals	Recovery Criteria ¹
2016 listing	unknown	unknown	N/A
2020 species report	unknown	unknown	N/A
2021 5-year review	unknown	unknown	N/A

¹N/A=not available; the recovery plan and species-specific recovery criteria is currently under development and is expected to publish in 2021.

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

Ostodes strigatus is known only from the western portion of the island of Tutuila in American Sāmoa, including the center and southeast edge of the central plateau, and the extreme southern coast and mountain slope near Pago Pago, (Figure 1) with an elevation range of 197 to 1,280 ft (60 to 390 m) (Girardi 1978, p. 224; Bishop Museum 2021, entire).

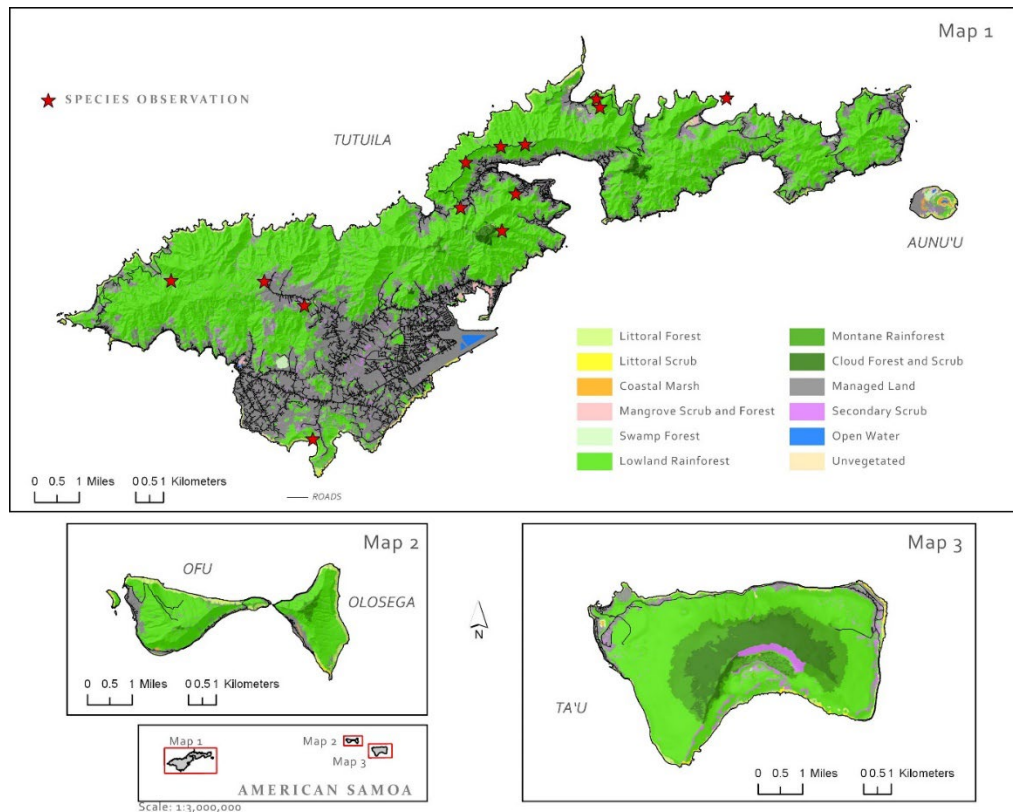


Figure 1. Map of *Ostodes strigatus* observations and vegetation on American Sāmoa. Developed from data by Meyer et al. (2017, entire).

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:

Habitat Destruction and Modification by Agriculture and Development – Several thousand years of subsistence agriculture and more recent plantation agriculture has resulted in the alteration and reduction in forest area on lower elevation arable land throughout American Sāmoa (Whistler 1994, p. 40; Mueller-Dombois and Fosberg 1998, p. 361). Fifty-five percent of the island of Tutuila has slopes of less than 45 percent where land-clearing for agriculture or development is feasible (ASCC 2010, p. 13; DMWR 2006, entire). Currently, agriculture and urban development covers approximately 23 percent of Tutuila (ASCC 2010, p. 13).

Farmers are increasingly encroaching on steep forested areas, and agriculture on Tutuila has spread from low elevation plots to plots in middle and high elevation areas (ASCC 2010, p. 13). Agricultural area has expanded by 59 percent from 1,675 to 2,664 acres (ac) (678 to 1,078 hectares [ha]) since 1970 on Tutuila (Pereira, 1981 p. 68; MNRE, 2014). This loss of forest area likely reduces habitat resilience, and may directly contribute to the decline of *Ostodes strigatus* through the loss of populations of native snails. An increase in housing is also projected to occur in some areas (Stein et al. 2014, p. 24).

The development of roads, trails, and utility corridors has also caused habitat destruction and modification in or adjacent to populations of *Ostodes strigatus* on Tutuila (Cowie and Cook 1999, pp. 3, 30). Development and agriculture on Tutuila is increasing. The population and agricultural land area on this island has increased by approximately 118 percent and 59 percent (Pereira, 1981 p. 68), respectively, since 1970. In addition, construction activities, regular vehicular and foot trail access, and road maintenance activities cause erosion and the increased spread of nonnative plants resulting in further destruction or modification of habitat (Cowie and Cook 1999, pp. 3, 47–48). Land conversion to agriculture on steeper topography at elevations above the coastal plain will accelerate if the human population continues to grow, or if changes in the economy shift toward commercial agriculture (DMWR 2006, p. 71).

Habitat Destruction or Modification by Feral Pigs – Erosion resulting from rooting and trampling by feral pigs (*Sus scrofa*) impacts native plant communities by contributing to watershed degradation, alteration of plant

nutrient status, and increasing the likelihood of landslides (Vitousek et al. 2009, pp. 3074–3086; Chan-Halbrecht et al. 2010, p. 251; Kessler 2011, pp. 320–324). In the Hawaiian Islands, feral 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 Hawai‘i’s forest ecosystems (Aplet et al. 1991, p. 56; Anderson and Stone 1993, p. 195).

Feral pigs have been present in American Sāmoa since human settlement (American Sāmoa Historic Preservation Office 2015, in litt., entire). In the past, hunting pressure kept their numbers down, however, increasing urbanization and increasing availability of material goods has resulted in the decline in the practice of pig hunting to almost nothing (Whistler 1992, p. 21; Whistler 1994, p. 41). Feral pigs are moderately common to abundant in many forested areas, where they spread invasive plants, damage understory vegetation, and destroy riparian areas by their feeding and wallowing behavior (DMWR 2006, p. 23; ASCC 2010, p. 15). Feral pigs are a serious problem in the NPAS because of the damage they cause to native vegetation through their rooting and wallowing (Whistler 1992, p. 21; 1994, p. 41; Hoshide 1996, p. 2; Cowie and Cook 1999, p. 48; Togia pers. comm. in Loope et al. 2013, p. 321). Feral pig densities have been reduced in some areas (Togia 2015, in litt., entire), but without control methods that effectively reduce feral pig populations, they are likely to persist and remain high in areas that provide habitat for *Ostodes strigatus* (Hess et al. 2006, p. 53; ASCC 2010, p. 15). Based on the reliance of *O. strigatus* on understory vegetation under native forest canopy, as well as the snail’s potential to feed on the ground in the leaf litter, the actions by feral pigs of rooting, wallowing, and trampling, and the associated impacts to native vegetation and soil, negatively affect the habitat of *O. strigatus* and are a current threat to the species.

Habitat Destruction and Modification by Nonnative Plant Species –

Nonnative plant species can adversely modify native habitat and render it unsuitable for native snail species (Hadfield 1986, p. 325). Although some Hawaiian tree snails have been recorded on nonnative vegetation, it is more generally the case that native snails throughout the Pacific are specialized to survive only on the native plants with which they have evolved (Cowie 2001, p. 219). Cowie (2001, p. 219) reported few observations of native snails, including *Ostodes strigatus*, in disturbed habitats on Tutuila.

Although the island of Tutuila contains many areas that are relatively free of human disturbance and nonnative plant invasion and largely represent pre-contact vegetation, the threat of invasion and further spread by nonnative plant species is of concern (Space and Flynn 2000, pp. 23–24; Craig 2009, pp. 94, 96–98; Atkinson and Medeiros 2006, p. 17; ASCC 2010, pp. 15, 20). Of the approximately 20 or more nonnative pest plant species in American Sāmoa, at least 11 have altered or may alter the habitat of *Ostodes strigatus* and include: *Adenanthera pavonina* (lopa, red bean tree, coral bean tree), *Castilla elastica*

(pulu mamoe, Mexican rubber tree), *Cinnamomum verum* (tinamoni, cinnamon), *Clidemia hirta* (Koster's curse), *Falcataria moluccana* (tamaligi, albizia), *Funtumia elastica* (pulu vao, African rubber tree), *Leucaena leucocephala* (fua pepe, lusina, wild tamarind), *Merremia peltata* (fue lautetele, merremia), *Mikania micrantha* (fue saina, mile-a-minute vine), *Psidium cattleianum* (kuava, strawberry guava), and *Spathodea campanulata* (faapasi, African tulip).

Nonnative plants can degrade or destroy native habitat in Pacific island environments by: (1) modifying light availability by altering canopy structure; (2) altering soil-water regimes; (3) modifying nutrient cycling; (4) converting native-dominated plant communities to nonnative plant communities; and (5) increasing the frequency of landslides and erosion (Smith et al. 1985, pp. 217–218; Cuddihy and Stone 1990, p. 74; Matson 1990, p. 245; D'Antonio and Vitousek 1992, p. 73; Vitousek et al. 1997, pp. 6–9; Atkinson and Medeiros 2006, p. 16). Nonnative plant species often exploit disturbance caused by other factors such as tropical cyclones, agriculture, development, and feral ungulates. In combination, these disturbances reinforce or exacerbate their negative impacts to native habitats.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

Based on the best available scientific and commercial information, we do not consider the overutilization for commercial, recreational, scientific, or educational purposes to be a current threat to *Ostodes strigatus*.

2.3.2.3 Disease or predation:

There are currently no known threats to *Ostodes strigatus* that are attributable to disease.

Predation by Nonnative Snails – At present, the primary threat to long-term survival of the native snail fauna in American Sāmoa is predation by the nonnative rosy wolf-snail, the most commonly recommended biological control agent of the giant African snail (*Achatina fulica*), which also is an invasive nonnative species in American Sāmoa. Numerous studies show that the rosy wolf-snail feeds on endemic island snails and is a causal factor in their decline and extinction (Hadfield and Mountain 1980, p. 357; Howarth 1983, p. 240; Howarth 1985, p. 161; Howarth 1991, p. 489; Clarke et al. 1984, pp. 101–103; Hadfield et al. 1993, p. 327, pp. 616–620; Murray et al. 1982 pp. 150–153; Cowie 2001, p. 219).

In 1980, the rosy wolf-snail was released on Tutuila to control the giant African snail (Lai and Nakahara 1980 as cited in Miller (1993, p. 9). By 1984, the rosy wolf-snail was considered to be well established on Tutuila, having

reached the mountains (Eldredge 1988, pp. 122, 124–125), and by 2001 was reported as widespread within the NPAS on Tutuila (Cowie and Cook 2001, pp. 156–157). Shells of *Ostodes strigatus* were found on the ground at several of the locations surveyed on Tutuila, along with numerous shells and an occasional live individual of the rosy wolf-snail (Miller 1993, pp. 13, 23–28).

Predation by several other nonnative carnivorous snails (e.g., *Gonaxis kibweziensis*, *Streptostele musaecola*, *Gulella bicolor*) are also a threat to *Ostodes strigatus*. Like the rosy wolf-snail, *Gonaxis* spp. were also widely introduced in the Pacific in attempts to control the giant African snail. These species have been implicated in contributing to the decline of native snail species in the region (Cowie and Cook 1999, p. 46). *Gonaxis kibweziensis* was introduced on Tutuila in American Sāmoa in 1977 (Eldredge 1988, p. 122). This species has been reported only from Tutuila (Miller 1993, p. 9, Cowie and Cook 1999, p. 36) and is not as common as the rosy wolf-snail (Miller 1993, p. 11).

Predation by the New Guinea Flatworm – Predation by the nonnative New Guinea flatworm (*Platydemus manokwari*) is a threat to *Ostodes strigatus*. The extinction of native land snails on several Pacific Islands has been attributed to this terrestrial flatworm, native to western New Guinea (Ohbayashi et al. 2007, p. 483; Sugiura 2010, p. 1499). The New Guinea flatworm was released in an unsanctioned effort to control the giant African snail in Sāmoa in the 1990s (Cowie and Cook 1999, p. 47). By 2004, the New Guinea flatworm had been found on the islands of Tutuila and Ta'ū (Craig 2009, p. 84).

Although mostly ground-dwelling, the New Guinea flatworm has been observed climbing trees to feed on partulid tree snails and has contributed to the decline of native land and tree snails (Hopper and Smith 1992, p. 82; Sugiura and Yamamura 2010, p. 741). Areas with populations of the flatworm usually lack, or have declining numbers, of snails (Hopper and Smith 1992, p. 82). Because *Ostodes strigatus* feeds on the ground, it faces increased risk of predation by the New Guinea flatworm (Cooke 1928, p. 6).

Predation by Rats – Rats are known to prey upon arboreal snails endemic to the Pacific islands, and they can devastate native snail populations (Hadfield et al. 1993, p. 621). Rat predation on tree snails has been observed on the Hawaiian Islands of Lāna'i (Hobdy 1993, p. 208; Hadfield and Saufler 2009, in litt, p. 4), Moloka'i (Hadfield and Saufler 2009, p. 1595), O'ahu (Hadfield et al., 1993, p. 616) and Maui (Hadfield 2006, in litt., entire). Three species of rat are present in American Sāmoa: The Polynesian rat (*Rattus exulans*), probably introduced by early Polynesian colonizers, and Norway (*Rattus norvegicus*) and black (*Rattus rattus*) rats, both introduced subsequent to western contact (Atkinson 1985, p. 38; Cowie and Cook 1999, p. 47; DMWR 2006, p. 22). Polynesian and Norway rats are abundant in American Sāmoa,

but insufficient data exist on the populations of black rats (DMWR 2006, p. 22). Frequent evidence of rat predation on native snails was also observed during subsequent surveys (Cowie and Cook 1999, p. 47).

2.3.2.4 Inadequacy of existing regulatory mechanisms:

No existing Federal laws, treaties, or regulations specify protection of *Ostodes strigatus* habitat from the threat of deforestation, or address the threat of predation by nonnative species such as rats, the rosy wolf-snail, and the New Guinea flatworm.

Existing Territorial laws and regulatory mechanisms have the potential to offer some level of protection for *Ostodes strigatus* and its habitat but are not currently implemented in a manner that would do so ([Table 2](#)). The Department of Marine and Wildlife Resources has not exercised its statutory authority to address threats to *O. strigatus* such as predation by nonnative predators, and the species is not listed pursuant to the Territorial Endangered Species Act.

The Coastal Management Act and its implementing regulations have the potential to address the threat of habitat loss to deforestation more substantively, but in practice do not appear to do so. Based on the best available information, some existing regulatory mechanisms have the potential to offer some protection of *Ostodes strigatus* and its habitat, but their implementation does not reduce or remove threats to the species such as habitat destruction or modification or predation by nonnative species. For these reasons, existing regulatory mechanisms do not address the threats to *O. strigatus*.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Tropical Cyclones (Hurricanes) – Tropical cyclones are a common natural disturbance in the tropical Pacific and have impacted American Sāmoa with varying frequency and intensity. Hurricanes adversely affect ground snail habitat by destroying vegetation, opening the canopy, and modifying light intensity and moisture, leading to the formation of disturbed areas that are open to invasion by nonnative plant species (Elmqvist et al. 1994, p. 387; Asner and Goldstein 1997, p. 148; Harrington et al. 1997, pp. 539–540; Lugo 2008, pp. 373–375, 386). These cyclone-mediated changes destroy or modify habitat elements (e.g., stem, branch, and leaf surfaces, undisturbed ground, leaf litter) that are essential in sustaining the snails' life-history. In addition, high winds and intense rains from tropical cyclones can also dislodge individual snails from leaves and branches of host plants and deposit them on the forest floor where they may be crushed by falling vegetation or exposed to predation by nonnative rats and snails (Hadfield 2011, pers. comm.).

Low Numbers of Individuals and Populations – Species that have experienced a decline in numbers and range reduction are inherently vulnerable to extinction from loss of habitat, predation, and localized catastrophes such as severe storms, diseases, climate change, or demographic stochasticity (Gilpin and Soule 1986, pp. 24–34; Pimm et al. 1988, p. 757; Mangel and Tier 1994, p. 607). Conditions leading to this level of vulnerability are easily reached by island species, such as *Ostodes strigatus*, that are in small isolated populations. Small, isolated populations can exhibit reduced levels of genetic variability, which can further diminish the species’ capacity to adapt to environmental changes, thereby increasing the risk of inbreeding depression and reducing the probability of long-term persistence (Shaffer 1981, p. 131; Gilpin and Soule 1986, pp. 24–34; Pimm et al. 1988, p. 757). The threat of small population size could seriously jeopardize the continued existence of *Ostodes strigatus*.

Effects of Climate Change – There are no climate change studies that directly address impacts to the specific habitats of *Ostodes strigatus*. The scientific assessment completed by the Pacific Science Climate Science Program (Australian Bureau of Meteorology and Commonwealth Scientific and Industrial and Research Organization. 2011, Vol. 1 and Vol. 2) provides general projections or trends for predicted changes in climate and associated changes in ambient temperature, precipitation, hurricanes, and sea level rise for countries in the western tropical Pacific region including Sāmoa (used as a proxy for American Sāmoa).

Although there is no specific information on the impacts of the effects of climate change to *Ostodes strigatus*, increased ambient temperature and precipitation and increased severity of hurricanes will likely exacerbate other threats to this species, and is likely to provide additional stresses on its habitat. The probability of extinction is likely to increase due to climate-change impacts (IPCC 2007, p. 48), especially given the restricted range of *Ostodes strigatus*, and small number of individuals and populations.

Table 2. Status of threats to *Ostodes strigatus* and ongoing conservation efforts.

Threat	Listing Factor	Current Status	Conservation/Management Efforts
Deforestation - agricultural/urban development	A	Ongoing	None
Invasive plants	A	Ongoing	None
Pigs	A	Ongoing	None
Collection	B	Ongoing	None
Rat predation	C	Ongoing	None

Threat	Listing Factor	Current Status	Conservation/Management Efforts
Nonnative invertebrate predation	C	Ongoing	None
Inadequate existing regulatory mechanisms	D	Ongoing	Partial; Existing Territorial laws and regulatory mechanisms have the potential to offer some level of protection for <i>Ostodes strigatus</i> and its habitat but are not currently implemented in a manner that would do so.
Cyclone impacts	E	Ongoing	None
Low population size	E	Ongoing	None
Loss of genetic diversity	E	Ongoing	None

2.4 Synthesis

The snail *Ostodes strigatus* is an endangered endemic species found only on the island of Tutuila in American Sāmoa. *Ostodes strigatus* was considered widespread and common until 1975. Live individuals of *O. strigatus* have not been reported since 1992, and no systematic surveys have been conducted for this species since the late 1990s (Cowie and Cook 1999, p. 24; Miles 2015, in litt., entire). The species is known to occur on the ground in rocky areas under relatively closed canopy with sparse understory plant coverage at elevations below 1,280 ft (390 m) (Girardi 1978, p. 224; Miller 1993, pp. 13, 15, 23, 24, 27).

The following summarizes the threats of *Ostodes strigatus*. *Ostodes strigatus* is likely to be affected by loss of forest habitat, overcollection for commercial purposes, predation by nonnative snails, flatworms, and rats, and the vulnerability of its small, isolated populations to chance demographic and environmental occurrences. Climate change effects as another source of risk to the species because increased ambient temperature and storm severity resulting from climate change are likely to exacerbate other direct threats to *O. strigatus* in American Sāmoa, and in particular place additional stress on its habitat; these effects of climate change are projected to increase in the future. Multiple stressors acting in combination have greater potential to affect *O. strigatus* than each factor alone. For example, projected warmer temperatures may enhance reproduction in nonnative predatory snails and flatworms or the spread of nonnative invasive plants. The combined effects of environmental, demographic, and catastrophic-event stressors, especially on small populations, can lead to a decline that is unrecoverable and results in extinction (Brook et al. 2008, pp. 457–458). The impacts of any one of the stressors described above might be sustained by a species with larger, more resilient populations, but in combination, habitat loss, predation, small-population risks, and climate change have the

potential to rapidly affect the size, growth rate, and genetic integrity of a species like *O. strigatus* that persists as small, disjunct populations. Thus, the synergy among factors may result in greater impacts to the species than any one stressor by itself. Given the extent of threats, declining numbers of individuals and populations, and lack of management of these threats, this species best fits the definition of endangered. A draft recovery plan is expected to be completed in 2021.

3.0 RESULTS

3.1 Recommended Classification:

- Downlist to Threatened**
- Uplist to Endangered**
- Delist**
 - Extinction*
 - Recovery*
 - Original data for classification in error*
- No change is needed**

3.2 New Recovery Priority Number:

No change

Brief Rationale:

3.3 Listing and Reclassification Priority Number:

No change

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

- Finalize the Draft Recovery Plan for Five Species from American Sāmoa
- Identify and survey extant populations of *Ostodes strigatus* and the habitats in which they occur to assess current distribution, abundance, and habitat use.
- Survey historically occupied areas for any persisting populations.
- Develop fine-scale climate models for *Ostodes strigatus* to identify future suitable habitat based on existing and historical ranges and to determine potential future climate conditions.
- Identify and prioritize areas necessary for habitat protection and restoration.
- Ensure long-term protection of management units.
- Monitor management and use results to adapt management actions.

- Develop and implement control programs for rats, updating methods as new technology becomes available.
- Develop and implement control programs for nonnative invertebrates (e.g., rosy wolf-snail, New Guinea flatworm), updating methods as new technology becomes available.
- Control other threats to specific species as appropriate.
- Monitor management and use results to adapt management actions.
- Expand the distribution of existing wild populations and establish additional populations.
- Utilize regulations and policy to support species recovery.

5.0 REFERENCES

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**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Ostodes strigatus***

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By:

James Breeden, Wildlife Biologist, PIFWO

John Vetter, Animal Recovery Coordinator, PIFWO

Megan Laut, Conservation and Restoration Team Manager, PIFWO

FIELD OFFICE APPROVAL:

for

Lead Field Supervisor, Fish and Wildlife Service

Date _____