

5-YEAR REVIEW

Short Form Summary

Species Reviewed: *Serianthes nelsonii* (Hayun lagu or Tronkon guafi)

Current Classification: Endangered

Federal Register Notice announcing initiation of this review:

[USFWS] U.S. Fish and Wildlife Service. 2014. Endangered and threatened wildlife and plants; initiation of 5-year status reviews of 5 species in Oregon, Palau, Guam, and the Northern Mariana Islands. Federal Register 79(32):9263-9264.

Lead Region/Field Office: Region 1/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawai`i

Name of Reviewer(s):

Peter McBride, Fish and Wildlife Biologist, PIFWO

Jacqueline Flores, Mariana Islands Team Manager, PIFWO

Gregory Koob, Conservation and Restoration Team Manager, PIFWO

Kristi Young, Programmatic Deputy Field Supervisor, PIFWO

Lauren Weisenberger, Plant Recovery Coordinator, PIFWO

Methodology used to complete this 5-year review:

This review was conducted by staff of the Pacific Islands Fish and Wildlife Office of the U.S. Fish and Wildlife Service (USFWS). The review was based on the recovery plan for *Serianthes nelsonii* (USFWS 1994), as well as a review of current, available information since the last 5-year review for *Serianthes nelsonii* (USFWS 2012). The evaluation by Peter McBride, Fish and Wildlife Biologist, was reviewed by the Mariana Islands Team Manager, Conservation and Restoration Team Manager, and Plant Recovery Coordinator before submission to the Programmatic Deputy Field Supervisor for review and approval.

Background:

For information regarding the species listing history and other facts, please refer to the Fish and Wildlife Service's Environmental Conservation On-line System (ECOS) database for threatened and endangered species (http://ecos.fws.gov/tess_public).

Review Analysis:

Please refer to the previous 5-year review for *Serianthes nelsonii* published on August 28, 2012 (available at http://ecos.fws.gov/docs/five_year_review/doc4060.pdf) for a complete review of the species' status, threats, and management efforts. No significant new information regarding the species biological status has come to light since listing to warrant a change in the Federal listing status of *Serianthes nelsonii* as endangered.

Serianthes nelsonii is a large forest tree endemic to the southern Marianas Islands, known to occur only on Guam and Rota (Costion & Lorence 2012). The species, known locally as Hâyun lâgu (on Guam) or Trongkon guâfi (on Rota) is a dominant tree in the native limestone forest community. Its broad crown of twice-pinnate, compound leaves,

highlighted with fine-textured pink flowers and arching leguminous seed-pods, creates a distinct presence amid a canopy dominated by the generally undivided leaves of most of its forest neighbors. Historically, on Guam the tree is known primarily from the limestone forests on the north part of the island, with some occurrences in the volcanic south as well. On Rota, the species is known from the forested flanks of the Mount Sabana plateau that dominates the southwestern half of the island. Wiles *et al.* (1996) detailed the historic distributions of *Serianthes nelsonii*, as well as the early evidence of the species decline on both islands.

The species was described by Merrill in 1919, and even then was considered rare (Merrill 1919). By the time surveys were attempted more than 60 years later, less than 150 individual trees were documented, and the species was subsequently listed as Endangered by USFWS, and is currently classified as Critically Endangered by the IUCN (Wiles 1998).

The current status for *Serianthes nelsonii* is provided in Table 1 below. Threats to the species (Table 2) continue, including recruitment failure due to insect and ungulate herbivory; vulnerability to typhoons, fire, and other disturbance events; and potential climate change effects.

New status information:

- Continued demographic decline of wild population on Rota. The decline anticipated by Wiles (1998) continues to play out. Recent field reviews on Rota (AnnMarie Gawel, USFWS, pers. comm. 2016a & 2016b) confirmed an apparent large die-off among the historic adult trees, relative to the approximately 120 adult trees inventoried in 1992 (Wiles et al 1996). Also, there was no regeneration (no seedlings recorded). Following is a more specific breakdown, organized by Wiles' original subpopulation numbers, all from AnnMarie Gawel, USFWS (pers. comm. 2016a & 2016b), except for subpopulation 1.
 - Subpopulation 1: Of the 15 adult trees recorded in 1992, at least 11 are still alive (McBride field notes and GPS points, September 14, 2016).
 - Subpopulations 2-10: Of the 67 adult trees in this area in 1992, only 19 were found alive in June 2016, while another 20+ large stumps and down logs (none recent) may represent some of the *Serianthes* lost there.
 - Subpopulations 11-13: Among the 28 live trees in this area in 1992, one was observed alive in June 2016.
 - Subpopulation 14: Of the 8 adult trees recorded in 1992, one was known to be alive in 2013.
 - Subpopulations 15-16: The 3 live *Serianthes* in 1992 were all known to have died several years ago.

Rangewide demographic decline. In aggregate, including the one surviving adult *Serianthes* on Guam, the current numbers represent a 73% overall decline of wild *Serianthes* trees from the 1992 baseline — from the 122 documented then to 33 currently known.

- Reduction in geographic range of wild population on Rota. Along with the demographic decline, there has also been significant contraction in the range of the wild population. At the time of the 1992 inventory, the species range on Rota could be described as largely surrounding the Mount Sabana massif, which dominates the west half of the island — a span of nearly 8 km. Following the loss of Wiles' 1992 subpopulations in the Palii area (#'s 15 & 16), that span already has been halved to just under 4 km. Other outlying subpopulations (#14, in Lupok area, and #'s 11-13, in the Isang area) have greatly declined, down to a single surviving individual in each location at last report — representing a 93% reduction of the 36 total individuals recorded among these subpopulations in 1992. If this trend continues and these vestigial groups are also lost, the range of the wild population may soon be limited to an extent spanning 1.6 km along the southwestern flank of the Mount Sabana massif. Whether or not such continuing collapse transpires, 94% of today's remaining known wild *Serianthes* population on Rota survive within an area of less than 100 ha. Such contracted range leaves the remaining population highly vulnerable to large- to mid-scale disturbance events, whether of anthropogenic, climatic, or other origin. Thus, the sharp decline and potential loss of smaller, outlying subpopulations amplifies the vulnerability of the remaining population to large disturbance events within its shrinking range.
- On Guam, the lone adult tree at Ritidian continues to decline, with no persisting natural regeneration to sustain a wild population. The one surviving *Serianthes* tree has undergone conspicuous crown reduction in recent years. Marler and Cascasan (2015) studied the survival of seedlings germinating beneath that tree, documenting both their high recruitment potential (an average of >1 seedling emerging per day throughout 2013) – and inability to survive to the juvenile stage. Over half the seedlings died within the first month after sprouting, while essentially all had died by 200 days post-emergence. During 2014-15, Marler and Musser (2015) monitored the survival and fate of 488 seedlings under the Ritidian tree, evaluating four different treatments as mitigations for potential seedling stressors. While insecticide, fertilizer, and supplemental lighting treatments did not meaningfully extend the longevity of test seedlings, those treated with a fungicide (Ridomil Gold) survived more than twice as long as the untreated control seedlings. This suggests that root pathogens may be significant agents of mortality, in addition to the previously-recognized problems of insect and ungulate herbivory. The capacity for *Serianthes* to regulate the soil's biogeochemistry beneath its canopy was also studied; in contrast to more distant samples, those taken from within the litterfall area beneath the tree had significantly more nitrogen, carbon, calcium, magnesium, copper, and zinc; and less iron (Naval Facilities Marianas 2015). At the Guam National Wildlife Refuge, Deregnier (USFWS, pers. comm. 2016a) observed a range of insect herbivory agents, among which mealybugs have been the most problematic; their attacks on both foliage and (particularly) roots of *Serianthes* have caused 10 of 12 seedling deaths to date. Also on the Refuge, Deregnier found that outplanted trees seemed to do best in forest-gap settings: that is, with relatively high light and

humidity, but low wind exposure (Ryan Deregnier, USFWS, pers. comm. 2016a). On both Guam and Rota, the clearly decadent state of the remaining wild trees — together with the failure of seedlings to persist — emphasizes the importance both of studies of the mechanisms of decline in the wild populations, as well as into propagation methods to sustain the species through the near to mid-term.

- In addition to these *in situ* studies, off-site research on Guam has contributed knowledge toward successful propagation practices and establishment of horticultural protocols. Marler *et al.* (2015) evaluated seedling emergence in varying shade conditions, finding that both percentage and velocity of seedling emergence for *Serianthes* were maximized in deep shade. They also found the *Serianthes* seed storage to be relatively durable, with seedling emergence percentage not affected by 9 months of storage at ambient temperature. The University of Guam's Guam Plant Extinction Prevention Program (GPEPP) worked on *in vitro* seedling propagation, including tissue culture from seedling meristematic tissues to mitigate limited seed availability (GPEPP 2015).
- Other field observations: On Rota, during the June 2016 field reviews it was observed that the root masses of mature *Serianthes* trees extend laterally from the trunks 6 m or more above ground (and perhaps further sub-surface), which may provide the trees greater stability and water-uptake (AnnMarie Gawel, USFWS, pers. comm. 2016a). Older outplanted *Serianthes* were producing flowers and seed-pods by the ages of 18-23 years (McBride, field observations August 2016), and may be capable of doing so as young as ages 12-15 (Manglona, pers. comm. 2016a & 2016b). On Guam, two trees less than 4 years old (outplanted in Nov. 2014) have produced flowers, but fruit has not yet been confirmed; these trees were known to be substantially stressed by mealybug infestations at the time (Ryan Deregnier, USFWS, pers. comm. 2016b).
- Distribution of recovered populations (future). Considering the eventual delisting objective for Rota of having four populations separated by at least 1 km, some of these older outplanted trees may provide the nuclei for those eventual recovery populations. Since the distribution of the existing wild subpopulations would only provide for two or three of the required recovery populations, it is evident that reintroduced (outplanted) populations may be essential to attain the delisting objective.
- Anticipated: An upcoming study by E. Demeulenaere (Aug 2016 – July 2018) on phylogenetics of *Serianthes*, to verify the actual conspecificity of the Guam and Rota populations; this may be instrumental to developing effective management strategies in the future.

New management actions:

- Propagation and outplanting programs on Guam: the Guam Plant Extinction Prevention Program propagated seedlings (seeds from the Ritidian tree) in their Rare Plant Nursery during FY2014-15; these were outplanted at the Guam National Wildlife Refuge, in partnership with USFWS (GPEPP 2015). From Nov. 2014 to Oct. 2015 at the Guam NWR, 59 young *Serianthes nelsonii* were outplanted, with 47 of those 2-4 year-old trees surviving as of August 2016. Also, there are 5 surviving older (5-9 years) outplanted *Serianthes*, planted during 2009-2012. All 64 seedlings were propagated by the University of Guam's Guam Plant Extinction Program, from seed from the last surviving adult *Serianthes* tree on Guam. These outplantings are distributed in four clusters throughout the Refuge. As of June 2016, another outplanting of 9 *Serianthes* was anticipated in the near future. Outplanting sites are fenced to exclude ungulates, with individual trees enclosed in netting to prevent defoliation or other damage by certain insects, including mealybugs, scale insects, whiteflies, psyllids, butterfly and looper caterpillars, katydids, and cerambycid beetles. Insecticidal treatment against mealybugs was conducted both directly (insecticidal soap on mealybugs themselves), and indirectly through bait poisons for their tending ants (Ryan Deregner, USFWS, pers. comm. 2016a & 2016b). Finally, a recent report confirms that as of October 2015, one older juvenile *Serianthes* survives in the Tarague Basin (out of 67 outplanted in 2000), while three had been alive as recently as 2013 (Naval Facilities Marianas 2015).
- Propagation and outplanting programs on Rota: from 2015-2016, 62 young *Serianthes* have been outplanted; these plants are protected by fenced enclosures and are currently 2-3 years old (Manglona 2016). Also, there are 10 older outplanted *Serianthes* (18-23 years old; identified as "mature" in Table 1) planted in four different locations (James Manglona, pers. comm. 2016b), among which at least 6 of 9 observed trees are currently producing flowers and seedpods (McBride, personal observation). Some of the older outplantings are farther northeast and in lower elevations (100-125m) than the historical range of the species on Rota (above 150m, Mount Sabana massif only). This expansion of the species range on Rota through propagation could prove beneficial in the event of large-scale disturbances.

Synthesis:

Downlisting, and delisting objectives are provided in the recovery plan for *Serianthes nelsonii* (USFWS 1994). To be downlisted to threatened: 1) on each island (Guam and Rota), there must be at least two populations, each containing at least 500 reproductive individuals; and 2) ungulate browsing and insect infestations must be reduced or eliminated. Final delisting criteria would require greater resilience to potential disturbance events, as measured by at least four populations on each island of more than 500 reproductive individuals (10-year average) each, as well as some minimum distribution requirements. The latter specifically entails separation of populations on Rota

by at least 1km, while on Guam at least one of the four minimum populations should be located in the southern part of the island.

The downlisting goals for this species have not been met, as there are no populations of 500 individuals on either island (Table 1) and not all threats are being managed (Table 2). Therefore, *Serianthes nelsonii* meets the definition of endangered as it remains in danger of extinction throughout its range.

Recommendations for Future Actions:

- Preserve the remaining genetic and geographic diversity of the species. Maintain presence of existing reproductive individuals on both islands. This will best assure continuity of seed sourcing for propagation efforts while safeguarding what remains of the species genetic diversity, and retaining some geographic distribution to mitigate the risk of catastrophic loss from disturbance events.
- Site / area / habitat protection – Develop and implement effective measures to reduce the impacts of military training activities, agricultural and urban development, and hurricanes (typhoons).
- Fire protection – Develop and implement a fire management plan for all populations.
- Implement fencing plans for both outplanted trees and wild subpopulations as described in the recovery plan; this fencing should be designed to exclude ungulates and allow greater chance for successful establishment of seedling regeneration. As one example, the Aplalago “grove” (subpopulation #1) of 11+ live adult trees could be enclosed with as little as 120-200 m of fencing, using the nearby cliff rim as a natural barrier along one side.
- Ecosystem-altering invasive plant species control – Control invasive introduced plant species within fenced exclosures.
- Surveys / inventories – Resurvey the historical range of the species to determine if previously unknown or newly reestablished populations exist.
- Continue propagation and outplanting programs on both islands to establish *Serianthes* in a range of locations, particularly within the known historic distribution around the Mount Sabana massif on Rota.
- Captive propagation for genetic storage and reintroduction:
 - Continue to collect seeds from all existing populations and send to at least two or three different venues for propagation.
 - Augment the species with specimens from Rota to encourage genetic mixing of the Guam population.
- Captive propagation protocol development – Protect seed pods with a fine mesh covering to prevent predation by arthropods before seeds mature.
- On Rota, collect seed stock at the Aplalago subpopulation (#1), to broaden genetic diversity of propagation material, and thus potentially enhance its survival characteristics.
- On Rota, conduct studies of the subpopulations with greater survival rates (#1, #7) to identify any distinct characteristics favoring enhanced survival.

- Invertebrate herbivory research – continue studies to identify the effects of invertebrate predation on seeds and seedlings of *S. nelsonii*. If determined to be a limiting factor, develop and implement control measures.
- Root pathogen research – Develop studies to identify specific root pathogens that influence the survival of *S. nelsonii* seedlings, and the mechanisms by which this occurs. If determined to be a limiting factor, develop and implement control measures.
- Population biology research – Research the use of mechanical pollination to enhance outbreeding.
- Threats research:
 - Research what factors are limiting the natural recruitment of individuals in Guam.
 - Assess the modeled effects of climate change on this species, and use to determine future landscape needed for the recovery of the species.
- Alliance and partnership development – Continue to work with Guam National Wildlife Refuge, and other land managers to continue implementation of ecosystem-level restoration and management to benefit this species. Encourage the Department of Lands and Natural Resources Forestry Division or the CNMI Fish and Wildlife Division to participate in the recovery of *S. nelsonii* on Rota.
- Review the recovery plan (USFWS 1994) to determine if any new information suggests a need to update the plan to more effectively attain recovery goals.

Table 1. Status and trends of *Serianthes nelsonii* from listing through current 5-year review.

Date	No. wild individuals	No. outplanted	Downlisting Criteria identified in Recovery Plan	Downlisting Criteria Completed?
1987 (listing)	65	0	2 populations with 500 mature individuals on each island	No
			Control or stop browsing ungulates and insect infestations on Rota on Guam	No
1994 (recovery plan)	122	0	2 populations with 500 mature individuals on each island	No
			Control or stop browsing ungulates and insect infestations on Rota on Guam	No
2012 (5-year review)	60-80	13*	2 populations with 500 mature individuals on each island	No
			Control or stop browsing ungulates and insect infestations on Rota on Guam	Partially (see Table 2)
2016 (5-yr review)	33	10 mature (18-23yrs); 115 young (2-18yrs)	2 populations with 500 mature individuals on each island	No
			Control or stop browsing ungulates and insect infestations on Rota on Guam	Partially (see Table 2)

*Originally reported as “3” in the 2012 5-year review; here revised upward to reflect the minimum # of outplants in 2012 that would allow for the currently-known total of older outplants in 2016.

Table 2. Threats to *Serianthes nelsonii* and ongoing conservation efforts.

Threat	Listing factor	Current Status	Conservation/ Management Efforts
Ungulates – Degradation of habitat and herbivory	A, C	Ongoing	Partially: on Guam, feral ungulate control on U.S. Navy lands and fenced exclosures constructed; on Rota, fenced exclosures around outplantings
Established ecosystem-altering invasive plant species degradation of habitat	A	Ongoing	No
Military training; agricultural and urban development	A	Ongoing	No
Invertebrate predation or herbivory	C	Ongoing	Partially: Invertebrate control research at the University of Guam and invertebrate control on a cultivated tree by University of Guam
Hurricanes - Typhoons	E	Ongoing	No
Fire	E	Ongoing	Partially: on Rota, CNMI DLNR signage posted in areas subject to unlawful burning; signs illustrate land and marine impacts of fire
Low numbers	E	Ongoing	Partially: Captive propagation for genetic storage and reintroduction, reintroduction / translocation implementation, and existing population management and restoration
Climate change	A, E	Ongoing	No

References:

See previous 5-year review for a full list of references. Only references not listed in that document are provided below.

- Costion, C.M. and D.H. Lorence. 2012. The endemic plants of Micronesia: a geographical checklist and commentary. *Micronesica* 43(1): 51-100.
- GPEPP. 2015. Progress report PIFWO consolidated funding FY2014 and 2015, reporting period 02-01-2014 until 07-31-2015. Guam Plant Extinction Prevention Program, University of Guam, 24pp.
- Manglona, J. 2016. Rota Rare Plants Project (Partners for Fish and Wildlife Program Grant F14AC00510), August 26, 2016 Progress Report.
- Marler, T.E. and A.N. Cascasan. 2015. Number of emerged seedlings and seedling longevity of the non-recruiting, critically-endangered Hayun lagu tree *Serianthes nelsonii* Merr. (Fabales: Leguminosae) are influenced by month of emergence. *Journal of Threatened Taxa* 7(15): 8221-8225.
- Marler, T.E., A. Cascasan, and J.H. Lawrence. 2015. Threatened native trees in Guam: short-term seed storage and shade conditions influence emergence and growth of seedlings. *HortScience* 50(7): 1049-1054.
- Marler, T. and C. Musser. 2015. Potential stressors leading to seedling mortality in the endemic Hayun lagu tree (*Serianthes nelsonii* Merr.) in the island of Guam. *Tropical Conservation Science* 8(3): 738-744.
- Marler, T. and C. Musser. 2016. Chemical and air pruning of roots influence post-transplant root traits of the critically endangered *Serianthes nelsonii*. *Plant Root* 10:21-25.
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- Wiles, G. 1998. *Serianthes nelsonii*. The IUCN Red List of Threatened Species. Version 2016-1. <www.iucnredlist.org>. Downloaded on **29 August 2016**.

Personal communications:

Deregnier, Ryan. 2016a. Biologist, U.S. Fish and Wildlife Service, Guam National Wildlife Refuge. Email to Carrie Harrington, U.S. Fish and Wildlife Service, dated July 10, 2016. Subject: *Serianthes*.

Deregnier, Ryan. 2016b. Biologist, U.S. Fish and Wildlife Service, Guam National Wildlife Refuge. Email to Peter McBride, U.S. Fish and Wildlife Service, dated August 31, 2016. Subject: *Serianthes* ages -?

Gawel, AnnMarie. 2016a. Biologist, U.S. Fish and Wildlife Service, Mariana Islands Team. Email to David Tessler *et al.*, U.S. Fish and Wildlife Service, dated June 17, 2016. Subject: update on *Serianthes*.

Gawel, AnnMarie. 2016b. Biologist, U.S. Fish and Wildlife Service, Mariana Islands Team. Email to Peter McBride and Leilani Takano, U.S. Fish and Wildlife Service, dated August 30, 2016. Subject: *Serianthes* visit, plus recent pics.

Manglona, James. 2016a. Forester, CNMI Forestry, and Rota Rare Plants Project lead. In-person interview on August 26, 2016. Subject: Propagation & native regeneration of *Serianthes nelsonii*, *Osmoxlon mariannense*, and *Nesogenes rotensis*.

Manglona, James. 2016b. Forester, CNMI Forestry, and Rota Rare Plants Project. Email to Peter McBride, U.S. Fish and Wildlife Service, dated August 31, 2016. Subject: *Serianthes* update.

Taisacan, Estanislao. 2016. Retired CNMI field biologist, and Rota Rare Plants Project participant. In-person interview on September 1, 2016. Subject: Field knowledge of *Serianthes nelsonii*, *Osmoxlon mariannense*, and *Nesogenes rotensis*.

U.S. FISH AND WILDLIFE SERVICE
SIGNATURE PAGE for 5-YEAR REVIEW of
Serianthes nelsonii

Pre-1996 DPS listing still considered a listable entity? N/A

Recommendation resulting from the 5-year review:

- Delisting
- Reclassify from Endangered to Threatened status
- Reclassify from Threatened to Endangered status
- No Change in listing status

605 **Field Supervisor, Pacific Islands Fish and Wildlife Office**



Date 10/26/16