

Draft Amendment to the Recovery Plan for the O‘ahu Tree Snails of the Genus *Achatinella*

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Original Prepared by: Pacific Region, U.S. Fish and Wildlife Service

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Species addressed in Draft Amendment: The following 41 species of O‘ahu Tree Snails (*Achatinella abbreviata*, *A. apexfulva*, *A. bellula*, *A. buddii*, *A. bulimoides*, *A. byronii*, *A. caesia*, *A. casta*, *A. cestus*, *A. concavospira*, *A. curta*, *A. decipiens*, *A. decora*, *A. dimorpha*, *A. elegans*, *A. fulgens*, *A. fuscobasis*, *A. juddii*, *A. juncea*, *A. lehuiensis*, *A. leucoraphe*, *A. lila*, *A. livida*, *A. lorata*, *A. mustelina*, *A. papyracea*, *A. phaeozona*, *A. pulcherrima*, *A. pupukanioe*, *A. rosea*, *A. sowerbyana*, *A. spaldingi*, *A. stewartii*, *A. swiftii*, *A. taeniolata*, *A. thaanumi*, *A. turgida*, *A. valida*, *A. viridans*, *A. vittata*, and *A. vulpina*)

We have analyzed all of the best available information and find that there is a need to amend the recovery criteria for the O‘ahu tree snails (*Achatinella* spp.) that have been in place since the recovery plan was completed. In this proposed modification, we discuss the adequacy of the existing recovery criteria, identify amended recovery criteria, and present the rationale supporting the proposed recovery plan modification. The proposed modification is to be shown as an appendix that supplements the recovery plan, superseding only the Objectives section (page 33) of the recovery plan (USFWS 1992).

BACKGROUND INFORMATION

Recovery plans should be consulted frequently, used to initiate recovery activities, and updated as needed. A review of the recovery plan and its implementation may show that the plan is out of date or its usefulness is limited, and therefore warrants modification. Keeping recovery plans current ensures that the species benefits through timely, partner-coordinated implementation based on the best available information. The need for, and extent of, plan modifications will vary considerably among plans. Maintaining a useful and current recovery plan depends on the scope and complexity of the initial plan, the structure of the document, and the involvement of stakeholders.

An amendment involves a substantial rewrite of a portion of a recovery plan that changes any of the statutory elements. The need for an amendment may be triggered when, among other possibilities: (1) the current recovery plan is out of compliance with regard to statutory requirements; (2) new information has been identified, such as population-level threats to the species or previously unknown life history traits, that necessitates new or refined recovery actions and/or criteria; or (3) the current recovery plan is not achieving its objectives. The amendment replaces only that specific portion of the recovery plan, supplementing the existing recovery plan, but not completely replacing it. An amendment may be appropriate in cases where significant plan improvements are needed, but resources are too scarce to accomplish a full recovery plan revision in a short time.

Although it would be inappropriate for an amendment to include changes in the recovery program that contradict the approved recovery plan, it could incorporate study findings that enhance the scientific basis of the plan, or that reduce uncertainties as to the life history, threats,

or species' response to management. An amendment could serve a critical function while awaiting a more comprehensive revised recovery plan by: (1) refining and/or prioritizing recovery actions that need to be emphasized, (2) refining recovery criteria, or (3) adding a species to a multispecies or ecosystem plan. An amendment can, therefore, efficiently balance resources spent on modifying a plan against those spent on managing implementation of ongoing recovery actions.

METHODOLOGY USED TO COMPLETE THE RECOVERY PLAN AMENDMENT

A draft of the updated recovery criteria was developed and sent to the Snail Extinction Prevention Program (SEPP), State of Hawai'i Division of Forestry and Wildlife. The SEPP program reviewed and submitted comments through Dr. David Sischo, the Director of SEPP. Input was also solicited from Dr. Michael G. Hadfield, University of Hawai'i, expert in the biology of O'ahu tree snails. All comments were considered and incorporated into the downlisting and delisting criteria for the O'ahu tree snails.

Peer review of the updated delisting criteria will be concurrent with the public review and comment period on the draft amendment, and comments received will be incorporated into the final recovery plan amendment.

ADEQUACY OF RECOVERY CRITERIA

Section 4(f)(1)(B)(ii) of the Endangered Species Act (Act) requires that each recovery plan shall incorporate, to the maximum extent practicable, "objective, measurable criteria which, when met, would result in a determination...that the species be removed from the list." Legal challenges to recovery plans (see *Fund for Animals v. Babbitt*, 903 F. Supp. 96 (D.D.C. 1995)) and a Government Accountability Audit (GAO 2006) also have affirmed the need to frame recovery criteria in terms of threats assessed under the five listing factors.

Recovery Criteria

See previous version of criteria in the Recovery Plan for O'ahu Tree Snails of the Genus *Achatinella*, page 33 (USFWS 1992).

Synthesis

The status and population size of each of the listed species in the genus *Achatinella* varies, but each continues to face the same threats identified in the recovery plan (USFWS 1992), but with increasing intensity. All extant populations are regularly monitored, and efforts to find new populations are ongoing (Hawaii Department of Land and Natural Resources (DLNR) 2014). Eleven species are maintained in captivity. Habitat loss and degradation continue to threaten *Achatinella* spp. and their host plants. Predation by the carnivorous snail *Euglandina rosea*, rats (*Rattus* spp.), Jackson's chameleon (*Chamaeleo jacksonii*), the terrestrial flatworms *Geoplana septemlineata* and *Platydemis monokwari*, and potentially the terrestrial snails *Oxychilus allinarius* and *Gonaxis kibwexiensis* continues to negatively impact wild populations. The response of *Achatinella* spp. to climate change is not known, but the anticipated hotter and dryer conditions are not favorable to these species.

AMENDED RECOVERY CRITERIA

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or that the protections afforded by the Act are no longer necessary and Oahu tree snails may be delisted. Delisting is the removal of a species from the Federal Lists of Endangered and Threatened Wildlife and Plants. Downlisting is the reclassification of a species from endangered to threatened. The term “endangered species” means any species (species, subspecies, or distinct population segment) that is in danger of extinction throughout all or a significant portion of its range. The term “threatened species” means any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Using available data on collection localities, survey history, habitat distribution, and genetic differentiation, appropriate Geographic Units (GUs) and/or Evolutionarily Significant Units (ESUs) should be identified and delineated for each species of *Achatinella*. A GU for a morphotype (i.e., any of a group of different types of individuals of the same species in a population) of an *Achatinella* tree snail species is defined as the landscape distribution of the morphotype in relation to other morphotypes of the same species. Tree snail morphotypes and GUs will be determined by expert tree snail ecologists and taxonomists working with botanists and landscape ecologists and in consultation with the State of Hawai‘i and the U.S. Fish and Wildlife Service. ESUs are groups within a species that are defined by genetic characters that cluster individuals into populations that are exclusive from other such clusters (Vogler and DeSalle 1994; Waples, 1995, 1998; Pennock and Dimmick, 1997; Riddle and Hafner 1999; Fraser and Bernatchez 2001). The delineation of genetically based ESUs should take precedence over the GUs of morphotypes (see Welch (1938) and Holland and Hadfield (2002, 2007) for a comparison of morphotype GUs and ESUs in *Achatinella mustelina*). Whenever possible, ESUs will be defined by analysis of genetic data for each extant species, following the most current and rigorous scientific standards available at the time.

We provide both downlisting and delisting criteria for the O‘ahu tree snails, which will supersede those included in the Recovery Plan for O‘ahu Tree Snails of the Genus *Achatinella* (USFWS 1992), as follows:

Downlisting Recovery Criteria

To downlist any of the O‘ahu tree snail species from endangered to threatened, the following criteria must be met for each species being considered for downlisting:

1. From 6 to 10 stable populations (possibly actively managed) are distributed across the known historical range of the species. Also, each Evolutionarily Significant Unit (ESU) of the species (or each Geographic Unit (GU) if ESUs have not been identified) must be represented by 1 or more stable populations; thus any species for which more than 6 GUs or ESUs are identified will require more than 6 stable populations to represent every GU or ESU.
2. To be considered stable, a population must number at least 300 individuals distributed across all size classes combined, and must have a population growth curve that is stable or positive for at least 4 of 5 sequential years.

Delisting Recovery Criteria

For any of the O‘ahu tree snail species to be considered fully recovered, it must maintain viable free-living populations in areas actively managed to protect native vegetation. The following criteria must be met for any of the O‘ahu tree snail species to be delisted:

1. From 12 to 20 populations are distributed across the known historical range of the species. Also, each Evolutionarily Significant Unit (ESU) of the species (or each Geographic Unit (GU) if ESUs have not been identified) must be represented by at least two populations; thus any species for which more than 6 GUs or ESUs are identified will require more than 12 populations to sufficiently represent every GU or ESU.
2. Each of these populations must have a population growth curve that is stable or positive for at least 7 of 10 sequential years, and have available habitat that is capable of supporting natural dispersal and expansion of the occupied range. Any new populations that are established through natural dispersal from these populations should also maintain a positive growth trajectory for 4 of 5 sequential years.
3. At least 12 populations must number at least 300 individuals, distributed across all size classes combined.

All classification decisions consider an analysis of the following five factors: (1) is there a present or threatened destruction, modification, or curtailment of the species’ habitat or range; (2) is the species subject to overutilization for commercial, recreational scientific or educational purposes; (3) is disease or predation a limiting factor; (4) are there inadequate existing regulatory mechanisms in place outside the Act (taking into account the efforts by states and other organizations to protect the species or habitat); and (5) are other natural or manmade factors affecting its continued existence. When delisting or downlisting a species, we first propose the action in the *Federal Register* and seek public comment and peer review of our analysis. Our final decision is announced in the *Federal Register*.

Rationale for Recovery Criteria

The amended delisting criteria are based upon the most up-to-date information about the species’ biology and threats and expert opinion.

In 2003, the Service recommended active management of 10 populations of each species of O‘ahu tree snail in order to stop the continuing declines, in numbers of populations, numbers of individuals, geographic ranges, and species’ genetic diversity (USFWS 2003). In practice, the management of 6 to 8 populations has been approved for stabilizing one species, *Achatinella mustelina* (U.S. Army Garrison, 2008). Successful protection and management of several populations of *A. mustelina* have demonstrated that each of the extant species of federally listed O‘ahu tree snails can be stabilized by actively managing 6 to 10 populations of each species. This estimate of 6 to 10 populations per species is based on the snails’ extreme vulnerability to catastrophic decline from predation by non-native predators (snails, rats, flatworms, and chameleons; Hadfield and Mountain 1981; Hadfield 1986; Hadfield *et al.* 1993; Hadfield and Saufler 2009; Holland *et al.* 2010), and the need to protect the remaining genetic diversity across the historical range of each species (Erickson and Hadfield 2014; Price and Hadfield 2014; Price *et al.* 2015; Sischo *et al.* 2016), as demonstrated for *A. mustelina* (Holland and Hadfield. 2002).

The determination of 300 individual snails in a single population is based on the recorded size of a growing wild population of *A. mustelina* in the Pahole Natural Area Reserve (Hadfield et al 1993). It is based on field observations of a single group of snails in an unprotected 25 square meter area that was relatively free of predation. The population was eventually decimated by non-native predatory snails and rats prior to reaching a stable population size or carrying capacity. Depending on the area that is actively managed, the population may increase beyond 300 snails.

The recovery criteria reflect the best available and most up-to-date information about the species and their habitat and threats. The recovery criteria reflect all known threats to these species. These include protection of suitable habitat to sustain the ecological, morphological, and genetic diversity of the species (Factor A), predation (Factor C), and management of anthropogenic threats (Factor E) such that the populations are self-sustaining and stable.

The amended recovery criteria for O'ahu tree snails support representation by ensuring the ecological, morphological, behavioral, and genetic diversity of the species is conserved across their historic range. The criteria support resiliency through stable or increasing populations. The criteria support redundancy by recommending distribution throughout their historic range. The recovery criteria are objective and measurable. Information is accurate, unbiased, and based upon the best available data known at this time.

LITERATURE CITED

- [DLNR] Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife, Snail Extinction Prevention Program. 2014. Snail Extinction Prevention Program Strategic Plan: 2015-2019. Department of Land and Natural Resources, Honolulu, HI. 133 pp.
- Erickson, P. B., and M. G. Hadfield. 2014. Population structure and genetic signs of population bottlenecks in the endangered Hawaiian tree snail *Achatinella sowerbyana*. *Conservation Genetics* 15:1209-1217. DOI 10.1007/s10592-014-0612-1.
- Fraser, D.J., and L. Bernatchez. 2001. Adaptive evolutionary conservation: towards a unified concept for defining conservation units. *Molecular Ecology* 10:2741-2752.
- [GAO] Government Accountability Office. 2006. Endangered species recovery. GAO-06-463R. April 6, 2006. 27 pp.
- Hadfield, M. G., and B. S. Mountain. 1981. A field study of a vanishing species, *Achatinella mustelina* (Gastropoda, Pulmonata), in the Waianae Mountains of Oahu. *Pac. Sci.* 34:345-358.
- Hadfield, M. G. 1986. Extinction in Hawaiian Achatinelline snails. *Malacologia* 27:67-81.

- Hadfield, M. G., S. E. Miller and A. H. Carwile. 1993. Decimation of endemic Hawai'ian tree snails by alien predators. *American Zoologist* 33(6): 610-622.
- Hadfield, M. G., and J. E. Saufler. 2009. The demographics of destruction: isolated populations of arboreal snails and sustained predation by rats on the island of Moloka'i 1982 – 2006. *Biological Invasions* 11:1595-1609.
- Holland, B. S., and M. G. Hadfield. 2002. Islands within an island: phylogeography and conservation genetics of the endangered Hawaiian tree snail *Achatinella mustelina*. *Molecular Ecology* 11:365-375.
- Holland, B. S. and M. G. Hadfield. 2007. Molecular systematics of the endangered O'ahu tree snail *Achatinella mustelina*: synonymization of subspecies and estimation of gene flow between chiral morphs. *Pacific Science* 61:53-66.
- Holland, B.S., S.L. Montgomery, and V. Castello. 2010. A reptilian smoking gun: First record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity Conservation* 19(5):1437-1441.
- Pennock, D.S. and W.W. Dimmick. 1997. Critique of the evolutionarily significant unit as a definition for "distinct population segments" under the U.S. Endangered Species Act. *Conservation Biology* 11(3): 611-619.
- Price, M. E., and M. G. Hadfield. 2014. Population genetics and bottleneck effects in an *ex situ* population of critically endangered Hawaiian tree snails. *PLoS ONE* 9(12): e114377. <https://doi.org/10.1371/journal.pone.0114377>.
- Price, M. R., D. Sischo, M. Pascua and M. G. Hadfield. 2015. Demographic and genetic factors in the recovery or demise of *ex situ* populations following a severe bottleneck in fifteen species of Hawaiian tree snails. *PeerJ*: DOI 10.7717/peerj.1406.
- Riddle, B.R., and D.J. Hafner. 1999. Species as units of analysis in ecology and biogeography: time to take the blinders off. *Global Ecology and Biogeography* 8:433-441.
- Sischo, D., M. R. Price, and M. G. Hadfield. 2016. Genetic and demographic insights into the decline of a captive population of the endangered Hawaiian tree snail *Achatinella fuscobasis* (Achatinellinae) *Pacific Science*, 70: 133-141. DOI 10.2984/70.2.1.
- U.S. Army Garrison. 2008. Final O'ahu implementation plan. October 2008. 624 pp.
- [USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (O'ahu) tree snails of the genus *Achatinella* as endangered species. Prepared by U.S. Department of the Interior, Fish and Wildlife Service. *Federal Register* 46(8): 3178-3182.

- [USFWS] U.S. Fish and Wildlife Service. 1992. Recovery plan for the O'ahu tree snails of the genus *Achatinella*. Portland, Oregon. 137 pp.
- [USFWS] U.S. Fish and Wildlife Service. 2003. Biological opinion of the U.S. Fish and Wildlife Service for routine military training and transformation of the 2nd brigade 25th infantry division (light) U.S. Army installations Island of O'ahu. Unpublished, 351 pp.
- Vogler, A.P., and R. DeSalle. 1994. Diagnosing units of conservation management. *Conservation Biology* 6:170–178.
- Waples, R.S. 1995. Evolutionarily significant units and the conservation of biological diversity under the Endangered Species Act. *American Fisheries Society Symposium* 17:8-27.
- Waples, R.S. 1998. Evolutionarily significant unit, distinct population segments, and the Endangered Species Act: reply to Pennock and Dimmick. *Conservation Biology* 12(3): 718-721.
- Welch, d'A. A. 1938. Distribution and variation of the Hawaiian tree snail *Achatinella mustelina* Mighels in the Waianae Mountains, Oahu. *Bernice P. Bishop Museum Bulletin* 152.