

*Achatinella abbreviata*  
(*O`ahu Tree Snail*)

**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: *Achatinella abbreviata* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION .....</b>	<b>3</b>
1.1	Reviewers.....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS.....</b>	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS .....</b>	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	10
3.3	Listing and Reclassification Priority Number: .....	10
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS.....</b>	<b>11</b>
<b>5.0</b>	<b>REFERENCES.....</b>	<b>11</b>
	Signature Page.....	14

**5-YEAR REVIEW**  
***Achatinella abbreviatta* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella abbreviata* is not robust with only one individual observed in the past 3 years. Currently this species is not in captive propagation. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella abbreviata*.

**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:**

Since the recovery plan was published in 1992, no surveys were conducted until 2001 when portions of the historical range of *A. abbreviata* were surveyed. The most recent sighting of *A. abbreviata* was in 2008. A single live snail was found on a small *Metrosideros polymorpha* (ohi`a lehua) near the summit of Waialae Nui, on the leeward side of the southern Ko`olau Mountains. Subsequent survey trips to the same spot resulted in zero snail observations (N. Yuen, Biological Consultant, pers. com. 20011a). In October 2009, a search was conducted along the summit of Waialae Nui, in the adjacent hanging valleys, and on the ridges off Waialae Nui (V. Costello, U.S. Army Natural Resource, pers. comm. 2011). No live snails were found during the trip.

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella abbreviata*.

#### **2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella abbreviata*.

#### **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.):**

There is no new information on the spatial distribution or historic range of *Achatinella abbreviata*.

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

The habitat near the summit of Waialae Nui, the adjacent hanging valleys, and the ridges off Waialae Nui is primarily native vegetation with numerous native common snails and some rare plants (V. Costello, U.S. Army Natural Resource, pers. comm. 2011).

#### **2.3.1.7 Other:**

None

### **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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella abbreviata* continues to be threatened by the spreading of invasive plants into higher elevations and feral pigs (*Sus scrofa*) and goats (*Capra hircus*), hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvenscens* (Weed Risk Assessments for Hawai'i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

#### **2.3.2.2 Overutilization for commercial, recreational, scientific, or**

### **educational purposes:**

Illegal shell collecting is a continuing threat to the species.

### **2.3.2.3 Disease or predation:**

*Achatinella abbreviata* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juvenile under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius*, and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eats snails (USFWS 1992) may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army 2008) and in the Ko'olau Mountains (B. Holland, University of Hawai'i, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and

birds may have on *Achatinella* spp. (B. Holland, University of Hawai'i, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. abbreviata* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

This species is not in captive propagation and there are no other conservation measures being taken at this time for *A. abbreviata*.

Climate change may also pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

## **2.4 Synthesis**

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *Achatinella abbreviata* was classified as having the status of probably being extinct. *A. abbreviata* was historically located in the southern Ko`olau Mountains, on the leeward slopes.

Since 2001, portions of the historical range of *A. abbreviata* have been surveyed by several individuals. The most recent sighting of *A. abbreviata* was in 2008 where a single live snail was found on a small *Metrosideros polymorpha* (ohi`a lehua) near the summit of Waialae Nui, on the leeward side of the southern Ko`olau Mountains (N. Yuen, Biological Consultant, pers. comm. 2009). Subsequent surveys in the same location, along the summit of Waialae Nui, in the adjacent hanging valleys, and on the ridges off Waialae Nui resulted in no snail sightings (V. Costello, U.S. Army Natural Resource, pers. comm. 2011).

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are

threatened by displacement and competition from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Predation by *Euglandina rosea* and rats are major threats to *A. abbreviata*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, University of Hawai`i, pers. comm. 2011a).

Species like *A. abbreviata* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Due to extremely limited numbers of individuals observed in the wild, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. abbreviata* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_

**Brief Rationale:** N/A

#### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella abbreviata* is found in the wild.
- Routinely survey and monitor areas with existing populations of *A. abbreviata*.
- Survey areas with suitable habitat and within the historical range of *A. abbreviata*.
- Identify suitable habitat within the historical range of *A. abbreviata* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons within the species' historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. abbreviata* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

#### 5.0 REFERENCES

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i ( Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawai'ian tree snails by alien predators. American Zoologist. 33: 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. Biodiversity and Conservation (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. Pacific Science. 46: 77-85.

[US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O`ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.

Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.

[USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. *Federal Register* 8(46):3178-3182.

[USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Costello, Vince. 2011. U.S. Army Natural Resource Staff, Directorate of Public Works, Natural Resources Division, Schofield Barracks, Hawai`i. Electronic message regarding 5-Year review questions. Received by Joy Browning, U.S. Fish and Wildlife Service, dated May 2, 2011.

Holland, Brenden. 2011. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation regarding *Gonaxis kibweziensis*. Received by Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011.

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Miller, Stephen. 2011. U.S. Fish and Wildlife Service, Honolulu, Hawai`i. Electronic message regarding O`ahu Tree Snail Surveys and *Gonaxis kibweziensis*. Received by Joy Browning, U.S. Fish and Wildlife Service, dated April 14, 2011.

Yuen, Nathan. 2011a. Biological Consultant, Honolulu, Hawai`i. Electronic message regarding O`ahu Tree Snail Surveys. Received by Guadalupe J. Ruiz-Jones, University of Hawaii at Manoa, dated Oct. 20, 2009.

Yuen, Nathan. 2011b. Biological Consultant, Honolulu, Hawai'i. Electronic message regarding *Gonaxis kibweziensis*. Received by Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011.



*Achatinella apexfulva*  
(*O`ahu Tree Snail*)

**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: *Achatinella apexfulva* (O'ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review: .....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria .....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis .....	10
<b>3.0</b>	<b>RESULTS</b> .....	<b>12</b>
3.1	Recommended Classification: .....	12
3.2	New Recovery Priority Number: .....	12
3.3	Listing and Reclassification Priority Number: .....	12
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>12</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>13</b>
	Signature Page .....	16

**5-YEAR REVIEW**  
***Achatinella apexfulva* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the O`ahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella apexfulva* is not robust with only one wild individual observed in the past 6 years and only two individuals in captive propagation (Hadfield 2010). The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella apexfulva*.

**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:**

*Achatinella apexfulva* is so rare in the wild (US Army 2009) that it was presumed extinct in the field (Holland and Hadfield 2004). In 1998, one population of *A. apexfulva* was identified on the Paomaho Trail, in the Ko’olau Mountains on the island of O’ahu. The most recent sighting of live *A. apexfulva* in the field was on February 16, 2005; only one adult was found and it was taken to the Hawaiian Tree Snail Conservation Captive-Propagation Lab located on the University of Hawai’i at Mānoa campus (US Army 2009).

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

Analyses of mitochondrial sequence data from 16S and cytochrome *c* oxidase subunit I (COI) revealed that *Achatinella apexfulva*, *Achatinella livida*, *Achatinella mustelina*, and *Achatinella sowerbyana* are in the same monophyletic clade (Thacker and Hadfield 2000; Holland and Hadfield 2002). Additionally, according to mitochondrial DNA-sequence analysis,

*A. apexfulva*, *A. livida*, and *A. sowerbyana* were grouped together into the same subgenus (Holland and Hadfield 2002).

According to COI-sequence analyses of all extant *Achatinella* spp., *A. apexfulva* is most closely related to *A. concavospira*, making the two species sister taxa. This is interesting, because these two species are found on different mountain ranges, *A. apexfulva* in the Ko`olau Mountains and *A. concavospira* in the Wai`anae Mountains (Holland and Hadfield 2004).

#### **2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella apexfulva*.

#### **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.):**

There is no new information on the spatial distribution or historic range of *Achatinella apexfulva*.

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

The tree-snail habitat present in the north Ko`olau summit area is in good condition. The area is characterized by tall native vegetation, but invasive grasses are present. Tree snails found in this location, live on native trees (M. Hadfield, University of Hawai`i, pers. comm. 2010).

#### **2.3.1.7 Other:**

None

### **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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella apexfulva* continues to be threatened by the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*), feral goats (*Capra hircus*), hunting, and hiking. Tree-snail host plants are threatened by

invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 20011). Invasive plant species compete with host plant species for space and resources. Feral pigs trample host plant species and spread the seeds of invasive plant species (USFWS 1992). The population of *A. apexfulva* located along the Poamoho Trail, that has been monitored by the Army Natural Resource Section (ANRS) since 1998, is not managed for weed control and no ungulate fence is present to keep feral pigs away (US Army 2009).

The majority of the historical range of *A. apexfulva* lies within the US Army's Kawaihoa Training Area and Schofield Barracks East Range, (USFWS 1992; USFWS 2003). Tree-snail species are threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the Military via transportation on boots, vehicles, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, Military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

#### **2.3.2.3 Disease or predation:**

*Achatinella apexfulva* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko`olau and Wai`anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O`ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juvenile under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O`ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai`i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O`ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius*, and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eats snails (USFWS 1992) may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O`ahu from low elevations up to Mount Ka`ala in the Wai`anae Mountains (US Army 2008) and in the Ko`olau Mountains (B. Holland, University of Hawai`i, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, University of Hawai`i, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. apexfulva* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

Conservation measures for this species include captive propagation and genetic research. Individuals of *Achatinella apexfulva* have been maintained in the Hawaiian Tree Snail Conservation Captive-Propagation

Lab at the University of Hawai'i at Mānoa since 1994. In July 1994, four *A. apexfulva* (two adults and two subadults) were brought into the facility. In July 1998, one more adult was added to the captive population. In March 2001, two more adults were added. In February 2005, one more adult was added (Hadfield 2010). All individuals of *A. apexfulva* were collected from Poamoho Trail. The population trend of *A. apexfulva* in the lab is one of decline due to low reproductive output and mortality (Hadfield 2010).

Tree snails are brought into the captive-propagation facility because they are highly endangered in the field. Conditions in the lab duplicate conditions in the field, as much as possible. Environmental data were gathered from field sites in order to reproduce similar conditions in the lab. The temperature (average between 16° C and 20° C), humidity, rainfall, day length (12 hours), and substratum (native host-tree species) found in the field, are reproduced as best as possible in the environmental chambers in which the captive-reared snails live. The snails are provided with leafy branches of *Metrosideros polymorpha*. The epiphytic black mold *Cladosporium* sp, which is the snails' food source, is propagated in the lab and added as an additional food source. Most of the species in the facility initially experience an adaptation period, in which there is very low reproductive output. In some species, the adaptation period is followed by an increase in reproductive output and population size (Hadfield *et al.* 2004).

The population of *A. apexfulva* that has been monitored by the ANRS since 1998 is not managed to control predators; a predator-exclosure fence is not present and no rat-control efforts are underway (US Army 2009).

Climate change may also pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

## 2.4 Synthesis

In the 1992 recovery plan for the O'ahu tree snails of the genus *Achatinella*, *Achatinella apexfulva* was classified as having the status of extant, but uncommon. *A. apexfulva* was historically located on the leeward slopes of the northern Ko'olau Mountains. The area within the historical range where there have been recent sightings of *A. apexfulva* lies within the U.S. Army's Training Area.

The U.S. Army has been surveying for *A. apexfulva* since 1998 and have found very few live snails in the wild. The most recent field sighting was in February 2005; a single live snail was found on Poamoho Trail and removed to the Hawaiian Tree Snail Conservation Captive Propagation laboratory. The Army Natural Resource Staff (ANRS) has surveyed for *A. apexfulva*, because portions of its historical range lie within the US Army's lands, where there are current populations of other species of *Achatinella*. The ANRS staff has conducted seven surveys of the area where this population was found between 1998 and 2007. The most recent survey of this population was conducted on August 31, 2007; no live *A. apexfulva* were found.

The Hawaiian Tree Snail Conservation Captive Propagation Lab located on the grounds of the University of Hawai'i at Mānoa campus has maintained individuals of *A. apexfulva* since 1994. The lab population of *A. apexfulva* has decreased overtime due to low reproductive output and mortality. In January 2010, there were two live *A. apexfulva* in the facility (Hadfield 2010).

The degree of habitat degradation varies within the historical range of the O'ahu tree snails. The presence and abundance of invasive plant species, feral pigs and goats result in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs and goats; hunting activities, and hiking activities threaten tree-snail host plants by trampling them.

Tree-snail habitat and snails located within US Army Training Areas can be threatened directly and indirectly by Military training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the Military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, Military vehicles and other equipment used during training activities can be potential sources of fire ignition.

Predation by *Euglandina rosea* and rats are major threats to *A. apexfulva*. The Jackson's chameleon has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snail *Oxychilus alliarius* and *Gonaxis kibweziensis* may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O'ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, University of Hawai'i, pers. comm. 2011a).

Species like *A. apexfulva* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

Due to extremely limited numbers of individuals observed in the wild, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. apexfulva* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:** N/A

### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella abbreviata* is found in the wild.
- Routinely survey and monitor areas with existing populations of *Achatinella. apexfulva*.
- Survey areas with suitable habitat, within the historical range of *A. apexfulva*.
- Continue and possibly expand captive-propagation efforts with the intended goals of increasing the population size in a predator-free environment and eventually reintroducing captive-reared *A. apexfulva* into the wild (Recovery Action 12 and 13).
- Develop reintroduction plans for future releases into predator free sites in the wild.
- Identify suitable habitat sites that may serve as potential reintroduction sites for captive-reared *A. apexfulva* (Recovery Action 51).
- Identify suitable habitat within the historical range of *A. apexfulva* to construct predator proof enclosures where snails found in the wild could be moved into.

- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. apexfulva* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). *Proceedings, Hawaiian Entomological Society*. 18: 377-389.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. *American Zoologist*. 33: 610-622.
- Hadfield, M.G., B.S. Holland, and K.J. Olival. 2004. Contributions of ex situ propagation and molecular genetics to conservation of Hawaiian tree snails. *Experimental approaches to conservation biology*. Gordon, M.S.; Bartol, S.M. [Eds]. University of California Press. Chapter pagination: 16-34.
- 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.
- Hadfield, M.G. 2010. Annual report to the USFWS for Permit TE826600-11. University of Hawai'i, Honolulu, Hawai'i. 12 pages. Unpublished.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- 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. 2004. Origin and diversification of the endemic Hawaiian tree snails (Achatinellidae: Achatinellinae) based on molecular evidence. *Molecular Phylogenetics and Evolution*. 32: 588-600.

- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.
- Thacker, R.W. and M.G. Hadfield. 2000. Mitochondrial phylogeny of extant Hawaiian tree snails (Achatinellinae). *Molecular Phylogenetics and Evolution*. 16 (2): 263-270.
- [US Army] U.S. Army Garrison, Hawai'i Directorate of Public Works Environmental Division. 2008. Final implementation plan for O'ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.
- [US Army] U.S. Army Garrison. 2009. Hawai'i Makua Collection Monitoring and Nursery Database. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawai'i. Unpublished.
- [USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O'ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O'ahu. Unpublished, 351 pp.
- Weed Risk Assessments for Hawai'i and Pacific Islands. 2011. Weed risk assessments for Hawai'i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai'i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

- Costello, Vince. 2011. Army Natural Resource Staff, Directorate of Public Works, Natural Resources Division, Schofield Barracks, Hawai'i. E-mail to Joy Browning, U.S. Fish and Wildlife Service, dated May 2, 2011. Subject: 5-year Review Questions.
- Hadfield, Michael. 2011. Kewalo Marine Laboratory, University of Hawai'i, Mānoa, Honolulu, Hawai'i. Email to Joy Browning, U.S. Fish and Wildlife Service, dated \_\_\_\_\_. Subject \_\_\_\_\_.

- Holland, Brenden. 2011a. Department of Zoology, University of Hawaii at Manoa, Honolulu, Hawaii. Telephone Conversation Record to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*
- Holland, Brenden. 2011b. Department of Zoology, University of Hawai'i at Mānoa, Honolulu, Hawai'i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.
- Miller, Stephen. 2011. U.S. Fish and Wildlife Service, Honolulu, Hawaii. E-mail to Joy Browning, U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: O`ahu Tree Snail Survey and *Gonaxis kibweziensis*
- Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawaii. E-mail to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree Snail Surveys and *Gonaxis kibweziensis*.

**Signature Page**  
**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of *Achatinella apexfulva***

**Current Classification:**           E          

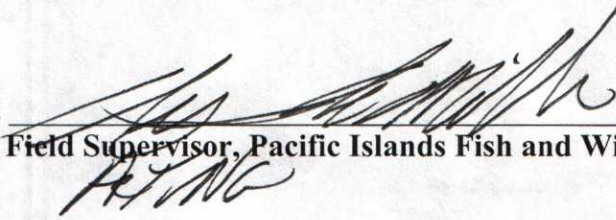
**Recommendation resulting from the 5-Year Review:**

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

**Appropriate Listing/Reclassification Priority Number, if applicable:** \_\_\_\_\_

**Review Conducted By:**

Joy Hiromasa Browning, Fish and Wildlife Biologist  
Jess Newton, Endangered Species Recovery Program Leader  
Assistant Field Supervisor for Endangered Species

Approved  Date 8/2/11  
Field Supervisor, Pacific Islands Fish and Wildlife Office

*Achatinella bellula*  
(*O`ahu Tree Snail*)

**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: *Achatinella bellula* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION .....</b>	<b>3</b>
1.1	Reviewers.....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS.....</b>	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS .....</b>	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	10
3.3	Listing and Reclassification Priority Number: .....	10
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS.....</b>	<b>10</b>
<b>5.0</b>	<b>REFERENCES.....</b>	<b>11</b>
	Signature Page.....	13

**5-YEAR REVIEW**  
***Achatinella bellula* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the O`ahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella bellula* is not robust when last observed in 1981 despite recent survey efforts. Currently this species is not in captive propagation. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *A. bellula*.

**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:**

There is no new information on the abundance, population trends, demographic features, or demographic trends of *A. bellula*.

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *A. bellula*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *A. bellula*.

**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.):**

There is no new information on the spatial distribution or historic range of *A. bellula*.

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

There is no new information on the habitat conditions.

**2.3.1.7 Other:**

In late May 2002, a snail was found at Kōnāhuanui and it was identified as *Achatinella stewartii*; however, it may in fact have been *A. bellula* (refer to the 5-year review of *Achatinella stewartii*).

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella bellula* continues to be threatened by the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats (*Capra hircus*), hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

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

Illegal collecting is a continuing threat to the species.

**2.3.2.3 Disease or predation:**

*Achatinella abbreviata* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When

*E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juvenile under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius*, and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eats snails (USFWS 1992) may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army 2008) and in the Ko'olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. bellula* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species

because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

This species is not in captive propagation and there are no other conservation measures being taken at this time for *A. bellula*.

Climate change may also pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

## 2.4 Synthesis

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *Achatinella bellula* was classified as having the status of probably extant. *A. bellula* was historically located on the leeward slopes of the southern Ko`olau Mountains. The most recent sighting of *A. bellula* was in 1981 above Pāhoa Flats (USFWS 1992).

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by displacement and competition from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Predation by *Euglandina rosea* and rats are major threats to *A. abbreviata*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. bellula* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

Due to extremely limited numbers of individuals observed in the wild, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. bellula* remain classified as endangered.

### 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: N/A

Brief Rationale: N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

Reclassification (from Threatened to Endangered) Priority Number: \_\_\_\_\_

Reclassification (from Endangered to Threatened) Priority Number: \_\_\_\_\_

Delisting (regardless of current classification) Priority Number: \_\_\_\_\_

Brief Rationale: N/A

### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella bellula* is found in the wild.
- Routinely survey and monitor areas with existing populations of *A. bellula*.
- Identify suitable habitat within the historical range of *A. abbreviata* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. abbreviata* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i ( Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawai'ian tree snails by alien predators. American Zoologist. 33: 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. Biodiversity and Conservation (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. Pacific Science. 46: 77-85.
- [US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O'ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. Biological Invasions. 11: 737-742.
- [USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. Federal Register 8(46):3178-3182.
- [USFWS] U.S. Fish and Wildlife Service. 1992. Recovery plan O'ahu tree snails of the genus *Achatinella*. Region 1, Portland, OR. 64 pp.
- Weed Risk Assessments for Hawai'i and Pacific Islands. 2011. Weed risk assessments for Hawai'i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai'i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 29 October 2011.

## PERSONAL AND WRITTEN COMMUNICATIONS

- Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Telephone Conversation regarding *Gonaxis kibweziensis*. Received by Joy Browning, U.S. Fish and Wildlife Service, dated April 14, 2011.
- Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.
- Miller, Stephen. 2011. U.S. Fish and Wildlife Service, Honolulu, Hawai`i. Electronic message regarding O`ahu Tree Snail Surveys and *Gonaxis kibweziensis*. Received by Joy Browning, U.S. Fish and Wildlife Service, dated April 14, 2011.
- Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawai`i. Electronic message regarding O`ahu Tree Snail Surveys and *Gonaxis kibweziensis*. Received by Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. .

**Signature Page**  
**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of *Achatinella bellula***

Current Classification:           E          

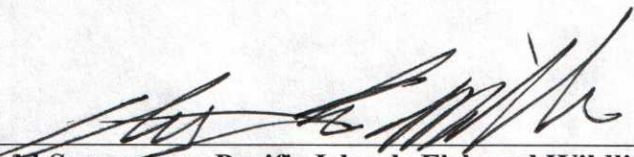
**Recommendation resulting from the 5-Year Review:**

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

**Appropriate Listing/Reclassification Priority Number, if applicable:** \_\_\_\_\_

**Review Conducted By:**

Joy Hiromasa Browning, Fish and Wildlife Biologist  
Jess Newton, Recovery Program Lead  
Assistant Field Supervisor for Endangered Species

Approved  Date 8/2/11  
Field Supervisor, Pacific Islands Fish and Wildlife Office  
ACTING

*Achatinella buddii*  
(*O`ahu Tree Snail*)

**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: *Achatinella buddii* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS</b> .....	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	10
3.3	Listing and Reclassification Priority Number: .....	10
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>10</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>11</b>
	Signature Page.....	13

**5-YEAR REVIEW**  
***Achatinella buddii* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella buddii* is not robust when no individuals have been observed in the past 10 years. Currently this species is not in captive propagation. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella buddii*.

**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:**

In November and December of 2008, two surveys were conducted within the historical range of *A. buddii*: (1) Wai`ōma`o Stream (small gullies in upper reaches of Wai`ōma`o Stream) and (2) the lower section of Waialae Nui Trail (valley between Mau`umae and Wai`alae Nui). No living snails or shells of *A. buddii* were found during the surveys (N. Yuen, Biological Consultant, pers. comm. 2011).

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella buddii*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella buddii*.

**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.):**

There is no new information on the spatial distribution or historic range of *Achatinella buddii*.

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

There is no new information on the habitat or ecosystem conditions.

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella buddii* continues to be threatened by the spreading of invasive plants into higher elevations and feral pigs (*Sus scrofa*) and goats (*Capra hircus*), hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai'i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

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

Illegal shell collecting is a continuing threat to the species.

**2.3.2.3 Disease or predation:**

*Achatinella buddii* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus*

*norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juvenile under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius*, and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eats snails (USFWS 1992) may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army 2008) and in the Ko'olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, University of Hawai'i, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued**

**existence:**

Species like *A. buddii* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

This species is not in captive propagation and there are no other conservation measures being taken at this time for *A. buddii*.

Climate change may also pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Climate change may also pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

## **2.4 Synthesis**

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. buddii* was classified as having the status of almost certainly extinct. *Achatinella buddii* was historically located on the leeward slopes of the southern Ko`olau Mountains. By 1900 *A. buddii* was considered uncommon (USFWS 1992). In 2008 two tree snail surveys were conducted in two different areas of *A. buddii*'s historical range; Wai`ōma`o Stream (the small gullies in the upper reaches of Wai`ōma`o Stream) and the lower section of Wai`alae Nui Trail (the valley between Mau`umae and Wai`alae Nui). No living snails or shells of *A. buddii* were found during either survey.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking activities have resulted in habitat degradation and loss. Tree-snail host plants are threatened by displacement and competition from invasive plants. Feral ungulates threaten tree-snail host plants by trampling them.

Predation by *Euglandina rosea* and rats are major threats to *A. buddii*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails *Oxychilus alliarius*, and *Gonaxis kibweziensis* may threaten *Achatinella*

spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. buddii* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

Due to extremely limited numbers of individuals observed in the wild, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. buddii* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:** N/A

### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella buddii* is found in the wild.
- Routinely survey and monitor areas with existing populations of *Achatinella. buddii*.
- Survey areas with suitable habitat, within the historical range of *A. buddii*
- Identify suitable habitat within the historical range of *A. buddii* to construct predator proof enclosures where snails found in the wild could be moved into.

- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. buddii* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). *Proceedings, Hawaiian Entomological Society*. 18: 377-389.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawai'ian tree snails by alien predators. *American Zoologist*. 33: 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- [US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O'ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.

[USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. Federal Register 8(46):3178-3182.

[USFWS 1992] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

### **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Miller, Stephen. 2011. U.S. Fish and Wildlife Service, Honolulu, Hawai`i. Electronic message regarding *Gonaxis kibweziensis*. Received by Joy Browning, U.S. Fish and Wildlife Service, dated April 14, 2011.

Yuen, Nathan. 2009. Biological Consultant, Honolulu, Hawai`i. Electronic message regarding O`ahu Tree Snail Surveys. Received by Guadalupe J. Ruiz-Jones, University of Hawaii at Manoa, dated Oct. 20, 2009.

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawai`i. Electronic message regarding O`ahu Tree snail surveys and *Gonaxis kibweziensis*. Received by Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011.

**Signature Page**  
**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of *Achatinella buddii***

**Current Classification:**           E          

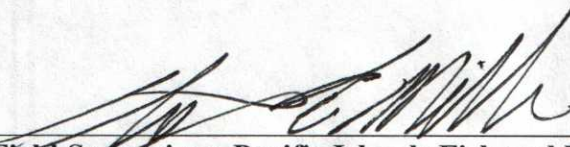

**Recommendation resulting from the 5-Year Review:**

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

**Appropriate Listing/Reclassification Priority Number, if applicable:**                                 

**Review Conducted By:**

Joy Hiromasa Browning, Fish and Wildlife Biologist  
Jess Newton, Endangered Species Recovery Program Leader  
Assistant Field Supervisor for Endangered Species

Approved  Date   
Field Supervisor, Pacific Islands Fish and Wildlife Office  
*ACTING*

*Achatinella bulimoides*  
(*O`ahu Tree Snail*)

**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: *Achatinella bulimoides* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	10
<b>3.0</b>	<b>RESULTS</b> .....	<b>11</b>
3.1	Recommended Classification:.....	11
3.2	New Recovery Priority Number: .....	12
3.3	Listing and Reclassification Priority Number: .....	12
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>12</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>13</b>
	Signature Page.....	15

**5-YEAR REVIEW**  
***Achatinella bulimoides* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the O`ahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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*  
       *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?**

  X   *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?**

  X   *Yes*  
       *No*

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

  X   *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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly know that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella bulimoides* is not robust with only one individual observed in the past 3 years. Currently this species is not in captive propagation. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella bulimoides*.

**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 table below lists the surveys of the single known population of *Achatinella bulimoides* that have been conducted since 2004 (M. Hadfield, University of Hawai`i, pers. comm. 2010; US Army 2009).

<b>Date</b>	<b>Total No. of <i>A. bulimoides</i> found</b>
12-1-2004	0
5-5-2005	2
7-12-2005	3
10-20-2005	2
4-19-2006	5
8-31-2007	2

Additional surveys have not been conducted in that area (US Army 2009).

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella bulimoides*.

#### **2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella bulimoides*.

#### **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.):**

*Achatinella bulimoides* is found at only one location on the windward cliffs of Punalu`u, below the Ko`olau Summit Trail and north of the Poamoho Trail summit (US Army 2009). Kamehameha Schools is the owner of this land (Hawai`i Statewide GIS Program 2009).

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

The tree-snail habitat present in the north Ko`olau summit area is in good condition. The area is characterized by tall native vegetation, but invasive grasses are present. Tree snails found in this location, live on native trees (M. Hadfield, University of Hawai`i, pers. comm. 2010).

#### **2.3.1.7 Other:**

None

### **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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella bulimoides* continues to be threatened by the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats (*Capra hircus*), hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific

Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992). The population of *A. bulimoides*, which is monitored by the U.S. Army Natural Resource Staff, is not managed for weed control and an ungulate fence is not present to keep feral pigs away (US Army 2009).

Portions of the historical range of *A. bulimoides* lie within the US Army's Kahuku Training Area, Kawaihoa Training Area, and Schofield Barracks East Range (USFWS 1992; USFWS 2003). Tree-snail species can be threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the Military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, Military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

#### **2.3.2.3 Disease or predation:**

*Achatinella bulimoides* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juvenile under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a

significant threat to *Achatinella* spp. Although released at various elevations around O`ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai`i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O`ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius*, and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eats snails (USFWS 1992) may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O`ahu from low elevations up to Mount Ka`ala in the Wai`anae Mountains (OIP 2008) and in the Ko`olau Mountains (B. Holland, University of Hawai`i, pers. comm. 2011b; however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992).

The population of *A. bulimoides* is not managed for predator control; *E. rosea* exclosures are not present and rat-control efforts are not underway (US Army 2009).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. bulimoides* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Conservation measures for this species include captive propagation. Individuals of *Achatinella bulimoides* have been maintained in the captive-propagation lab at the University of Hawai`i at Mānoa since 2005. In 2005, three trips were taken to the windward cliffs of Punalu`u, below the Ko`olau summit trail and north of the Poamoho trail summit, and collections of *A. bulimoides* were made. In total, seven adults were

collected to initiate the captive propagation of *A. bulimoides* (M. Hadfield, University of Hawai'i, pers. comm. 2010). An additional collection was made in April 2006; three adult *A. bulimoides* were brought into the lab from the same location as previous collections (US Army 2009). The lab population of *A. bulimoides* has steadily increased, reaching 39 individuals as of December 2009 (M. Hadfield, University of Hawai'i, pers. comm. 2010).

Tree snails are brought into the captive-propagation facility because they are highly endangered in the field. Conditions in the lab duplicate conditions in the field, as much as possible. Environmental data were gathered from field sites in order to reproduce similar conditions in the lab. The temperature (average between 16° C and 20° C), humidity, rainfall, day length (12 hours), and substratum (native host-tree species) found in the field, are reproduced as best as possible in the environmental chambers in which the captive-reared snails live. The snails are provided leafy branches of *Metrosideros polymorpha*. The epiphytic black mold *Cladosporium* sp, which is the snails' food source, is propagated in the lab and added as an additional food source. Most of the species in the facility initially experience an adaptation period, in which there is very low reproductive output. In some species, the adaptation period is followed by an increase in reproductive output and population size (Hadfield *et al.* 2004).

Climate change may also pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

## 2.4 Synthesis

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. bulimoides* was classified as having the status of probably extant, having last been seen in 1985. *Achatinella bulimoides* was historically located on the windward and leeward slopes of the northern Ko`olau Mountains. The area within the historical range where there have been recent sightings of *A. bulimoides* is located on the windward cliffs above Punalu`u, below the Ko`olau Summit Trail and north of the Poamoho Trail summit.

The most recent field sighting of *A. bulimoides* was in August 2007; two live snails were found at the only currently known population of *A. bulimoides*. The Army Natural Resource Staff (ANRS) has surveyed for *A. bulimoides*, because portions of its historical range lie within the US Army's Kawaihoa Training Area and Schofield Barracks East Range, where there are current populations of other species of *Achatinella*. The ANRS

has been monitoring the only current known population of *A. bulimoides* since 2004 and has conducted six surveys of this population.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Tree-snail habitat and snails located within US Army lands can be threatened directly and indirectly by Military training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the Military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, Military vehicles and other equipment used during training activities can be potential sources of fire ignition.

Predation by *Euglandina rosea* and rats are major threats to *A. bulimoides*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snail *Oxychilus alliarius*, *Gonaxis kibweziensis* may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, University of Hawai`i, pers. comm. 2011).

Species like *A. bulimoides* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

The Hawai`i Tree Snail Conservation Lab captive-propagation program at the University of Hawai`i at Mānoa has maintained individuals of *A. bulimoides* since 2005. A total of ten *A. bulimoides* was brought into the lab in 2005 and 2006. The population has slowly increased, reaching 39 in December 2009.

Due to the lack of data and the present circumstance of *A. bulimoides*, it is recommended that *A. bulimoides* remains classified as endangered.

### 3.0 RESULTS

#### 3.1 Recommended Classification:

- Downlist to Threatened
- Uplist to Endangered
- Delist

\_\_\_\_ *Extinction*  
\_\_\_\_ *Recovery*  
\_\_\_\_ *Original data for classification in error*  
 X  **No change is needed**

**3.2 New Recovery Priority Number: N/A**

**Brief Rationale: N/A**

**3.3 Listing and Reclassification Priority Number: N/A**

**Reclassification (from Threatened to Endangered) Priority Number: \_\_\_\_**

**Reclassification (from Endangered to Threatened) Priority Number: \_\_\_\_**

**Delisting (regardless of current classification) Priority Number: \_\_\_\_**

**Brief Rationale: N/A**

**4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

- Routinely survey and monitor areas with currently existing populations of *Achatinella bulimoides*.
- Survey areas with suitable habitat, within the historical range of *A. bulimoides*.
- If additional *A. bulimoides* individuals or populations are found in the wild, its geographical position and area should be mapped (Recovery Action 22).
- Immediately implement the best available predator control measures if an individual(s) is found.
- Continue and possibly expand captive-propagation efforts with the intended goals of increasing the population size in a predator-free environment and eventually reintroducing captive-reared *A. bulimoides* into the wild (Recovery Action 12 and 13).
- Develop reintroduction plans for future releases into predator free sites in the wild.
- Identify suitable habitat sites that may serve as potential reintroduction sites for captive-reared *A. bulimoides* (Recovery Action 51).
- Identify sites where *A. bulimoides* are present that may be potential locations for predator enclosure fences.
- Identify areas within the historical range of *A. abbreviate* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.

- Design and implement more effective predator elimination techniques within the historical range of *A. bulimoides* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. *American Zoologist*. 33: 610-622.

Hadfield, M.G., B.S. Holland, and K.J. Olival. 2004. Contributions of ex situ propagation and molecular genetics to conservation of Hawaiian tree snails. *Experimental approaches to conservation biology*. Gordon, M.S.; Bartol, S.M. [Eds]. University of California Press. Chapter pagination: 16-34.

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.

Hawai'i Statewide GIS Program. 2009. Large Landowners download [web application]. Office of Planning, Department of Business, Economic Development, and Tourism, State of Hawai'i. Available online at <Hawaii.gov/dbedt/gis>.

Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).

Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.

Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.

[US Army] U.S. Army Garrison, Hawai'i Directorate of Public Works Environmental Division. 2008. Final implementation plan for O'ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.

[US Army] U.S. Army Garrison. 2009. Hawai'i Makua Collection Monitoring and Nursery Database. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawai'i. Unpublished.

[USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. Federal Register 8(46):3178-3182.

[USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Hadfield, Michael. 2010. Department of Zoology, University of Hawai`i, Honolulu, Hawai`i.

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Telephone Conversation regarding *Gonaxis kibweziensis*. Conversation with Joy Browning U.S. Fish and Wildlife Service. Dated April 14, 2011.

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Miller, Stephen. 2011. U.S. Fish and Wildlife Service, Honolulu, Hawai`i. Electronic message regarding *Gonaxis kibweziensis*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated April 14, 2011.

**Signature Page**  
**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of *Achatinella bulimoides***

**Current Classification:**           E          

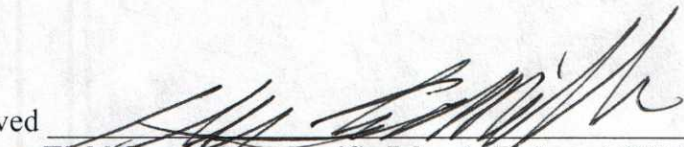
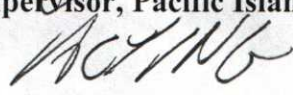
**Recommendation resulting from the 5-Year Review:**

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

**Appropriate Listing/Reclassification Priority Number, if applicable:** \_\_\_\_\_

**Review Conducted By:**

Joy Hiromasa Browning, Fish and Wildlife Biologist  
Jess Newton, Endangered Species Recovery Program Leader  
Assistant Field Supervisor for Endangered Species

Approved  Date 8/2/11  
  
Field Supervisor, Pacific Islands Fish and Wildlife Office

*Achatinella byronii*  
(*O`ahu Tree Snail*)

**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: *Achatinella byronii* (O'ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>1</b>
1.1	Reviewers .....	1
1.2	Methodology used to complete the review:.....	1
1.3	Background: .....	1
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>2</b>
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.....	7
<b>3.0</b>	<b>RESULTS</b> .....	<b>9</b>
3.1	Recommended Classification:.....	9
3.2	New Recovery Priority Number: .....	9
3.3	Listing and Reclassification Priority Number: .....	9
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>9</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>10</b>
	Signature Page.....	12

## **5-YEAR REVIEW**

### ***Achatinella byronii* / O`ahu Tree Snail**

#### **1.0 GENERAL INFORMATION**

##### **1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the O`ahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

##### **1.3 Background:**

###### **1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella byronii* is not robust with only eight snails found in the wild in 2009 (US Army 2009). This species is not in captive propagation. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella byronii*.

**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 most recent sighting of live *A. byronii* was on May 6, 2009; seven large snails and one medium snail were sighted in the Kawaihoa Training Area (US Army 2009).

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

A genetic analysis of specimens that were identified as *Achatinella byronii* and *Achatinella decipiens* found the two specimens differed by one base pair in their mitochondrial 16S ribosomal DNA sequence. This high degree of genetic similarity signifies that the two specimens were not members of separate species (Thacker and Hadfield 2000).

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella byronii*.

**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.):**

*Achatinella byronii* is found in the northern Ko`olau Mountains, at elevations ranging from 1800 ft. to 2520 ft. (549 m to 768 m). The Army Natural Resource Staff (ANRS) monitors 15 sites. Nine of the sites for *A. byronii* are at least 100 m from each other and, therefore, are considered distinct populations. There are population sites for *A. byronii* that are located within 100 m of population sites for *Achatinella bulimoides*, *Achatinella lila*, and *Achatinella sowerbyana* (US Army 2009).

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

The tree-snail habitat present in the north Ko`olau summit area is in good condition. The area is characterized by tall native vegetation, but invasive grasses are present (US Army 2009).

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella byronii* continues to be threatened by the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*), feral goats (*Capra hircus*), hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral pigs trample host plant species and spread the seeds of invasive plant species (USFWS 1992). Only one site that the ANRS monitors for *A. byronii* has a predator enclosure and is controlled for rats and weeds.

The portion of the historical range of *A. byronii* lies within the US Army's Kawaihoa Training Area and Schofield Barracks East Range (USFWS 1992; USFWS 2003). Tree-snail species are threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, vehicles, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

#### **2.3.2.3 Disease or predation:**

*Achatinella byronii* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. comm. 2011b; Hawaiianforest.com 2011). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N.

Yuen, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius*, and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eats snails (USFWS 1992) may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O`ahu from low elevations up to Mount Ka`ala in the Wai`anae Mountains (US Army 2008) and in the Ko`olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. byronii* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

This species is not in captive propagation and there are no other conservation measure being taken at this time specifically for *A. byronii*.

## **2.4 Synthesis**

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. byronii* was classified as having the status of probably extant. *Achatinella byronii* was historically located on the leeward slopes of the central Ko`olau Mountains. The

northern portion of its historical range lies within the US Army's Kawaihoa Training Area and Schofield Barracks East Range.

The Army Natural Resource Staff (ANRS) began monitoring *A. byronii* in 1997. The most recent sighting of *A. byronii* was in May 2009; eight live snails were found at a population located in the Kawaihoa Training Area. The ANRS has surveyed for *A. byronii*, because portions of its historical range lie within the US Army's Kawaihoa Training Area and Schofield Barracks East Range, where there are current populations of other species of *Achatinella*. The ANRS has identified 15 sites for *A. byronii*; these sites are the same for *Achatinella decipiens*, which the ANRS does not distinguish from *A. byronii*.

The degree of habitat degradation varies within the historical range of the O'ahu tree snails. The presence and abundance of invasive plant species and feral pigs and goats result in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs and goats, hunting activities, and hiking activities threaten tree-snail host plants due to trampling.

Tree-snail habitat and snails located within US Army Training Areas can be threatened directly and indirectly by military training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition.

Predation by *Euglandina rosea* and rats are major threats to *A. byronii*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O'ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. byronii* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to extremely limited numbers of individuals observed in the wild, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. byronii* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:** N/A

### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella byronii* is found in the wild.
- Routinely survey and monitor areas with existing populations of *Achatinella byronii*.
- Survey areas with suitable habitat, within the historical range of *A. byronii*.
- Develop reintroduction plans for future releases into predator free sites in the wild.
- Identify suitable habitat sites that may serve as potential reintroduction sites for captive-reared *A. byronii* (Recovery Action 51).
- Reintroduce captive-reared *A. byronii* into the wild (Recovery Action 12 and 13).
- Identify suitable habitat within the historical range of *A. byronii* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons on *Achatinella* spp.

- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. byronii* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i ( Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawai`ian tree snails by alien predators. American Zoologist. 33: 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.
- HawaiianForest.com. 2011. Pu`u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai`i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. Biodiversity and Conservation (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. Pacific Science. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. Biological Invasions. 11: 737-742.
- Thacker, R.W. and M.G. Hadfield. 2000. Mitochondrial phylogeny of extant Hawaiian tree snails (Achatinellinae). Molecular Phylogenetics and Evolution. 16 (2): 263-270.
- [US Army] U.S. Army Garrison, Hawai`i Directorate of Public Works Environmental Division. 2008. Final implementation plan for O`ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.
- [USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Costello, Vince. 2011. Army Natural Resource Staff, Directorate of Public Works, Natural Resources Division, Schofield Barracks, Hawai`i. E-mail to Joy Browning, U.S. Fish and Wildlife Service, dated May 2, 2011. Subject: 5-year Review Questions.

Holland, Brenden. 2011a. Department of Zoology, University of Hawaii at Manoa, Honolulu, Hawaii. Telephone Conversation Record to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Miller, Stephen. 2011. U.S. Fish and Wildlife Service, Honolulu, Hawaii. E-mail to Joy Browning, U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: O`ahu Tree Snail Survey and *Gonaxis kibweziensis*

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawaii. E-mail to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree Snail Surveys and *Gonaxis kibweziensis*.

Signature Page  
U.S. FISH AND WILDLIFE SERVICE  
5-YEAR REVIEW of *Achatinella byronii*

Current Classification:           E          



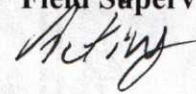
**Recommendation resulting from the 5-Year Review:**

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

Appropriate Listing/Reclassification Priority Number, if applicable:           

**Review Conducted By:**

Joy Hiromasa Browning, Fish and Wildlife Biologist  
Jess Newton, Endangered Species Recovery Program Leader  
Assistant Field Supervisor for Endangered Species

Approved  Date   
  
Field Supervisor, Pacific Islands Fish and Wildlife Office

*Achatinella cestus*  
(*O`ahu Tree Snail*)

**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: *Achatinella cestus* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION .....</b>	<b>3</b>
1.1	Reviewers.....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS.....</b>	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS .....</b>	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number:.....	10
3.3	Listing and Reclassification Priority Number: .....	10
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS.....</b>	<b>10</b>
<b>5.0</b>	<b>REFERENCES.....</b>	<b>11</b>
	Signature Page.....	13

**5-YEAR REVIEW**  
***Achatinella cestus* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella cestus* has not been seen since 1966 (USFWS 1992). Currently this species is not in captive propagation. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella cestus*.

**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:**

Occasional surveys have been completed between 2002 and 2009. No living snails or shells of *A. cestus* were found during the surveys (V. Costello, Biological Consultant, pers. comm. 2011; N. Yuen, Biological Consultant, pers. comm. 2009a).

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella cestus*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella cestus*.

**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.):**

*Achatinella cestus* was historically located on the leeward slopes of the southern Ko'olau Mountains. There is no new information on the spatial distribution or historic range of *A. cestus*.

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

The habitat near the summit of Waialae Nui is suitable habitat with native vegetation (V. Costello, pers. comm. 2011).

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella cestus* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai'i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

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

Illegal shell collecting is a continuing threat to the species.

**2.3.2.3 Disease or predation:**

*Achatinella cestus* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus*

*norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993). The population of *A. cestus* is not managed for predator control; *E. rosea* exclosures are not present and rat-control efforts are not underway (US Army 2009).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. comm. 2011b; Hawaiianforest.com 2011). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius*, and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eats snails (USFWS 1992) may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army 2008) and in the Ko'olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. cestus* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

This species is not in captive propagation and there are no other conservation measures being implemented directly for this species at this time.

## **2.4 Synthesis**

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *Achatinella cestus* was classified as having the status of possibly being extant. *A. cestus* was historically located on the leeward slopes of the southern Ko`olau Mountains. The most recent sighting of *A. cestus* was in 1966 on Hawai`i Loa Ridge. Surveys were conducted in various areas of the historical range of *A. cestus* from 2002 to 2009, but it was not sighted during any of those surveys.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Predation by *Euglandina rosea* and rats are major threats to *A. cestus*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. cestus* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to no individuals being observed in the wild, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. cestus* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:** N/A

### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella cestus* is found in the wild.
- Survey areas with suitable habitat, within the historical range of *A. cestus*.

- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. cestus* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). *Proceedings, Hawaiian Entomological Society*. 18: 377-389.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. *American Zoologist*. 33: 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.
- [USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. *Federal Register* 8(46):3178-3182.

[USFWS 1992] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 pp.

[USFWS 2003] 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Costello, Vince. 2011. Biological Consultant, Honolulu, Hawai`i. E-mail to Joy Browning, U.S. Fish and Wildlife Service, dated May 2, 2011. Subject: 5-year Review Questions.

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011a. Biological Consultant, Honolulu, Hawai`i. E-mail message to Guadalupe J. Ruiz-Jones, University of Hawaii at Manoa, dated Oct. 20, 2009. Subject: O`ahu Tree Snail Surveys.

Yuen, Nathan. 2011b. Biological Consultant, Honolulu, Hawai`i. E-mail message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree snail surveys and *Gonaxis kibweziensis*.

**Signature Page**  
**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of *Achatinella cestus***

**Current Classification:**           E          


**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:**

Joy Hiromasa Browning, Fish and Wildlife Biologist  
Jess Newton, Endangered Species Recovery Program Leader  
Assistant Field Supervisor for Endangered Species

Approved  Date 8/29/11  
**Field Supervisor, Pacific Islands Fish and Wildlife Office**  
*Acting*

*Achatinella concavospira*  
(*O`ahu Tree Snail*)

**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: *Achatinella concavospira* (O`ahu tree snail)

### TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	10
<b>3.0</b>	<b>RESULTS</b> .....	<b>11</b>
3.1	Recommended Classification:.....	11
3.2	New Recovery Priority Number: .....	11
3.3	Listing and Reclassification Priority Number: .....	11
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>11</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>12</b>
	Signature Page.....	15

**5-YEAR REVIEW**  
***Achatinella concavospira* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella concavospira* is not robust with only 47 individuals known in the wild. Currently this species is not in captive propagation. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella concavospira*.

**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 most recent sightings of live *A. concavospira* were in October 2008; a total of 47 snails (17 large, 19 medium, and 11 small) were sighted on areas monitored by the Army Natural Resource Staff (ANRS). Surveys have been conducted by ANRS since 2000 (US Army 2009).

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

According to mitochondrial cytochrome *c* oxidase subunit I DNA sequence analyses of all extant *Achatinella* spp., *A. concavospira* is most closely related to *A. apexfulva*, making the two species sister taxa. This is interesting because these two species are found on different mountain ranges, *A. concavospira* in the Wai`anae Mountains and *A. apexfulva* in the Ko`olau Mountains (Holland and Hadfield 2004).

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella concavospira*.

**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.):**

*Achatinella concavospira* was historically located in the southern Wai`anae Mountains. *A. concavospira* is found at ten locations in the southern Wai`anae Mountains, at elevations ranging from 2140 ft. to 2600 ft. (652 m to 792 m). Some sites for *A. concavospira* are separated from other populations of *A. concavospira* by a large distance (>100 m) and, therefore, are considered distinct populations. There are at least three sites for *A. concavospira* that are located within 100 m of sites for *Achatinella mustelina* (US Army 2009).

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

The habitat of *Achatinella concavospira* in the southern Wai`anae Mountains is characterized as varying between dry-mesic forest and wet-mesic forest (US Army 2009).

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella concavospira* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the

seeds of invasive plant species (USFWS 1992).

The northern tip of the historical range of *A. concavospira* lies within the US Army's Schofield Barracks Military Reservation and South Range Acquisition Area (USFWS 1992; USFWS 2003). Tree-snail species are threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

#### **2.3.2.3 Disease or predation:**

*Achatinella concavospira* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993). The population of *A. concavospira* is not managed for predator control; *E. rosea* exclosures are not present and rat-control efforts are not underway (US Army 2009).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, pers. comm. 2011). In April 2011, this species

was found in the back of Kuliouou Valley on O`ahu at 2,200 feet elevation (N. Yuen, pers. comm. 2011b; Hawaiianforest.com 2011). In April 2011, this species was found in the back of Kuliouou Valley on O`ahu at 2,200 feet elevation (N. Yuen, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992) may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O`ahu from low elevations up to Mount Ka`ala in the Wai`anae Mountains (US Army 2008) and in the Ko`olau Mountains (V. Costello, pers. comm. 2011); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992).

The population of *A. concavospira* is not managed for predator control; *E. rosea* exclosures are not present and rat-control efforts are not underway (US Army 2009).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. concavospira* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

This species is not in captive propagation and only two of the ten sites in the wild are within an ungulate fence where weed and rat control measures are being conducted.

## 2.4 Synthesis

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *Achatinella concavospira* was classified as having the status of extant, but uncommon. *A. concavospira* was historically located in the southern Wai`anae Mountains, which is where the species is still found. The northern tip of the historical range of *A. concavospira* lies within the US Army's Schofield Barracks Military Reservation and South Range Acquisition Area (USFWS 1992; USFWS 2003).

The Army Natural Resource Staff (ANRS) began monitoring *A. concavospira* in 2000. The ANRS has surveyed extensively for *A. concavospira*, because portions of its historical range lie within the US Army's Schofield Barracks Military Reservation, where there are current populations of *Achatinella mustelina*. The most recent sightings of *A. concavospira* were in October 2008; a total of 47 live snails were found at four sites.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Tree-snail habitat and snails located within US Army Action Areas can be threatened directly and indirectly by military training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition.

Predation by *Euglandina rosea* and rats are major threats to *A. concavospira*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011).

*A. concavospira* is not in captive propagation. Only two of the ten sites in the wild are within an ungulate fence and weed and rat control measures are being conducted.

Species like *A. concavospira* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to extremely limited numbers of individuals observed in the wild, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. concavospira* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_

**Brief Rationale:** N/A

### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella concavospira* is found in the wild.
- Routinely survey and monitor areas with currently existing populations of *A. concavospira*.

- Survey areas with suitable habitat, within the historical range of *A. concavospira*.
- Develop reintroduction plans for future releases into predator free sites in the wild.
- Identify sites where *A. concavospira* are present that may be potential locations for predator enclosure fences.
- Identify areas within the historical range of *A. concavospira* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplane septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplane septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. concavospira* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. American Zoologist. 33: 610-622.
- Hadfield, M.G., B.S. Holland, and K.J. Olival. 2004. Contributions of ex situ propagation and molecular genetics to conservation of Hawaiian tree snails. Experimental approaches to conservation biology. Gordon, M.S.; Bartol, S.M. [Eds]. University of California Press. Chapter pagination: 16-34.
- Hadfield, M.G. and J.E. Saufier. 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. Biodiversity and Conservation (online first: DOI 10.1007/s10531-009-9773-5).

Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.

Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.

[US Army 2008] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O`ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.

[US Army 2009] U.S. Army Garrison. 2009. Hawai`i Makua Collection Monitoring and Nursery Database. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawai`i. Unpublished.

[USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. *Federal Register* 8(46):3178-3182.

[USFWS 1992] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 pp.

[USFWS 2003] 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawai`i. E-mail message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree snail surveys and *Gonaxis kibweziensis*.



**Signature Page**  
**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of *Achatinella concavospira***

**Current Classification:**           E          


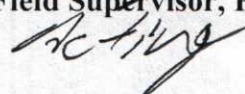
**Recommendation resulting from the 5-Year Review:**

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

**Appropriate Listing/Reclassification Priority Number, if applicable:** \_\_\_\_\_

**Review Conducted By:**

Joy Hiromasa Browning, Fish and Wildlife Biologist  
Jess Newton, Endangered Species Recovery Program Leader  
Assistant Field Supervisor for Endangered Species

Approved  Date 8/29/11  
**Field Supervisor, Pacific Islands Fish and Wildlife Office**  


*Achatinella curta*  
(*O`ahu Tree Snail*)

**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: *Achatinella curta* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION .....</b>	<b>3</b>
1.1	Reviewers.....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS.....</b>	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS .....</b>	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	10
3.3	Listing and Reclassification Priority Number: .....	10
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS.....</b>	<b>11</b>
<b>5.0</b>	<b>REFERENCES.....</b>	<b>11</b>
	Signature Page.....	13

**5-YEAR REVIEW**  
***Achatinella curta* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella curta* has not been seen since 1989 (USFWS 1992). This species is not in captive propagation. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella curta*.

**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:**

There is no new information on the abundance, population trends, demographic features, or demographic trends of *A. curta*.

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella curta*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella curta*.

**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.):**

*A. curta* was historically in the northern portion of the Ko`olau Mountain range and most of its range was on the leeward slopes (USFWS 1992). The majority of its historical range lies within the US Army's Kawaioloa Training Area (US Army 2009). There is no new information on the spatial distribution or historic range of *A. curta*.

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

Survey reports did not include habitat conditions.

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella curta* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

The majority of the historical range of *A. curta* lies within the US Army's Kawaioloa Training Area (USFWS 1992; USFWS 2003). Tree-snail species are threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

### **2.3.2.3 Disease or predation:**

*Achatinella curta* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993). The population of *A. curta* is not managed for predator control; *E. rosea* enclosures are not present and rat-control efforts are not underway (US Army 2009).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. comm. 2011b; Hawaiianforest.com 2011). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from

low elevations up to Mount Ka`ala in the Wai`anae Mountains (US Army 2008) and in the Ko`olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. curta* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

There are no conservation measures being implemented at this time specifically for *A. curta*.

## **2.4 Synthesis**

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *Achatinella curta* was classified as having the status of extant, but uncommon. *A. curta* was historically in the northern portion of the Ko`olau Mountain range and most of its range was on the leeward slopes (USFWS 1992). The majority of its historical range lies within the US Army's Kawaihoa Training Area.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Predation by *Euglandina rosea* and rats are major threats to *A. curta*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a

major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. curta* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to no individuals observed in the wild, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. curta* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:** N/A

#### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella curta* is found in the wild.
- Survey areas with suitable habitat, within the historical range of *A. curta*.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. curta* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

#### 5.0 REFERENCES

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). *Proceedings, Hawaiian Entomological Society*. 18: 377-389.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. *American Zoologist*. 33: 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.

[USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. Federal Register 8(46):3178-3182.

[USFWS 1992] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 pp.

[USFWS 2003] 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011a. Biological Consultant, Honolulu, Hawai`i. E-mail message to Guadalupe J. Ruiz-Jones, University of Hawaii at Manoa, dated Oct. 20, 2009. Subject: O`ahu Tree Snail Surveys.

Yuen, Nathan. 2011b. Biological Consultant, Honolulu, Hawai`i. E-mail message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree snail surveys and *Gonaxis kibweziensis*.



*Achatinella decipiens*  
(*O`ahu Tree Snail*)

**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: *Achatinella decipiens* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION .....</b>	<b>2</b>
1.1	Reviewers.....	2
1.2	Methodology used to complete the review:.....	2
1.3	Background: .....	2
<b>2.0</b>	<b>REVIEW ANALYSIS.....</b>	<b>3</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	3
2.2	Recovery Criteria.....	4
2.3	Updated Information and Current Species Status .....	5
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS .....</b>	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	11
3.3	Listing and Reclassification Priority Number: .....	11
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS.....</b>	<b>11</b>
<b>5.0</b>	<b>REFERENCES.....</b>	<b>11</b>
	Signature Page.....	14

**5-YEAR REVIEW**  
***Achatinella decipiens* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the O`ahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella decipiens* is not robust with 8 individuals observed in the wild (US Army 2009) and 18 in captive propagation (Hadfield 2010). The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella decipiens*.

**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 most recent sighting of live *A. decipiens* was on May 6, 2009; seven large snails and one medium snail were sighted (US Army 2009).

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

A genetic analysis of specimens that were identified as *Achatinella decipiens* and *Achatinella byronii* found the two specimens differed by one base pair in their mitochondrial 16S ribosomal DNA sequence. This high degree of genetic similarity signifies that the two specimens were not members of separate species (Thacker and Hadfield 2000).

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

*Achatinella decipiens* and *Achatinella byronii* are difficult to distinguish from each other, because they are morphologically very similar. There are color variants, from dark brown to light gold and even green, but the variation is continuous. There is no publication formally synonymizing

them. There has been no change to the taxonomic classification or nomenclature of *Achatinella decipiens* (S. Miller, US Fish and Wildlife Service, pers. comm. 2011).

**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.):**

*Achatinella decipiens* is found in the northern Ko`olau Mountains, at elevations ranging from 1800 ft. to 2520 ft. (549 m to 768 m). The Army Natural Resource Staff (ANRS) monitors 15 sites. Nine of the sites for *A. decipiens* are at least 100 m from other sites and, therefore, are considered distinct populations. There are population sites for *A. decipiens* that are located within 100 m of population sites for *Achatinella bulimoides*, *Achatinella lila*, and *Achatinella sowerbyana* (US Army 2009).

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

The tree-snail habitat present in the north Ko`olau summit area is in good condition. The area is characterized by tall native vegetation, but invasive grasses are present (US Army 2009).

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella decipiens* continues to be threatened by the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*), feral goats (*Capra hircus*), hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvenscens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral pigs trample host plant species and spread the

seeds of invasive plant species (USFWS 1992). Only one population of *A. decipiens* that ANRS monitors has a predator enclosure and is controlled for rats and weeds.

The southeastern edge of the historical range of *A. decipiens* lies within the US Army's Kawaihoa Training Area and Schofield Barracks East Range (USFWS 1992; USFWS 2003). Tree-snail species are threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, vehicles, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

#### **2.3.2.3 Disease or predation:**

*Achatinella decipiens* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In

April 2011, this species was found in the back of Kuliouou Valley on O`ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. comm. 2011; Hawaiianforest.com 2011). In April 2011, this species was found in the back of Kuliouou Valley on O`ahu at 2,200 feet elevation (N. Yuen, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O`ahu from low elevations up to Mount Ka`ala in the Wai`anae Mountains (US Army 2008) and in the Ko`olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. decipiens* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

Conservation measures for this species include captive propagation and genetic research. Individuals of *Achatinella decipiens* have been maintained in the Hawaiian Tree Snail Conservation Captive-Propagation Lab at the University of Hawai`i at Mānoa since 1990. In March 1990, five adults of *A. decipiens* were collected and brought into the lab. In May 1997, an additional collection of *A. decipiens* was made for the lab; eight adults. The population trend of *A. decipiens* in the lab is one of low population growth due to low reproductive output. As of December 2009, there were 18 individuals of *A. decipiens* in the lab (Hadfield 2010)

Tree snails are brought into the captive-propagation facility because they are highly endangered in the field. Conditions in the lab duplicate conditions in the field, as much as possible. Environmental data were gathered from field sites in order to reproduce similar conditions in the lab. The temperature (average between 16° C and 20° C), humidity, rainfall, day length (12 hours), and substratum (native host-tree species) found in the field, are reproduced as best as possible in the environmental chambers in which the captive-reared snails live. The snails are provided with leafy branches of *Metrosideros polymorpha*. The epiphytic black mold *Cladosporium* sp, which is the snails' food source, is propagated in the lab and added as an additional food source. Most of the species in the facility initially experience an adaptation period, in which there is very low reproductive output. In some species, the adaptation period is followed by an increase in reproductive output and population size (Hadfield *et al.* 2004).

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

In addition to being in the captive propagation lab, other conservation measures include a predator enclosure and weed and rat control (US Army 2009).

## 2.4 Synthesis

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. decipiens* was classified as having the status of extant, but uncommon. *Achatinella decipiens* was historically located in northern Ko`olau Mountains.

The Army Natural Resource Staff (ANRS) began monitoring *A. decipiens* in 1997. The most recent sighting of *A. decipiens* was in May 2009; eight live snails were found. The ANRS has surveyed for *A. decipiens* because portions of its historical range lie within the US Army's Kawaihoa Training Area and Schofield Barracks East Range, where there are current populations of other species of *Achatinella*.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species, feral pigs, and feral goats result in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs and goats, hunting activities, and hiking activities threaten tree-snail host plants due to by trampling.

Tree-snail habitat and snails located within US Army Training Areas can be threatened directly and indirectly by military training activities. Food disposed of during military

troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition.

Predation by *Euglandina rosea* and rats are major threats to *A. decipiens*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O'ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. decipiens* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to extremely limited numbers of individuals observed in the wild, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. decipiens* remain classified as endangered.

### 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: N/A**

**Brief Rationale: N/A**

**3.3 Listing and Reclassification Priority Number: N/A**

**Reclassification (from Threatened to Endangered) Priority Number: \_\_\_\_\_**

**Reclassification (from Endangered to Threatened) Priority Number: \_\_\_\_\_**

**Delisting (regardless of current classification) Priority Number: \_\_\_\_\_**

**Brief Rationale: N/A**

**4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

- Identify the actions to take when *Achatinella decipiens* is found in the wild.
- Routinely survey and monitor areas with existing populations of *Achatinella decipiens*.
- Survey areas with suitable habitat, within the historical range of *A. decipiens*.
- Continue and possibly expand captive-propagation efforts with the intended goals of increasing the population size in a predator-free environment and eventually reintroducing captive-reared *A. decipiens* into the wild (Recovery Action 12 and 13).
- Develop reintroduction plans for future releases into predator free sites in the wild.
- Identify suitable habitat sites that may serve as potential reintroduction sites for captive-reared *A. decipiens* (Recovery Action 51).
- Identify suitable habitat within the historical range of *A. decipiens* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's Chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. decipiens* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

**5.0 REFERENCES**

Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.

- Hadfield, M.G. 2010. Annual report to the USFWS for Permit TE826600-11. University of Hawai'i, Honolulu, Hawai'i. 12 pages. Unpublished.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawai'ian tree snails by alien predators. *American Zoologist*. 33: 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.
- Thacker, R.W. and M.G. Hadfield. 2000. Mitochondrial phylogeny of extant Hawaiian tree snails (Achatinellinae). *Molecular Phylogenetics and Evolution*. 16 (2): 263-270.
- [US Army] U.S. Army Garrison, Hawai'i Directorate of Public Works Environmental Division. 2008. Final implementation plan for O'ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.
- [US Army] U.S. Army Garrison. 2009. Hawai'i Makua Collection Monitoring and Nursery Database. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawai'i. Unpublished.
- [USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O'ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O'ahu. Unpublished, 351 pp.
- Weed Risk Assessments for Hawai'i and Pacific Islands. 2011. Weed risk assessments for Hawai'i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai'i.

Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

- Holland, Brenden. 2011a. Department of Zoology, University of Hawaii at Manoa, Honolulu, Hawaii. Telephone Conversation Record to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*
- Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.
- Miller, Stephen. 2011. U.S. Fish and Wildlife Service, Honolulu, Hawaii. Telephone Conversation to Joy Browning, U.S. Fish and Wildlife Service, dated July 22, 2011. Subject: Similarity between *A. byronii* an *A. decipiens*
- Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawaii. E-mail to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree Snail Surveys and *Gonaxis kibweziensis*.



*Achatinella dimorpha*  
(*O`ahu Tree Snail*)

**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: *Achatinella dimorpha* (O'ahu tree snail)

### TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION .....</b>	<b>3</b>
1.1	Reviewers.....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS.....</b>	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS .....</b>	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	11
3.3	Listing and Reclassification Priority Number: .....	11
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS.....</b>	<b>11</b>
<b>5.0</b>	<b>REFERENCES.....</b>	<b>11</b>
	Signature Page.....	14

**5-YEAR REVIEW**  
***Achatinella dimorpha* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly know that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella dimorpha* has not been seen since 1967 (USFWS 1992). The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella dimorpha*.

**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:**

No living snails or shell of *Achatinella dimorpha* were found in surveys conducted in portions of *A. dimorpha* historical range.

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella dimorpha*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella dimorpha*.

**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.):**

*Achatinella dimorpha* was historically located in the northern half of the Ko`olau Mountains with most of its range on the windward slopes (USFWS 1992). There is no new information on the spatial distribution or historic range of *Achatinella dimorpha*.

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

Survey reports did not provide habitat conditions (US Army 2009).

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella dimorpha* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

The historical range of *A. dimorpha* overlaps portions of the US Army's Kahuku Training Area, Kawaihoa Training Area, and Schofield Barracks East Range (USFWS 1992; USFWS 2003). Tree-snail species are threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

### **2.3.2.3 Disease or predation:**

*Achatinella dimorpha* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993). The population of *A. dimorpha* is not managed for predator control; *E. rosea* exclosures are not present and rat-control efforts are not underway (US Army 2009).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army

2008) and in the Ko`olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. dimorpha* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

This species is not in captive propagation and there are no other conservation measures being taken at this time for *A. dimorpha*.

## **2.4 Synthesis**

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *Achatinella dimorpha* was classified as having the status of possibly extant. *A. dimorpha* was historically located in the northern half of the Ko`olau Mountains with most of its range on the windward slopes (USFWS 1992). Portions of its historical range overlap the US Army's Kahuku Training Area, Kawaihoa Training Area, and Schofield Barracks East Range.

The most recent field sighting of *A. dimorpha* was in 1967 on the Pupukea Trail and at Paumaulu-Kaunala (USFWS 1992). In April and September of 2009, surveys conducted within the historical range resulted in no living snails or shells of *A. dimorpha*.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants

are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Tree-snail habitat and snails located within US Army Action Areas can be threatened directly and indirectly by military training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition.

Predation by *Euglandina rosea* and rats are major threats to *A. dimorpha*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. dimorpha* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to no individuals being observed in the wild since 1967, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. dimorpha* remain classified as endangered.

### 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: N/A**

**Brief Rationale: N/A**

**3.3 Listing and Reclassification Priority Number: N/A**

**Reclassification (from Threatened to Endangered) Priority Number: \_\_\_\_**

**Reclassification (from Endangered to Threatened) Priority Number: \_\_\_\_**

**Delisting (regardless of current classification) Priority Number: \_\_\_\_**

**Brief Rationale: N/A**

#### **4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

- Identify the actions to take when *Achatinella dimorpha* is found in the wild.
- Survey areas with suitable habitat, within the historical range of *A. dimorpha*.
- Identify areas within the historical range of *A. dimorpha* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. dimorpha* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

#### **5.0 REFERENCES**

Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.

Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. American Zoologist. 33: 610-622.

Hadfield, M.G., B.S. Holland, and K.J. Olival. 2004. Contributions of ex situ propagation and molecular genetics to conservation of Hawaiian tree snails. Experimental approaches to

- conservation biology. Gordon, M.S.; Bartol, S.M. [Eds]. University of California Press. Chapter pagination: 16-34.
- Hadfield, M.G. 2005. Annual report to the USFWS for Permit TE826600-11. University of Hawai'i, Honolulu, Hawai'i. 7 pages. Unpublished.
- Hadfield, M.G. 2010. Annual report to the USFWS for Permit TE826600-11. University of Hawai'i, Honolulu, Hawai'i. 12 pages. Unpublished.
- 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.
- [US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O'ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawailoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.
- [US Army] U.S. Army Garrison. 2009. Hawai'i Makua Collection Monitoring and Nursery Database. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawai'i. Unpublished.
- [USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. *Federal Register* 8(46):3178-3182.
- [USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O'ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O'ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawai`i. E-mail message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree snail surveys and *Gonaxis kibweziensis*.

**Signature Page**  
**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of *Achatinella dimorpha***

**Current Classification:**           E          

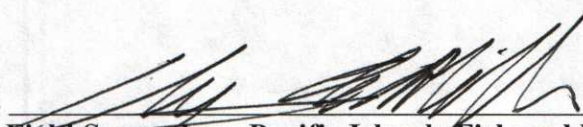
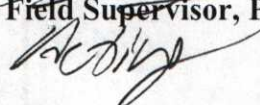
**Recommendation resulting from the 5-Year Review:**

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

**Appropriate Listing/Reclassification Priority Number, if applicable:** \_\_\_\_\_

**Review Conducted By:**

Joy Hiromasa Browning, Fish and Wildlife Biologist  
Jess Newton, Endangered Species Recovery Program Leader  
Assistant Field Supervisor for Endangered Species

Approved  Date 8/29/11  
**Field Supervisor, Pacific Islands Fish and Wildlife Office**  


*Achatinella elegans*  
(*O`ahu Tree Snail*)

**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: *Achatinella elegans* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS</b> .....	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	11
3.3	Listing and Reclassification Priority Number: .....	11
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>11</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>11</b>
	Signature Page.....	14

**5-YEAR REVIEW**  
***Achatinella elegans* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella elegans* has not been seen since 1952 (USFWS 1992). This species is not in captive propagation. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella elegans*.

**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:**

No living snails or shell of *Achatinella elegans* were found in surveys conducted in portions of *A. elegans* historical range.

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella elegans*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella elegans*.

**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.):**

*Achatinella elegans* historically was located on the windward slopes of the northern Ko`olau Mountains (USFWS 1992). There is no new information on the spatial distribution or historic range of *Achatinella elegans*.

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

Survey reports did not provide habitat conditions (US Army 2009).

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella elegans* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

The historical range of *A. elegans* overlaps the southern end of the US Army's Kahuku Training Area, Kawaihoa Training Area (USFWS 1992; USFWS 2003). Tree-snail species are threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

### **2.3.2.3 Disease or predation:**

*Achatinella elegans* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993). The population of *A. elegans* is not managed for predator control; *E. rosea* enclosures are not present and rat-control efforts are not underway (US Army 2009).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army 2008) and in the Ko'olau Mountains (B. Holland, pers. comm. 2011b);

however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. elegans* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

This species is not in captive propagation and there are no other conservation measures being taken at this time for *A. elegans*.

## **2.4 Synthesis**

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. elegans* was classified as having the status of probably extinct. *Achatinella elegans* historically was located on the windward slopes of the northern Ko`olau Mountains (USFWS 1992). The northern portion of its historical range overlaps the southern-end of the US Army's Kahuku Training Area, which is located within an Action Area.

The most recent sighting of *A. elegans* was in 1952 at Ma`akua-Papali and Punaiki-Makao (USFWS 1992). In April and September of 2009, surveys conducted within the historical range resulted in no living snails or shells of *A. elegans*.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Tree-snail habitat and snails located within US Army Action Areas can be threatened directly and indirectly by military training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition.

Predation by *Euglandina rosea* and rats are major threats to *A. elegans*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. elegans* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to no individuals being observed in the wild since 1952, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. elegans* remain classified as endangered.

### 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:** N/A

**Brief Rationale:** N/A

**3.3 Listing and Reclassification Priority Number:** N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:** N/A

#### **4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

- Identify the actions to take when *Achatinella elegans* is found in the wild.
- Survey areas with suitable habitat, within the historical range of *A. elegans*.
- Identify areas within the historical range of *A. elegans* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. elegans* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

#### **5.0 REFERENCES**

Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.

Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. American Zoologist. 33: 610-622.

Hadfield, M.G., B.S. Holland, and K.J. Olival. 2004. Contributions of ex situ propagation and molecular genetics to conservation of Hawaiian tree snails. Experimental approaches to

- conservation biology. Gordon, M.S.; Bartol, S.M. [Eds]. University of California Press. Chapter pagination: 16-34.
- Hadfield, M.G. 2005. Annual report to the USFWS for Permit TE826600-11. University of Hawai'i, Honolulu, Hawai'i. 7 pages. Unpublished.
- Hadfield, M.G. 2010. Annual report to the USFWS for Permit TE826600-11. University of Hawai'i, Honolulu, Hawai'i. 12 pages. Unpublished.
- 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.
- [US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O'ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawailoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.
- [US Army] U.S. Army Garrison. 2009. Hawai'i Makua Collection Monitoring and Nursery Database. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawai'i. Unpublished.
- [USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. *Federal Register* 8(46):3178-3182.
- [USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O'ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O'ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

#### **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawai`i. E-mail message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree snail surveys and *Gonaxis kibweziensis*.

**Signature Page**  
**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of *Achatinella elegans***

**Current Classification:**           E          

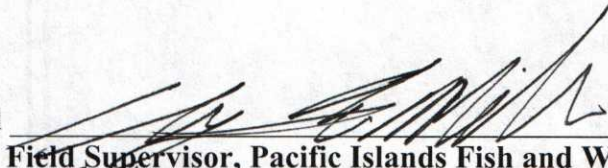
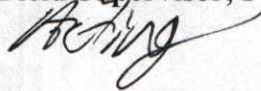
**Recommendation resulting from the 5-Year Review:**

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

**Appropriate Listing/Reclassification Priority Number, if applicable:** \_\_\_\_\_

**Review Conducted By:**

Joy Hiromasa Browning, Fish and Wildlife Biologist  
Jess Newton, Endangered Species Recovery Program Leader  
Assistant Field Supervisor for Endangered Species

Approved  Date 8/24/11  
**Field Supervisor, Pacific Islands Fish and Wildlife Office**  


*Achatinella fulgens*  
(*O`ahu Tree Snail*)

**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: *Achatinella fulgens* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION .....</b>	<b>3</b>
1.1	Reviewers.....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS.....</b>	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	10
<b>3.0</b>	<b>RESULTS .....</b>	<b>11</b>
3.1	Recommended Classification:.....	11
3.2	New Recovery Priority Number: .....	11
3.3	Listing and Reclassification Priority Number: .....	11
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS.....</b>	<b>11</b>
<b>5.0</b>	<b>REFERENCES.....</b>	<b>12</b>
	Signature Page.....	14

**5-YEAR REVIEW**  
***Achatinella fulgens* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly know that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella fulgens* is not robust. Only 15 individuals comprise the captive population (Hadfield 2010). In 2008, only 14 live snails were seen in the wild. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella fulgens*.

**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:**

*Achatinella fulgens* may exist in only a few very small populations (Holland and Hadfield 2004). In 2008, 14 *A. fulgens* were sighted in Pia Valley (N. Yuen, Biological Consultant, pers. comm. 2011a). There are reports that a couple of additional small populations of *A. fulgens* exist in the southern Ko`olau Mountains, including where *A. fulgens* was collected for the captive-propagation program in 2006.

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

According to mitochondrial 16S ribosomal DNA sequence analyses *Achatinella fulgens*, *Achatinella byronii*, and *Achatinella decipiens* are in a monophyletic clade; i.e., these three species shared a common ancestor in evolutionary history (Thacker and Hadfield 2000). A genetic study using the mitochondrial cytochrome *c* oxidase subunit I sequence found that the maximum genetic divergence between any *Achatinella* spp. was between *A. fulgens* and *Achatinella lila*, which both occur in the Ko`olau

Mountains; *A. fulgens* in the south and *A. lila* in the north (Holland and Hadfield 2004).

#### **2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella fulgens*.

#### **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.):**

*Achatinella fulgens* is known to exist in the southern Ko`olau Mountains. Live snails of *A. fulgens* have most recently been sighted on the upper leeward slopes of the southern Ko`olau Mountains (N. Yuen, pers. comm. 2011a).

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

Survey reports did not provide habitat conditions (N. Yuen, pers. comm. 2011a).

#### **2.3.1.7 Other:**

None

### **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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella fulgens* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the

seeds of invasive plant species (USFWS 1992).

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

Illegal shell collecting is a continuing threat to the species.

### **2.3.2.3 Disease or predation:**

*Achatinella fulgens* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army 2008) and in the Ko'olau Mountains (B. Holland, pers. comm. 2011b);

however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. fulgens* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Conservation measures for this species include captive propagation and genetic research. Individuals of *A. fulgens* have been maintained in the captive-propagation facility at the University of Hawai'i at Mānoa since 2006 when twenty live snails were collected. No additional collections of *A. fulgens* have been made for the captive-propagation program. Since 2007 the lab population of *A. fulgens* has been declining. As of December 2009, there were 15 individuals of *A. fulgens* present in the lab (Hadfield 2010).

Tree snails are brought into the captive-propagation facility because they are highly endangered in the field. Conditions in the lab duplicate conditions in the field, as much as possible. Environmental data were gathered from field sites in order to reproduce similar conditions in the lab. The temperature (average between 16° C and 20° C), humidity, rainfall, day length (12 hours), and substratum (native host-tree species) found in the field, are reproduced as best as possible in the environmental chambers in which the captive-reared snails live. The snails are provided with leafy branches of *Metrosideros polymorpha*. The epiphytic black mold *Cladosporium* sp, which is the snails' food source, is propagated in the lab and added as an additional food source. Most of the species in the facility initially experience an adaptation period, in which there is very

low reproductive output. In some species, the adaptation period is followed by an increase in reproductive output and population size (Hadfield *et al.* 2004).

## 2.4 Synthesis

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. fulgens* was classified as having the status of extant, but uncommon. *Achatinella fulgens* was historically located in the southern portion of the Ko`olau Mountain range, and most of its range was on the leeward slopes.

The most recent field sighting of *A. fulgens* was in 2008; 14 live snails were found at two locations in Pia Valley. Although in the past few years several surveys have been conducted within the historical range of *A. fulgens*, it has become more difficult to find live snails of *A. fulgens* in the wild. The captive-propagation program at the University of Hawai`i at Mānoa has maintained individuals of *A. fulgens* since 2006. In December 2009, there were 15 *A. fulgens* in the facility.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Predation by *Euglandina rosea* and rats are major threats to *A. fulgens*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. fulgens* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to extremely limited numbers of individuals observed in the wild and held in the captive propagation facility, an extremely limited historical spatial distribution, and the

absence of management actions to mitigate threats to this species, it is recommended that *A. fulgens* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:** N/A

### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella fulgens* is found in the wild.
- Routinely survey and monitor areas with currently existing populations of *A. fulgens*.
- Survey areas with suitable habitat, within the historical range of *A. fulgens*.
- Continue and possibly expand captive-propagation efforts with the intended goals of increasing the population size in a predator-free environment and eventually reintroducing captive-reared *A. fulgens* into the wild (Recovery Action 12 and 13).
- Develop reintroduction plans for future releases into predator free sites in the wild.
- Identify areas within the historical range of *A. fulgens* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.

- Design and implement more effective predator elimination techniques within the historical range of *A. fulgens* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). *Proceedings, Hawaiian Entomological Society*. 18: 377-389.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. *American Zoologist*. 33: 610-622.
- Hadfield, M.G., B.S. Holland, and K.J. Olival. 2004. Contributions of ex situ propagation and molecular genetics to conservation of Hawaiian tree snails. *Experimental approaches to conservation biology*. Gordon, M.S.; Bartol, S.M. [Eds]. University of California Press. Chapter pagination: 16-34.
- Hadfield, M.G. 2010. Annual report to the USFWS for Permit TE826600-11. University of Hawai'i, Honolulu, Hawai'i. 12 pages. Unpublished.
- 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S. and M.G. Hadfield. 2004. Origin and diversification of the endemic Hawaiian tree snails (Achatinellidae: Achatinellinae) based on molecular evidence. *Molecular Phylogenetics and Evolution*. 32: 588-600.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.

[US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O`ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.

[USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. Federal Register 8(46):3178-3182.

[USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011a. Biological Consultant, Honolulu, Hawai`i. E-mail message to Guadalupe J. Ruiz-Jones, University of Hawaii at Manoa, dated Oct. 20, 2009. Subject: O`ahu Tree Snail Surveys

Yuen, Nathan. 2011b. Biological Consultant, Honolulu, Hawai`i. Email message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: *Gonaxis kibweziensis*



*Achatinella fuscobasis*  
(*O`ahu Tree Snail*)

**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: *Achatinella fuscobasis* (O`ahu tree snail)

### TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	10
<b>3.0</b>	<b>RESULTS</b> .....	<b>11</b>
3.1	Recommended Classification:.....	11
3.2	New Recovery Priority Number: .....	11
3.3	Listing and Reclassification Priority Number: .....	11
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>11</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>12</b>
	Signature Page.....	14

**5-YEAR REVIEW**  
***Achatinella fuscobasis* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly know that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella fuscobasis* is not robust with 300 individuals in the captive population (Hadfield 2010) and only 2 live snails seen in the wild in 2008. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella fuscobasis*.

**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:**

*Achatinella fuscobasis* may exist in a couple very small populations (Holland and Hadfield 2004). Most recently, two live *A. fuscobasis* were sighted in August 2008 in the upper reaches of Pia Valley (N. Yuen, Biological Consultant, pers. comm. 2011a). There are additional reports that a couple small populations of *A. fuscobasis* exist in the southern Ko`olau Mountains.

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

Genetic analysis of mitochondrial 16S ribosomal DNA sequences of the lab population of *Achatinella fuscobasis* shows close relationship within the population, which is not surprising, because all individuals are descended from the individuals collected at one location in the field and brought into the lab (Thacker and Hadfield 2000). Holland and Hadfield (2004) conducted a genetic analysis using mitochondrial cytochrome *c* oxidase subunit I sequence data, and found that the closest relative to *A. fuscobasis* is *Perdicella helena* on Moloka`i.

#### **2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella fuscobasis*.

#### **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.):**

*Achatinella fuscobasis* has been sighted on the leeward side of the southern Ko`olau Mountains; however, the specie's distribution is limited and fragmented (N. Yuen, pers. comm. 2011a).

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

Survey reports did not provide habitat conditions (N. Yuen, pers. comm. 2011a).

#### **2.3.1.7 Other:**

None

### **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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella fuscobasis* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvenscens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

#### **2.3.2.2 Overutilization for commercial, recreational, scientific, or**

### **educational purposes:**

Illegal shell collecting is a continuing threat to the species.

### **2.3.2.3 Disease or predation:**

*Achatinella fuscobasis* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, pers. comm. 2011b; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army 2008) and in the Ko'olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have

on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. fuscobasis* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Conservation measures for this species include captive propagation and genetic research. Individuals of *A. fuscobasis* have been maintained in the captive-propagation lab at the University of Hawai`i at Mānoa since 1991. In January 1991, 11 *A. fuscobasis* (10 adults and one subadult) were collected and brought into the lab. Over the years, the lab population of *A. fuscobasis* has increased, reaching 300 individuals in December 2009 (Hadfield 2010).

Tree snails are brought into the captive-propagation facility because they are highly endangered in the field. Conditions in the lab duplicate conditions in the field, as much as possible. Environmental data were gathered from field sites in order to reproduce similar conditions in the lab. The temperature (average between 16° C and 20° C), humidity, rainfall, day length (12 hours), and substratum (native host-tree species) found in the field, are reproduced as best as possible in the environmental chambers in which the captive-reared snails live. The snails are provided with leafy branches of *Metrosideros polymorpha*. The epiphytic black mold *Cladosporium* sp, which is the snails' food source, is propagated in the lab and added as an additional food source. Most of the species in the facility initially experience an adaptation period, in which there is very low reproductive output. In some species, the adaptation period is followed by an increase in reproductive output and population size (Hadfield *et al.* 2004).

## 2.4 Synthesis

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. fuscobasis* was classified as having the status of extant, but uncommon. *A. fuscobasis* was historically located in the southern portion of the Ko`olau Mountain range, and most of its range was on the leeward slopes.

The most recent field sighting of *A. fuscobasis* was in 2008; 14 live snails were found at two locations in Pia Valley. Although in the past few years several surveys have been conducted within the historical range of *A. fuscobasis*, it has become more difficult to find live snails of *A. fuscobasis* in the wild. The captive-propagation program at the University of Hawai`i at Mānoa has maintained individuals of *A. fuscobasis* since 2006. In December 2009, there were 15 *A. fuscobasis* in the facility.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Predation by *Euglandina rosea* and rats are major threats to *A. fuscobasis*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. fuscobasis* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to extremely limited numbers of individuals observed in the wild and in captive propagation, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. fuscobasis* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:** N/A

### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella fuscobasis* is found in the wild.
- Routinely survey and monitor areas with currently existing populations of *A. fuscobasis*.
- Survey areas with suitable habitat, within the historical range of *A. fuscobasis*.
- Continue and possibly expand captive-propagation efforts with the intended goals of increasing the population size in a predator-free environment and eventually reintroducing captive-reared *A. fuscobasis* into the wild (Recovery Action 12 and 13).
- Develop reintroduction plans for future releases into predator free sites in the wild.
- Identify areas within the historical range of *A. fuscobasis* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. fuscobasis* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.

- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. *American Zoologist*. 33: 610-622.
- Hadfield, M.G., B.S. Holland, and K.J. Olival. 2004. Contributions of ex situ propagation and molecular genetics to conservation of Hawaiian tree snails. *Experimental approaches to conservation biology*. Gordon, M.S.; Bartol, S.M. [Eds]. University of California Press. Chapter pagination: 16-34.
- Hadfield, M.G. 2010. Annual report to the USFWS for Permit TE826600-11. University of Hawai'i, Honolulu, Hawai'i. 12 pages. Unpublished.
- 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S. and M.G. Hadfield. 2004. Origin and diversification of the endemic Hawaiian tree snails (Achatinellidae: Achatinellinae) based on molecular evidence. *Molecular Phylogenetics and Evolution*. 32: 588-600.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.
- [US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O'ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.

[USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. Federal Register 8(46):3178-3182.

[USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011a. Biological Consultant, Honolulu, Hawai`i. E-mail message to Guadalupe J. Ruiz-Jones, University of Hawaii at Manoa, dated Oct. 20, 2009. Subject: O`ahu Tree Snail Surveys

Yuen, Nathan. 2011b. Biological Consultant, Honolulu, Hawai`i. Email message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: *Gonaxis kibweziensis*



*Achatinella juddii*  
(*O`ahu Tree Snail*)

**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: *Achatinella juddii* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS</b> .....	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	10
3.3	Listing and Reclassification Priority Number: .....	10
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>10</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>11</b>
	Signature Page.....	13

**5-YEAR REVIEW**  
***Achatinella juddii* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella juddii* has not been seen since 1958 (USFWS 1992). This species is not in captive propagation. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella juddii*.

**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:**

No living snails or shell of *Achatinella juddii* were found in surveys conducted in portions of *A. juddii* historical range.

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella juddii*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella juddii*.

**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.):**

*Achatinella juddii* was historically located on the leeward slopes of the central Ko`olau Mountains. There is no new information on the spatial distribution or historic range of *A. juddii*.

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

There is no new information on habitat or ecosystem conditions of *Achatinella juddii*.

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella juddii* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

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

Illegal shell collecting is a continuing threat to the species.

**2.3.2.3 Disease or predation:**

*Achatinella juddii* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When

*E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. comm. 2011; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army 2008) and in the Ko'olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. juddii* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species

because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

This species is not in captive propagation and there are no other conservation measures being taken at this time for *A. juddii*.

## 2.4 Synthesis

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. juddii* was classified as having the status of probably extinct. *Achatinella juddii* was historically located on the leeward slopes of the central Ko`olau Mountains. The most recent sighting of *A. juddii* was in 1958 at Pu`u Uau (USFWS 1992).

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Predation by *Euglandina rosea* and rats are major threats to *A. juddii*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. juddii* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to this species not being seen since 1958, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. juddii* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:** N/A

### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella juddii* is found in the wild.
- Survey areas with suitable habitat, within the historical range of *A. juddii*.
- Identify areas within the historical range of *A. abbreviate* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. juddii* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.

- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. *American Zoologist*. 33: 610-622.
- Hadfield, M.G., B.S. Holland, and K.J. Olival. 2004. Contributions of ex situ propagation and molecular genetics to conservation of Hawaiian tree snails. *Experimental approaches to conservation biology*. Gordon, M.S.; Bartol, S.M. [Eds]. University of California Press. Chapter pagination: 16-34.
- Hadfield, M.G. 2005. Annual report to the USFWS for Permit TE826600-11. University of Hawai'i, Honolulu, Hawai'i. 7 pages. Unpublished.
- Hadfield, M.G. 2010. Annual report to the USFWS for Permit TE826600-11. University of Hawai'i, Honolulu, Hawai'i. 12 pages. Unpublished.
- 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.
- [US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O'ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.

[US Army] U.S. Army Garrison. 2009. Hawai'i Makua Collection Monitoring and Nursery Database. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawai'i. Unpublished.

[USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. Federal Register 8(46):3178-3182.

[USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai'i and Pacific Islands. 2011. Weed risk assessments for Hawai'i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai'i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawai'i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai'i at Mānoa, Honolulu, Hawai'i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawai'i. E-mail message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree snail surveys and *Gonaxis kibweziensis*.



*Achatinella juncea*  
(*O`ahu Tree Snail*)

**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: *Achatinella juncea* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS</b> .....	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	11
3.3	Listing and Reclassification Priority Number: .....	11
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>11</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>11</b>
	Signature Page.....	14

**5-YEAR REVIEW**  
***Achatinella juncea* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella juncea* has not been observed in recent times (USFWS 1992). There are no records of *A. juncea* being observed alive in the wild. Currently this species is not in captive propagation. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella juncea*.

**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:**

There is no new information on the abundance, population trends, demographic features, or demographic trends of *A. juncea*.

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella juncea*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella juncea*.

**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.):**

There is no new information on the spatial distribution or historic range of *A. juncea*.

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

There is no new information on the habitat or ecosystem conditions of *A. juncea*.

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella juncea* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai'i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

The majority of the historical range of *A. juncea* overlaps the southern half of the US Army's Kawaihoa Training Area (USFWS 1992; USFWS 2003). Tree-snail species are threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

### **2.3.2.3 Disease or predation:**

*Achatinella juncea* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993). The population of *A. juncea* is not managed for predator control; *E. rosea* exclosures are not present and rat-control efforts are not underway (US Army 2009).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. comm. 2011; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army

2008) and in the Ko`olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. juncea* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

This species is not in captive propagation. There are no conservation measures being implemented at this time specifically for *A. juncea*.

## **2.4 Synthesis**

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. juncea* was classified as having the status of probably extinct. *Achatinella juncea* historically was located on the leeward slopes of the northern Ko`olau Mountains and its last known record is unknown (USFWS 1992). The majority of its historical range overlaps the southern half of the US Army's Kawaihoa Training Area. Portions of the historical range of *A. juncea* have been surveyed extensively, because they lie within the US Army's Kawaihoa Training Area, where there are current populations of *Achatinella* spp. The ANRS has not found any living snails or shells of *A. juncea* during their surveys (US Army 2009).

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Tree-snail habitat and snails located within US Army Training Areas can be threatened directly and indirectly by military training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition.

Predation by *Euglandina rosea* and rats are major threats to *A. juncea*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. juncea* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to no individuals observed in the wild, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. juncea* remain classified as endangered.

### 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:** N/A

**Brief Rationale:** N/A

**3.3 Listing and Reclassification Priority Number:** N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:** N/A

#### **4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

- Identify the actions to take when *Achatinella juncea* is found in the wild.
- Survey areas with suitable habitat, within the historical range of *A. juncea*.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. juncea* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

#### **5.0 REFERENCES**

Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.

Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. American Zoologist. 33: 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.

- HawaiianForest.com. 2011. Pu`u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai`i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. Biodiversity and Conservation (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. Pacific Science. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. Biological Invasions. 11: 737-742.
- [US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O`ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.
- [US Army] U.S. Army Garrison. 2009. Hawai`i Makua Collection Monitoring and Nursery Database. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawai`i. Unpublished.
- [USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. Federal Register 8(46):3178-3182.
- [USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.
- Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

- Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawai`i. E-mail message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree snail surveys and *Gonaxis kibweziensis*.



*Achatinella lila*  
(*O`ahu Tree Snail*)

**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: *Achatinella lila* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	10
<b>3.0</b>	<b>RESULTS</b> .....	<b>11</b>
3.1	Recommended Classification:.....	11
3.2	New Recovery Priority Number: .....	11
3.3	Listing and Reclassification Priority Number: .....	11
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>12</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>12</b>
	Signature Page.....	15

**5-YEAR REVIEW**  
***Achatinella lila* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the O`ahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella lila* is not robust. Low numbers of *A. lila* are known to occur at 7 small sites in the wild (US Army 2009) and 586 individuals are in captive propagation (Hadfield 2010). The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella lila*.

**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 Army Natural Resource Staff have been monitoring *A. lila* since 2000. The most recent sighting of live *A. lila* in the field was in 2009; a total of 22 snails were observed (US Army 2009).

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

A genetic study using the mitochondrial cytochrome *c* oxidase subunit I (COI) sequence found that the maximum genetic divergence between any *Achatinella* spp. was between *Achatinella lila* and *A. fulgens*, which both occur in the Ko’oalu Mountains; *A. lila* in the north and *A. fulgens* in the south. Additionally, according to COI-sequence analysis, *A. lila* and *Achatinella decipiens* are sister taxa and therefore, are distinct species (Holland and Hadfield 2004).

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change in the taxonomic classification or nomenclature of *Achatinella lila*.

**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.):**

*Achatinella lila* is found at seven locations in the northern Ko`olau Mountains, at elevations ranging from 2300 ft. to 2760 ft. (701 m to 841 m). More than half of the sites for *A. lila* are located at least 100 m from each other and, therefore, are considered distinct populations (US Army 2009).

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

The tree-snail habitat present in the north Ko`olau summit area is in good condition. The area is characterized by tall native vegetation, but invasive grasses are present (US Army 2009).

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella lila* continues to be threatened by the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*), feral goats (*Capra hircus*), hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvenscens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral pigs trample host plant species and spread the seeds of invasive plant species (USFWS 1992). Only one population that the ANRS monitors for *A. lila* has a predator enclosure and is controlled for rats and weeds.

The majority of one of the two historical ranges of *A. lila* lies within the US Army's Kawaihoa Training Area (USFWS 1992; USFWS 2003). Tree-snail species are threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, vehicles, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

#### **2.3.2.3 Disease or predation:**

*Achatinella lila* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. com. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. com. 2011; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O`ahu from low elevations up to Mount Ka`ala in the Wai`anae Mountains (US Army 2008) and in the Ko`olau Mountains (B. Holland, pers. com. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. com. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. lila* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

Conservation measures for this species include captive propagation and genetic research. Individuals of *Achatinella lila* have been maintained in the captive-propagation lab at the University of Hawai`i at Mānoa since 1997. In May 1997 seven adults of *A. lila* were collected from ~500 m north of Poamoho Summit Monument. The population trend of *A. lila* in the lab has been one of high reproductive output and low mortality. The population has grown to over 500 live snails, reaching 586 in December 2009 (Hadfield 2010).

Tree snails are brought into the captive-propagation facility, because they are highly endangered in the field. Conditions in the lab duplicate conditions in the field, as much as possible. Environmental data were gathered from field sites in order to reproduce similar conditions in the lab. The temperature (average between 16° C and 20° C), humidity, rainfall, day length (12 hours), and substratum (native host-tree species) found in the field, are reproduced as best as possible in the environmental chambers in which the captive-reared snails live. The snails are provided

with leafy branches of *Metrosideros polymorpha*. The epiphytic black mold *Cladosporium* sp, which is the snails' food source, is propagated in the lab and added as an additional food source. Most of the species in the facility initially experience an adaptation period, in which there is very low reproductive output. In some species, the adaptation period is followed by an increase in reproductive output and population size (Hadfield *et al.* 2004).

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

In addition to being in the captive propagation lab, one natural population has an ungulate fence, with weed and rat control being conducted (US Army 2009).

## 2.4 Synthesis

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. lila* was classified as having the status of extant, but uncommon. *Achatinella lila* was historically located in two areas on the leeward slopes of the northern Ko`olau Mountains. The area within the northern historical range where there have been recent sightings of *A. lila* lies within the US Army's Kawaihoa Training Area.

The Army Natural Resource Staff (ANRS) have been monitoring *A. lila* since 2000. The most recent field sighting of *A. lila* was in 2009; a total of 22 live snails was found. The ANRS has surveyed for *A. lila*, because portions of its historical range lie within the US Army's Kawaihoa Training Area, where there are current populations of other species of *Achatinella*.

The captive-propagation program at the University of Hawai`i at Manoa has maintained individuals of *A. lila* since 1997. The lab population of *A. lila* began with seven adults and, over the years, has experience high reproductive output and low mortality, resulting in a large population. As of December 2009, there were 586 live *A. lila* in the facility.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species, feral pigs and goats result in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs and goats, hunting activities, and hiking activities threaten tree-snail host plants due to trampling.

Tree-snail habitat and snails located within US Army Training Areas can be threatened directly and indirectly by military training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native

plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition.

Predation by *Euglandina rosea* and rats are major threats to *A. lila*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. com. 2011a).

Species like *A. lila* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to extremely limited numbers of individuals observed in the wild, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. lila* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number: \_\_\_\_\_**  
**Reclassification (from Endangered to Threatened) Priority Number: \_\_\_\_\_**  
**Delisting (regardless of current classification) Priority Number: \_\_\_\_\_**

**Brief Rationale:** N/A

#### **4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

- Identify the actions to take when *Achatinella lila* is found in the wild.
- Routinely survey and monitor areas with existing populations of *Achatinella lila*.
- Survey areas with suitable habitat, within the historical range of *A. lila*.
- Continue and possibly expand captive-propagation efforts with the intended goals of increasing the population size in a predator-free environment and eventually reintroducing captive-reared *A. lila* into the wild (Recovery Action 12 and 13).
- Develop reintroduction plans for future releases into predator free sites in the wild.
- Identify suitable habitat sites that may serve as potential reintroduction sites for captive-reared *A. lila* (Recovery Action 51).
- Identify suitable habitat within the historical range of *A. lila* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplanea septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplanea septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. lila* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

#### **5.0 REFERENCES**

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.
- Hadfield, M.G. 2010. Annual report to the USFWS for Permit TE826600-11. University of Hawai'i, Honolulu, Hawai'i. 12 pages. Unpublished.

- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawai`ian tree snails by alien predators. *American Zoologist*. 33: 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.
- HawaiianForest.com. 2011. Pu`u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai`i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.
- Thacker, R.W. and M.G. Hadfield. 2000. Mitochondrial phylogeny of extant Hawaiian tree snails (Achatinellinae). *Molecular Phylogenetics and Evolution*. 16 (2): 263-270.
- [US Army] U.S. Army Garrison, Hawai`i Directorate of Public Works Environmental Division. 2008. Final implementation plan for O`ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.
- [US Army] U.S. Army Garrison. 2009. Hawai`i Makua Collection Monitoring and Nursery Database. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawai`i. Unpublished.
- [USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.
- Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

- Holland, Brenden. 2011a. Department of Zoology, University of Hawaii at Manoa, Honolulu, Hawaii. Telephone Conversation Record to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*
- Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.
- Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawaii. E-mail to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree Snail Surveys and *Gonaxis kibweziensis*.



*Achatinella livida*  
(*O`ahu Tree Snail*)

**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: *Achatinella livida* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	10
<b>3.0</b>	<b>RESULTS</b> .....	<b>11</b>
3.1	Recommended Classification:.....	11
3.2	New Recovery Priority Number: .....	12
3.3	Listing and Reclassification Priority Number: .....	12
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>12</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>13</b>
	Signature Page.....	15

**5-YEAR REVIEW**  
***Achatinella livida* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the O`ahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella livida* is not robust with only 4 populations in the wild (US Army 2009) and 62 individuals in captive propagation (Hadfield 2010). The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella livida*.

**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 most recent sightings of live *A. livida* in the field were in 2009; a total of 103 snails (63 large, 20 medium, and 20 small) was sighted across all four populations (US Army 2009).

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

Analyses of mitochondrial 16S ribosomal DNA sequences revealed that *Achatinella livida*, *Achatinella apexfulva*, and *Achatinella sowerbyana* are in a monophyletic clade indicating the traditional placement of these three species in separate subgenera is inappropriate (Thacker and Hadfield 2000). The same analysis revealed that *A. livida* and *A. sowerbyana* are genetically very similar. Thacker and Hadfield (2000) concluded that *A. livida* and *A. sowerbyana* are either a single species, with different morphologies, or are two species hybridizing. Further genetic examination of these species using mitochondrial cytochrome *c* oxidase subunit I sequence data supports the conclusions made by Thacker and Hadfield (2000). Additionally, the high degree of genetic similarity

among populations of *A. livida* and populations of *A. sowerbyana* indicates that these taxa underwent a separation relatively recently in evolutionary history (Holland and Hadfield 2002; Holland and Hadfield 2004).

#### **2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change in the taxonomic classification or nomenclature of *Achatinella livida*.

#### **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.):**

*Achatinella livida* is found in the northern Ko`olau Mountains, along the summit, where there is a continuous band of suitable habitat provided by native vegetation and high precipitation. Populations of *A. livida* are physically separated from each other by 100 m or more (Holland and Hadfield 2002). Currently, there are four populations of *A. livida*, at elevations ranging from 2300 ft. to 2560 ft. (701 m to 780 m) (US Army 2009). Populations of *A. livida* are found in the same region as populations of *Achatinella sowerbyana*; however, populations of the two species, defined by different shell chiralities, are not found mixed together (Holland and Hadfield 2002).

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

The habitat *Achatinella livida* occupies in the northern Ko`olau Mountains is characterized by a band of continuous native vegetation, exposed to high levels of precipitation (Holland and Hadfield 2002).

#### **2.3.1.7 Other:**

None

### **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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella*

*livida* continues to be threatened by the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*), feral goats (*Capra hircus*), hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai'i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral pigs trample host plant species and spread the seeds of invasive plant species (USFWS 1992). Only one population that the ANRS monitors for *A. livida* has a predator exclosure and is controlled for rats and weeds.

The majority of the historical range of *A. livida* lies within the US Army's Kawaioloa Training Area (USFWS 1992; USFWS 2003). Tree-snail species are threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, vehicles, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

#### **2.3.2.3 Disease or predation:**

*Achatinella livida* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O`ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O`ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai`i, pers. com. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O`ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. com. 2011; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O`ahu from low elevations up to Mount Ka`ala in the Wai`anae Mountains (US Army 2008) and in the Ko`olau Mountains (B. Holland, pers. com. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. com. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. livida* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

Conservation measures for this species include captive propagation and genetic research. Individuals of *Achatinella livida* have been maintained in the captive-propagation lab at the University of Hawai`i at Mānoa since 1997. In 1997, a total of 13 snails (including six subadults) of *A. livida* was collected from the Ko`olau Summit region. The lab population of *A.*

*livida* has steadily increased over the years, but recently has experienced a decline. As of December 2009, there were 62 live *A. livida* in the facility (Hadfield 2010).

Tree snails are brought into the captive-propagation facility, because they are highly endangered in the field. Conditions in the lab duplicate conditions in the field, as much as possible. Environmental data were gathered from field sites in order to reproduce similar conditions in the lab. The temperature (average between 16° C and 20° C), humidity, rainfall, day length (12 hours), and substratum (native host-tree species) found in the field, are reproduced as best as possible in the environmental chambers in which the captive-reared snails live. The snails are provided with leafy branches of *Metrosideros polymorpha*. The epiphytic black mold *Cladosporium* sp, which is the snails' food source, is propagated in the lab and added as an additional food source. Most of the species in the facility initially experience an adaptation period, in which there is very low reproductive output. In some species, the adaptation period is followed by an increase in reproductive output and population size (Hadfield *et al.* 2004).

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

In addition to being in the captive propagation lab, one population has an ungulate fence, with weed and rat control being conducted (US Army 2009).

## 2.4 Synthesis

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. livida* was classified as having the status of probably extant, but uncommon. *Achatinella livida* was historically located on the leeward slopes of the northern Ko`olau Mountains. The majority of its historical range lies within the US Army's Kawaihoa Training Area.

The Army Natural Resource Staff (ANRS) has been monitoring *A. livida* since 1997 and has identified four populations separated by at least 100 m. The ANRS has surveyed for *A. livida*, because portions of its historical range lie within the US Army's Kawaihoa Training Area, where there are current populations of other species of *Achatinella*. The most recent field sightings of *A. livida* were in 2009; 103 live snails were found at four sites.

The captive-propagation program at the University of Hawai`i at Mānoa has maintained individuals of *A. livida* since 1997. In 1997, 13 live *A. livida* were bought into the lab.

The population slowly increased, but recently has experienced a decline. In December 2009, there were 62 *A. livida* in the facility.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species, feral pigs and goats result in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs and goats hunting activities, and hiking activities threaten tree-snail host plants due to trampling.

Tree-snail habitat and snails located within US Army Training Areas can be threatened directly and indirectly by military training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition.

Predation by *Euglandina rosea* and rats are major threats to *A. livida*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. com. 2011a).

Species like *A. livida* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to extremely limited numbers of individuals observed in the wild, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. livida* remain classified as endangered.

### **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:** N/A

**Brief Rationale:** N/A

**3.3 Listing and Reclassification Priority Number:** N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:** N/A

#### **4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

- Identify the actions to take when *Achatinella livida* is found in the wild.
- Routinely survey and monitor areas with existing populations of *Achatinella livida*.
- Survey areas with suitable habitat, within the historical range of *A. livida*.
- Continue and possibly expand captive-propagation efforts with the intended goals of increasing the population size in a predator-free environment and eventually reintroducing captive-reared *A. livida* into the wild (Recovery Action 12 and 13).
- Develop reintroduction plans for future releases into predator free sites in the wild.
- Identify suitable habitat sites that may serve as potential reintroduction sites for captive-reared *A. livida* (Recovery Action 51).
- Identify suitable habitat within the historical range of *A. livida* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. livida* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). *Proceedings, Hawaiian Entomological Society*. 18: 377-389.
- Hadfield, M.G. 2010. Annual report to the USFWS for Permit TE826600-11. University of Hawai'i, Honolulu, Hawai'i. 12 pages. Unpublished.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawai'ian tree snails by alien predators. *American Zoologist*. 33: 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.
- Thacker, R.W. and M.G. Hadfield. 2000. Mitochondrial phylogeny of extant Hawaiian tree snails (Achatinellinae). *Molecular Phylogenetics and Evolution*. 16 (2): 263-270.
- [US Army] U.S. Army Garrison, Hawai'i Directorate of Public Works Environmental Division. 2008. Final implementation plan for O'ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.
- [US Army] U.S. Army Garrison. 2009. Hawai'i Makua Collection Monitoring and Nursery Database. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawai'i. Unpublished.
- [USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O'ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawaii at Manoa, Honolulu, Hawaii. Telephone Conversation Record to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawaii. E-mail to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree Snail Surveys and *Gonaxis kibweziensis*.

**Signature Page**  
**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of *Achatinella livida***

**Current Classification:**           E          



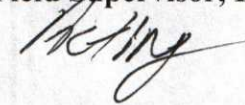
**Recommendation resulting from the 5-Year Review:**

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

**Appropriate Listing/Reclassification Priority Number, if applicable:**           

**Review Conducted By:**

Joy Hiromasa Browning, Fish and Wildlife Biologist  
Jess Newton, Endangered Species Recovery Program Leader  
Assistant Field Supervisor for Endangered Species

Approved  Date   
**Field Supervisor, Pacific Islands Fish and Wildlife Office**  


*Achatinella lorata*  
(*O`ahu Tree Snail*)

**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: *Achatinella lorata* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION .....</b>	<b>2</b>
1.1	Reviewers.....	2
1.2	Methodology used to complete the review:.....	2
1.3	Background: .....	2
<b>2.0</b>	<b>REVIEW ANALYSIS.....</b>	<b>3</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	3
2.2	Recovery Criteria.....	4
2.3	Updated Information and Current Species Status .....	5
2.4	Synthesis.....	8
<b>3.0</b>	<b>RESULTS .....</b>	<b>9</b>
3.1	Recommended Classification:.....	9
3.2	New Recovery Priority Number: .....	9
3.3	Listing and Reclassification Priority Number: .....	9
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS.....</b>	<b>9</b>
<b>5.0</b>	<b>REFERENCES.....</b>	<b>10</b>
	Signature Page.....	12

**5-YEAR REVIEW**  
***Achatinella lorata* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella lorata* has not been seen since 1979 (USFWS 1992). This species is not in captivity. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella lorata*.

**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:**

In 2002 two surveys were conducted in areas within the historical range of *A. lorata*. Additionally, in 2008 two more surveys were conducted in areas within the historical range of *A. lorata*. No living snails or shells of *A. lorata* were found during the surveys.

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella lorata*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella lorata*.

**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.):**

*Achatinella lorata* was historically located on the leeward slopes of the southern Ko`olau Mountains (USFWS 1992). There is no new information on the spatial distribution or historic range of *Achatinella lorata*.

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

Survey reports did not provide habitat conditions (N Yuen, Biological Consultant, pers. comm. 2011).

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella lorata* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

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

Illegal shell collecting is a continuing threat to the species.

**2.3.2.3 Disease or predation:**

*Achatinella lorata* is threatened by predation from the rosy wolf snail

(*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, pers. comm. 2011; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army 2008) and in the Ko'olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued**

**existence:**

Species like *A. lorata* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

This species is not in captive propagation and there are no other conservation measures being taken at this time for *A. lorata*.

## **2.4 Synthesis**

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. lorata* was classified as having the status of probably extant. *Achatinella lorata* was historically located on the leeward slopes of the southern Ko`olau Mountains. The most recent sighting of *A. lorata* was in 1979 at Tantalus-Pauoa Flats (USFWS 1992). In 2002 two surveys were conducted in areas within the historical range of *A. lorata*. Additionally, in 2008 two more surveys were conducted in areas within the historical range of *A. lorata*. No living snails or shells of *A. lorata* were found during the surveys.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Predation by *Euglandina rosea* and rats are major threats to *A. lorata*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. lorata* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized

catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to no recent observations of this species in the wild, no captive population, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. lorata* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:** N/A

### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella lorata* is found in the wild.
- Survey areas with suitable habitat, within the historical range of *A. lorata*.
- Identify areas within the historical range of *A. lorata* to construct predator proof enclosures where snails found in the wild could be moved into.

- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. lorata* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

- Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i ( Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.
- Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. *American Zoologist*. 33: 610-622.
- Hadfield, M.G., B.S. Holland, and K.J. Olival. 2004. Contributions of ex situ propagation and molecular genetics to conservation of Hawaiian tree snails. Experimental approaches to conservation biology. Gordon, M.S.; Bartol, S.M. [Eds]. University of California Press. Chapter pagination: 16-34.
- Hadfield, M.G. 2005. Annual report to the USFWS for Permit TE826600-11. University of Hawai'i, Honolulu, Hawai'i. 7 pages. Unpublished.
- 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.
- HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.

Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.

[US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O`ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.

[USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. *Federal Register* 8(46):3178-3182.

[USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawai`i. E-mail message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree snail surveys and *Gonaxis kibweziensis*.

Signature Page  
U.S. FISH AND WILDLIFE SERVICE  
5-YEAR REVIEW of *Achatinella lorata*

Current Classification:           E          


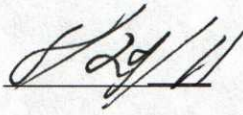
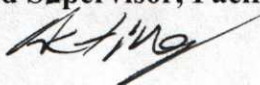
Recommendation resulting from the 5-Year Review:

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

Appropriate Listing/Reclassification Priority Number, if applicable:           

Review Conducted By:

Joy Hiromasa Browning, Fish and Wildlife Biologist  
Jess Newton, Endangered Species Recovery Program Leader  
Assistant Field Supervisor for Endangered Species

Approved  Date   
Field Supervisor, Pacific Islands Fish and Wildlife Office  


*Achatinella papyracea*  
(*O`ahu Tree Snail*)

**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: *Achatinella papyracea* (O`ahu tree snail)

### TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS</b> .....	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	11
3.3	Listing and Reclassification Priority Number: .....	11
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>11</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>11</b>
	Signature Page.....	14

**5-YEAR REVIEW**  
***Achatinella papyracea* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly know that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella papyracea* has not been seen since prior to 1945 (USFWS 1992). Currently this species is not in captive propagation. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella papyracea*.

**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:**

Portions of the historical range of *A. papyracea* have been surveyed because they lie within the US Army’s Kawaihoa Training Area and Schofield Barracks East Range, where there are current populations of *Achatinella* spp. The Army Natural Resource Staff has not found any living snails or shells of *A. papyracea* during their surveys. There is no new information on the abundance, population trends, demographic features, or demographic trends of *A. papyracea*.

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella papyracea*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella papyracea*.

**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.):**

There is no new information on the spatial distribution or historic range of *A. papyracea*.

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

There is no new information on the habitat or ecosystem conditions of *A. papyracea*.

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella papyracea* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai'i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

Portions of the historical range of *A. papyracea* lie within the US Army's Kawaihoa Training Area and Schofield Barracks East Range (USFWS 1992; USFWS 2003). Tree-snail species are threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop

movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

#### **2.3.2.3 Disease or predation:**

*Achatinella papyracea* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers.comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers.comm. 2011; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992;

Sugiura 2009). *Platydemis manokwari* is known to occur on O`ahu from low elevations up to Mount Ka`ala in the Wai`anae Mountains (US Army 2008) and in the Ko`olau Mountains (B. Holland, pers.comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. papyracea* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

This species is not in captive propagation. There are no conservation measures being implemented at this time specifically for *A. papyracea*.

## **2.4 Synthesis**

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. papyracea* was classified as having the status of almost certainly extinct. *Achatinella papyracea* historically was located on the leeward slopes of the central Ko`olau Mountains (USFWS 1992). Portions of its historical range lie within the US Army's Kawaihoa Training Area and Schofield Barracks East Range.

Portions of the historical range of *A. papyracea* have been surveyed, because they lie within the US Army's Kawaihoa Training Area and Schofield Barracks East Range, where there are current populations of *Achatinella* spp. The Army Natural Resource Staff has not found any living snails or shells of *A. papyracea* during their surveys

The degree of habitat degradation varies within the historical range of the O`ahu tree

snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Tree-snail habitat and snails located within US Army Training Areas can be threatened directly and indirectly by Military training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition.

Predation by *Euglandina rosea* and rats are major threats to *A. papyracea*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O'ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. papyracea* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to no recent observations of this species in the wild, no captive population, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. papyracea* remain classified as endangered.

### 3.0 RESULTS

#### 3.1 Recommended Classification:

\_\_\_\_\_ **Downlist to Threatened**

\_\_\_\_\_ **Uplist to Endangered**

\_\_\_\_\_ **Delist**

\_\_\_\_\_ *Extinction*

\_\_\_\_ Recovery  
\_\_\_\_ Original data for classification in error  
X No change is needed

**3.2 New Recovery Priority Number:** N/A

**Brief Rationale:** N/A

**3.3 Listing and Reclassification Priority Number:** N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_

**Brief Rationale:** N/A

#### **4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

- Identify the actions to take when *Achatinella papyracea* is found in the wild.
- Survey areas with suitable habitat, within the historical range of *A. papyracea*.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. papyracea* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

#### **5.0 REFERENCES**

Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.

Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. American Zoologist. 33: 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.
- HawaiianForest.com. 2011. Pu`u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai`i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.
- [US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O`ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawailoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.
- [USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. *Federal Register* 8(46):3178-3182.
- [USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.
- Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

- Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawai`i. E-mail message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree snail surveys and *Gonaxis kibweziensis*.



*Achatinella phaeozona*  
(*O`ahu Tree Snail*)

**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: *Achatinella phaeozona* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS</b> .....	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	10
3.3	Listing and Reclassification Priority Number: .....	10
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>10</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>11</b>
	Signature Page.....	13

**5-YEAR REVIEW**  
***Achatinella phaeozona* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella phaeozona* has not been seen since 1974 (USFWS 1992). This species is not in captivity. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella phaeozona*.

**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:**

There is no new information on the abundance, population trends, demographic features, or demographic trends of *A. phaeozona*.

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella phaeozona*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella phaeozona*.

**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.):**

*Achatinella phaeozona* was historically located on the windward slopes of the southern Ko`olau Mountains, with a small portion of its historical range on the leeward side. There is no new information on the spatial distribution or historic range of *A. phaeozona*.

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

Survey reports did not provide habitat conditions (N Yuen, Biological Consultant, pers. comm. 2011).

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella phaeozona* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

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

Illegal shell collecting is a continuing threat to the species.

**2.3.2.3 Disease or predation:**

*Achatinella phaeozona* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can

result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, pers. comm. 2011; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army 2008) and in the Ko'olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. phaeozona* that are endemic to small portions of a single

island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

This species is not in captive propagation and there are no other conservation measures being taken at this time for *A. phaeozona*.

## 2.4 Synthesis

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. phaeozona* was classified as having the status of probably extant. *Achatinella phaeozona* was historically located on the windward slopes of the southern Ko`olau Mountains, with a small portion of its historical range on the leeward side. The most recent sighting of *A. phaeozona* was in 1974 in Ka`alakei Valley (USFWS 1992).

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Predation by *Euglandina rosea* and rats are major threats to *A. phaeozona*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. phaeozona* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to

make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to no recent sightings of individuals in the wild, the lack of a captive population, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. phaeozona* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_

**Brief Rationale:** N/A

### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella phaeozona* is found in the wild.
- Survey areas with suitable habitat, within the historical range of *A. phaeozona*.
- Identify areas within the historical range of *A. phaeozona* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.

- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. phaeozona* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i ( Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.

Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. *American Zoologist*. 33: 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.

HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.

Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).

Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.

Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.

[US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O'ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.

[USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. *Federal Register* 8(46):3178-3182.

[USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O'ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawai`i. E-mail message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree snail surveys and *Gonaxis kibweziensis*.



*Achatinella pulcherrima*  
(*O`ahu Tree Snail*)

**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: *Achatinella pulcherrima* (O`ahu tree snail)

### TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS</b> .....	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	11
3.3	Listing and Reclassification Priority Number: .....	11
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>11</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>11</b>
	Signature Page.....	14

**5-YEAR REVIEW**  
***Achatinella pulcherrima* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella pulcherrima* has not been seen since 1993 (USFWS 1992). This species is not in captivity. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella pulcherrima*.

**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 most recent sighting of *A. pulcherrima* was in 1993, at the Opaepa drainage near the south fork of Opaepa Stream and on the Peahinaia Trail (USFWS 2003; OIP 2008). Recent surveys within the historical range have not found any live snails or shells (US Army 2009).

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella pulcherrima*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella pulcherrima*.

**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.):**

*Achatinella pulcherrima* was historically located on the windward slopes of the southern Ko`olau Mountains, with a small portion of its historical range on the leeward side. There is no new information on the spatial distribution or historic range of *A. pulcherrima*.

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

Survey reports did not provide habitat conditions (N Yuen, Biological Consultant, pers. comm. 2011).

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella pulcherrima* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

The majority of the historical range of *A. pulcherrima* lies within the US Army's Kawaihoa Training Area and a small portion lies within the US Army's Schofield Barracks East Range (USFWS 1992; USFWS 2003). Tree-snail species are threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas

may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

### **2.3.2.3 Disease or predation:**

*Achatinella pulcherrima* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, pers. comm. 2011; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from

low elevations up to Mount Ka`ala in the Wai`anae Mountains (US Army 2008) and in the Ko`olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. pulcherrima* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

This species is not in captive propagation and there are no other conservation measures being taken at this time for *A. pulcherrima*.

## **2.4 Synthesis**

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. pulcherrima* was classified as having the status of probably being extant. *Achatinella pulcherrima* historically was located on the leeward slopes of the northern Ko`olau Mountains. The majority of its historical range lies within the US Army's Kawaihoa Training Area, and a small portion lies within the US Army's Schofield Barracks East Range (USFWS 1992).

The most recent sighting of *A. pulcherrima* was in 1993, near the south fork of Opaueula Stream and on the Peahinaia Trail. Portions of the historical range of *A. pulcherrima* have been surveyed but no living snails or shells of *A. pulcherrima* have been found.

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates,

hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Tree-snail habitat and snails located within US Army Training Areas can be threatened directly and indirectly by military training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition.

Predation by *Euglandina rosea* and rats are major threats to *A. pulcherrima*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. pulcherrima* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to no recent sightings of individuals in the wild, the lack of a captive population, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. pulcherrima* remain classified as endangered.

### 3.0 RESULTS

#### 3.1 Recommended Classification:

\_\_\_ **Downlist to Threatened**

\_\_\_ **Uplist to Endangered**

\_\_\_ **Delist**

\_\_\_ *Extinction*

\_\_\_ *Recovery*

\_\_\_\_\_ Original data for classification in error  
 X  No change is needed

**3.2 New Recovery Priority Number: N/A**

**Brief Rationale: N/A**

**3.3 Listing and Reclassification Priority Number: N/A**

**Reclassification (from Threatened to Endangered) Priority Number: \_\_\_\_\_**

**Reclassification (from Endangered to Threatened) Priority Number: \_\_\_\_\_**

**Delisting (regardless of current classification) Priority Number: \_\_\_\_\_**

**Brief Rationale: N/A**

**4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

- Identify the actions to take when *Achatinella pulcherrima* is found in the wild.
- Survey areas with suitable habitat, within the historical range of *A. pulcherrima*.
- Identify areas within the historical range of *A. pulcherrima* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. pulcherrima* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

**5.0 REFERENCES**

Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.

Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. American Zoologist. 33: 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.
- HawaiianForest.com. 2011. Pu`u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai`i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.
- [US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O`ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.
- [US Army] U.S. Army Garrison. 2009. Hawai`i Makua Collection Monitoring and Nursery Database. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawai`i. Unpublished.
- [USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. *Federal Register* 8(46):3178-3182.
- [USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.
- Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawai`i. E-mail message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree snail surveys and *Gonaxis kibweziensis*.



*Achatinella pupukanioe*  
(*O`ahu Tree Snail*)

**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: *Achatinella pupukanioe* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION</b> .....	<b>3</b>
1.1	Reviewers .....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS</b> .....	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS</b> .....	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	10
3.3	Listing and Reclassification Priority Number: .....	10
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS</b> .....	<b>10</b>
<b>5.0</b>	<b>REFERENCES</b> .....	<b>11</b>
	Signature Page.....	13

**5-YEAR REVIEW**  
***Achatinella pupukanioe* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella pupukanioe* has not been seen since 1980 (USFWS 1992). This species is not in captivity. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella pupukanioe*.

**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:**

There is no new information on the abundance, population trends, demographic features, or demographic trends of *A. pupukanioe*.

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella pupukanioe*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella pupukanioe*.

**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.):**

*Achatinella pupukanioe* was historically located on the windward slopes of the southern Ko`olau Mountains, with a small portion of its historical range on the leeward side. There is no new information on the spatial distribution or historic range of *A. pupukanioe*.

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

There is no new information on the habitat or ecosystem conditions of *A. pupukanioe*.

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella pupukanioe* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

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

Illegal shell collecting is a continuing threat to the species.

**2.3.2.3 Disease or predation:**

*Achatinella pupukanioe* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can

result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. comm. 2011; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army 2008) and in the Ko'olau Mountains (B. Holland, pers. comm. 2011b); however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. pupukanioe* that are endemic to small portions of a single

island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

This species is not in captive propagation and there are no other conservation measures being taken at this time for *A. pupukanioe*.

## 2.4 Synthesis

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. pupukanioe* was classified as having the status of probably extant. *Achatinella pupukanioe* was historically located on the leeward slopes of the central Ko`olau Mountains. The most recent sighting of *A. pupukanioe* was in 1980 on the Aiea Ridge Trail (USFWS 1992).

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host plants by trampling them.

Predation by *Euglandina rosea* and rats are major threats to *A. pupukanioe*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. pupukanioe* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change

Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to no recent sightings of individuals in the wild, lack of a captive population, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. pupukanioe* remain classified as endangered.

### 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: N/A

**Brief Rationale:** N/A

#### 3.3 Listing and Reclassification Priority Number: N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_\_

**Brief Rationale:** N/A

### 4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify the actions to take when *Achatinella pupukanioe* is found in the wild.
- Survey areas with suitable habitat, within the historical range of *A. pupukanioe*.
- Identify areas within the historical range of *A. pupukanioe* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplanea septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplanea septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.

- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. pupukanioe* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

## 5.0 REFERENCES

Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.

Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. American Zoologist. 33: 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.

HawaiianForest.com. 2011. Pu'u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai'i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.

Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. Biodiversity and Conservation (online first: DOI 10.1007/s10531-009-9773-5).

Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. Pacific Science. 46: 77-85.

Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. Biological Invasions. 11: 737-742.

[US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O'ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawaihoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.

[US Army] U.S. Army Garrison. 2009. Hawai'i Makua Collection Monitoring and Nursery Database. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawai'i. Unpublished.

[USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. Federal Register 8(46):3178-3182.

[USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.

Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawai`i. E-mail message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree snail surveys and *Gonaxis kibweziensis*.

**Signature Page**  
**U.S. FISH AND WILDLIFE SERVICE**  
**5-YEAR REVIEW of *Achatinella pupukanioe***

**Current Classification:**           E          

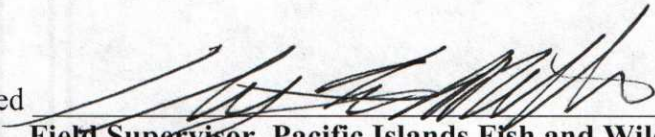
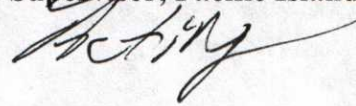
**Recommendation resulting from the 5-Year Review:**

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

**Appropriate Listing/Reclassification Priority Number, if applicable:** \_\_\_\_\_

**Review Conducted By:**

Joy Hiromasa Browning, Fish and Wildlife Biologist  
Jess Newton, Endangered Species Recovery Program Leader  
Assistant Field Supervisor for Endangered Species

Approved  Date 8/29/11  
Field Supervisor, Pacific Islands Fish and Wildlife Office  


*Achatinella rosea*  
(*O`ahu Tree Snail*)

**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: *Achatinella rosea* (O`ahu tree snail)

## TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL INFORMATION .....</b>	<b>3</b>
1.1	Reviewers.....	3
1.2	Methodology used to complete the review:.....	3
1.3	Background: .....	3
<b>2.0</b>	<b>REVIEW ANALYSIS.....</b>	<b>4</b>
2.1	Application of the 1996 Distinct Population Segment (DPS) policy .....	4
2.2	Recovery Criteria.....	5
2.3	Updated Information and Current Species Status .....	6
2.4	Synthesis.....	9
<b>3.0</b>	<b>RESULTS .....</b>	<b>10</b>
3.1	Recommended Classification:.....	10
3.2	New Recovery Priority Number: .....	11
3.3	Listing and Reclassification Priority Number: .....	11
<b>4.0</b>	<b>RECOMMENDATIONS FOR FUTURE ACTIONS.....</b>	<b>11</b>
<b>5.0</b>	<b>REFERENCES.....</b>	<b>11</b>
	Signature Page.....	14

**5-YEAR REVIEW**  
***Achatinella rosea* / O`ahu Tree Snail**

**1.0 GENERAL INFORMATION**

**1.1 Reviewers**

**Lead Regional Office:**

Region 1, Endangered Species Program, Division of Recovery Jesse D'Elia,  
(503) 231-2071

**Lead Field Office:**

Pacific Islands Fish and Wildlife Office, Loyal Mehrhoff, Field Supervisor,  
(808) 792-9400

**Cooperating Field Office(s):**

N/A

**Cooperating Regional Office(s):**

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 (USFWS), beginning on August 7, 2009. The review was based on the final rule to list the Hawaiian (O`ahu) tree snails genus *Achatinella* and the Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella* (USFWS 1981, 1992), as well as a review of current available information. The Hawaiian Tree Snail Conservation Lab provided an initial draft of portions of the review and recommendations for conservation actions needed prior to the next five-year review. The draft 5-year review was then reviewed by the Recovery Program Leader and the Assistant Field Supervisor for Endangered Species before submission to the Field Supervisor for approval.

**1.3 Background:**

**1.3.1 FR Notice citation announcing initiation of this review:**

[USFWS] U.S. Fish and Wildlife Service. 2009. Endangered and threatened wildlife and plants; initiation of 5-year reviews of 103 species in Hawaii. Federal Register 74(49):11130-11133.

### 1.3.2 Listing history

#### Original Listing

**FR notice:** [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. Federal Register 8(46):3178-3182.

**Date listed:** February 12, 1981

**Entity listed:** Genus

**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:

Critical Habitat was not designated for the Hawaiian (O`ahu) tree snails genus *Achatinella* in 1981 when it was listed because it would make these animals more vulnerable to collection.

### 1.3.4 Review History:

Species status review [FY2010 Recovery Data Call (August 2010)]: Declining

#### **Recovery achieved:**

1 (0-25%) [FY2010 Recovery Data Call - August 2010]

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

2

### 1.3.6 Current Recovery Plan or Outline

**Name of plan:** Recovery Plan for the Oahu Tree Snails of the Genus *Achatinella*

**Date issued:** June 20, 1992

**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*  
  X   *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?**

*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:**

The recovery plan states “the status of most Hawaiian tree snails is so poorly known that no downlisting or delisting objective can be established at this time. Eventually, through the development of populations in nature that are robust and free of the twin threats of predation and habitat destruction, steps should be taken to downlist the Hawaiian tree snails (or individual species) to Threatened.”

These criteria have not been met. The population of *Achatinella rosea* has not been seen since 1949 (USFWS 1992). This species is not in captivity. The threats of predation and habitat destruction are largely unmanaged.

**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:**

There is no new information on the biology and life history of *Achatinella rosea*.

**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:**

There is no new information on the abundance, population trends, demographic features, or demographic trends of *A. rosea*.

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

There is no new information on the genetics, genetic variation, or trends in genetic variation of *Achatinella rosea*.

**2.3.1.4 Taxonomic classification or changes in nomenclature:**

There has been no change to the taxonomic classification or nomenclature of *Achatinella rosea*.

**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.):**

*Achatinella rosea* was historically located on the leeward slopes of the northern Ko`olau Mountains, with a small portion of its historical range on the leeward side. There is no new information on the spatial distribution or historic range of *A. rosea*.

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

There is no new information on the habitat or ecosystem conditions of *A. rosea*.

**2.3.1.7 Other:**

None

**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 degradation is a major threat to *Achatinella* spp.; however, the degree of habitat degradation varies within the historical range of each species. The tree-snail habitat within the historical range of *Achatinella rosea* continues to be threatened with the spreading of invasive plants into higher elevations by feral pigs (*Sus scrofa*) and goats, hunting, and hiking. Tree-snail host plants are threatened by invasions from *Psidium cattleianum* (strawberry guava), *Grevillea robusta* (silk oak), *Schinus terebinthifolius* (christmas berry), *Lantana camara*, *Clidemia hirta* (USFWS 1992), *Leucaena leucocephala* (koa haole), and *Miconia calvescens* (Weed Risk Assessments for Hawai`i and Pacific Islands 2011). Invasive plant species compete with host plant species for space and resources. Feral ungulates trample host plant species and spread the seeds of invasive plant species (USFWS 1992).

Large portions of the historical range of *A. rosea* lie within the US Army's Kawaihoa Training Area and Schofield Barracks East Range (USFWS 1992; USFWS 2003). Tree-snail species are threatened directly and indirectly by training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, vehicles, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition (USFWS 2003).

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

Illegal shell collecting is a continuing threat to the species.

### **2.3.2.3 Disease or predation:**

*Achatinella rosea* is threatened by predation from the rosy wolf snail (*Euglandina rosea*) and rats (*Rattus exulans*, *Rattus rattus*, and *Rattus norvegicus*) (USFWS 1992; Hadfield *et al.* 1993; Hadfield and Saufler 2009). *E. rosea* preys on all sizes of snails. Predation by *E. rosea* can result in the extirpation of a snail population in less than one year. When *E. rosea* preys on snails, the shell is left clean and undamaged. Rats prey on larger snails. When rats prey on snails, the shells are crushed (Hadfield *et al.* 1993).

The Jackson's chameleon (*Chamaeleo jacksonii*) has recently been documented as a predator of *Achatinella* spp. and may pose a major threat to their existence. Jackson's chameleons are found in the Ko'olau and Wai'anae Mountains (Holland *et al.* 2009); however, their impact on *Achatinella* spp. is not well documented.

The terrestrial snail *Gonaxis kibweziensis* was introduced around O'ahu to control *Achatina fulica* or African Snail. *Gonaxis kibweziensis* have been observed preying on *Achatina* egg clutches and juveniles under the length of 35mm and unidentified native terrestrial snails (Davis and Butler 1964). Carnivorous snails introduced to control other introduced snails pose a significant threat to *Achatinella* spp. Although released at various elevations around O'ahu (Davis and Butler 1964), they are mainly found in the lowland (B. Holland, University of Hawai'i, pers. comm. 2011a). In April 2011, this species was found in the back of Kuliouou Valley on O'ahu at 2,200 feet elevation (N. Yuen, Biological Consultant, pers. comm. 2011; Hawaiianforest.com 2011).

The terrestrial snail *Oxychilus alliarius* and the terrestrial flatworm *Geoplana septemlineata*, which reportedly eat snails (USFWS 1992), may threaten *Achatinella* spp.; however, predation on *Achatinella* spp. by *G. septemlineata* and *O. alliarius* has not been observed (USFWS 1992).

Additionally, the flatworm *Platydemis manokwari* is a known predator of land and arboreal snails on many Pacific islands (Hopper and Smith 1992; Sugiura 2009). *Platydemis manokwari* is known to occur on O'ahu from low elevations up to Mount Ka'ala in the Wai'anae Mountains (US Army 2008) and in the Ko'olau Mountains (B. Holland, pers. comm. 2011b);

however, predation by *P. manokwari* on *Achatinella* spp. has not been documented. There are no known diseases that threaten *Achatinella* spp. (USFWS 1992). It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

#### **2.3.2.4 Inadequacy of existing regulatory mechanisms:**

None.

#### **2.3.2.5 Other natural or manmade factors affecting its continued existence:**

Species like *A. rosea* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations, localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks, and climate change effects for example lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

This species is not in captive propagation and there are no other conservation measures being taken at this time for *A. rosea*.

## **2.4 Synthesis**

In the 1992 recovery plan for the O`ahu tree snails of the genus *Achatinella*, *A. rosea* was classified as having the status of probably extinct. *Achatinella rosea* historically was located on the leeward slopes of the northern Ko`olau Mountains (USFWS 1992). Large portions of its historical range lie within the US Army's Kawaihoa Training Area and Schofield Barracks East Range.

The most recent sighting of *A. rosea* was in 1949 at Pu`u Peahinaia (USFWS 1992). Portions of the historical range of *A. rosea* have been surveyed because they lie within the US Army's Kawaihoa Training Area and Schofield Barracks East Range, where there are current populations of *Achatinella* spp. No live snails or shells of *A. rosea* were found during their surveys (US Army 2009).

The degree of habitat degradation varies within the historical range of the O`ahu tree snails. The presence and abundance of invasive plant species and feral ungulates, hunting, and hiking have resulted in habitat degradation and loss. Tree-snail host plants are threatened by invasions from invasive plants. Feral pigs threaten tree-snail host

plants by trampling them.

Tree-snail habitat and snails located within US Army Training Areas can be threatened directly and indirectly by military training activities. Food disposed of during military troop activities leads to an increase in the size of rat populations. Seeds of non-native plants may be spread along the trails used by the military via transportation on boots, equipment, or clothing. Dismounted troop movement in forested areas may result in the trampling of host plants and possibly tree snails. Discarded cigarettes, military vehicles and other equipment used during training activities can be potential sources of fire ignition.

Predation by *Euglandina rosea* and rats are major threats to *A. rosea*. The Jackson's chameleon has recently been identified as a predator of *Achatinella* spp. and may pose a major threat to their existence. The terrestrial flatworm *Geoplana septemlineata* and the terrestrial snails, *Oxychilus alliarius* and *Gonaxis kibweziensis*, may threaten *Achatinella* spp. The flatworm *Platydemis manokwari* is a predator of arboreal snails on many Pacific islands and does occur on O`ahu. It is unknown what impacts skinks and birds may have on *Achatinella* spp. (B. Holland, pers. comm. 2011a).

Species like *A. rosea* that are endemic to small portions of a single island are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a few populations and individuals by random demographic fluctuations; localized catastrophes such as hurricanes, landslides, flooding, and disease outbreaks; and climate change effects such as lowland predators moving to higher elevations.

Current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2013.

Due to no recent sightings of individuals in the wild, lack of a captive population, an extremely limited historical spatial distribution, and the absence of management actions to mitigate threats to this species, it is recommended that *A. rosea* remain classified as endangered.

### 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:** N/A

**Brief Rationale:** N/A

**3.3 Listing and Reclassification Priority Number:** N/A

**Reclassification (from Threatened to Endangered) Priority Number:** \_\_\_\_

**Reclassification (from Endangered to Threatened) Priority Number:** \_\_\_\_

**Delisting (regardless of current classification) Priority Number:** \_\_\_\_

**Brief Rationale:** N/A

#### **4.0 RECOMMENDATIONS FOR FUTURE ACTIONS**

- Identify the actions to take when *Achatinella rosea* is found in the wild.
- Survey areas with suitable habitat, within the historical range of *A. rosea*.
- Identify areas within the historical range of *A. rosea* to construct predator proof enclosures where snails found in the wild could be moved into.
- Survey and monitor the presence and abundance of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons within the specie's historical range (Recovery Actions 311, 313, and 315).
- Assess the impacts of *Euglandina rosea*, rats, *Geoplana septemlineata*, *Platydemis manokwari*, *Oxychilus alliarius*, and Jackson's chameleons on *Achatinella* spp.
- Assess the impact of feral pigs and other ungulates on tree-snail habitat.
- Collect anecdotal information on other potential predators of *Achatinella* spp. such as *Gonaxis kibweziensis*, skinks, and birds.
- Design and implement more effective predator elimination techniques within the historical range of *A. rosea* (Recovery Actions 31 and 312).
- Control feral ungulates within the historic range of *Achatinella* spp.
- Remove invasive plant species responsible for habitat degradation (Recovery Action 3274).

#### **5.0 REFERENCES**

Davis, C. J. and G. D. Butler. 1964. Introduced enemies of the Giant African Snail, *Achatina fulica* Bowdich, in Hawai'i (Pulmonata: Achatinidae). Proceedings, Hawaiian Entomological Society. 18: 377-389.

Hadfield, M.G., S.E. Miller, and A.H. Carwile. 1993. The decimation of endemic Hawaiian tree snails by alien predators. American Zoologist. 33: 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.
- HawaiianForest.com. 2011. Pu`u O Kona in the Rain [web blog]. Nathan Yuen, Honolulu, Hawai`i. Available online at <HawaiianForest.com>. Accessed 8 July 2011.
- Holland, B.S., S.L. Montgomery, and V. Costello. 2009. A reptilian smoking gun: first record of invasive Jackson's chameleon (*Chamaeleo jacksonii*) predation on native Hawaiian species. *Biodiversity and Conservation* (online first: DOI 10.1007/s10531-009-9773-5).
- Hopper, D.R. and B.D. Smith. 1992. Status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. *Pacific Science*. 46: 77-85.
- Sugiura, S. 2009. Potential impacts of the invasive flatworm *Platydemus manokwari* on arboreal snails. *Biological Invasions*. 11: 737-742.
- [US Army] U.S. Army Garrison, Hawaii Directorate of Public Works Environmental Division. 2008. Final implementation plan for O`ahu training areas: Schofield Barracks Military Reservation, Schofield Barracks East Range, Kawailoa Training Area, Kahuku Training Area, and Dillingham Military Reservation. 624 pp.
- [US Army] U.S. Army Garrison. 2009. Hawai`i Makua Collection Monitoring and Nursery Database. U.S. Army Garrison, Directorate of Public Works, Environmental Division, Schofield Barracks, Hawai`i. Unpublished.
- [USFWS] U.S. Fish and Wildlife Service. 1981. Endangered and threatened wildlife and plants; listing the Hawaiian (Oahu) tree snails of the genus *Achatinella* as endangered species. *Federal Register* 8(46):3178-3182.
- [USFWS] U.S. Fish and Wildlife Service. 1992. Recovery Plan O`ahu Tree Snails of the Genus *Achatinella*. Region 1, Portland, OR. 64 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 2<sup>nd</sup> brigade 25<sup>th</sup> infantry division (light) U.S. Army installations Island of O`ahu. Unpublished, 351 pp.
- Weed Risk Assessments for Hawai`i and Pacific Islands. 2011. Weed risk assessments for Hawai`i and Pacific islands [web application]. Curt Daehler, Honolulu, Hawai`i. Available online at <<http://www.botany.hawaii.edu/faculty/daehler/wra/>>. Accessed 13 April 2011.

## **PERSONAL AND WRITTEN COMMUNICATIONS**

Holland, Brenden. 2011a. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawaii. Telephone Conversation to Joy Browning U.S. Fish and Wildlife Service, dated April 14, 2011. Subject: *Gonaxis kibweziensis*

Holland, Brenden. 2011b. Department of Zoology, University of Hawai`i at Mānoa, Honolulu, Hawai`i. Electronic message regarding *Platydemis manokwari*. Received by Joy Browning, U.S. Fish and Wildlife Service. Dated July 8, 2011.

Yuen, Nathan. 2011. Biological Consultant, Honolulu, Hawai`i. E-mail message to Joy Browning, U.S. Fish and Wildlife Service, dated April 13, 2011. Subject: O`ahu Tree snail surveys and *Gonaxis kibweziensis*.

