Virgin Islands Tree Boa
(*Epicrates monensis granti*)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Southeast Region
Ecological Services
Boquerón, Puerto Rico

5-YEAR REVIEW
Virgin Islands Tree Boa / *Epicrates monensis granti*

I. GENERAL INFORMATION

A. Methodology used to complete the review:

On September 12, 2005, the Service (USFWS) published a notice in the *Federal Register* (70 FR 53807) announcing the 5-year review of *Epicrates monensis granti*, commonly known as the Virgin Islands tree boa (VI boa) and requesting new information concerning the biology and status of the species. A 60-day comment period was opened. We received comment letters from Dr. Peter J. Tolson, Director of Conservation and Research of Toledo Zoological Garden, Ohio, USA; and Dr. Barbara Kojis, Director, Virgin Island Department of Planning and Natural Resources, Division of Fish and Wildlife, St Thomas, U.S. Virgin Islands.

The lead Service biologist for the VI boa prepared this 5-year review. It is based on the best available information including, distribution and status reports, captive breeding reports, and information on the species' biology and ecology. Sources of information included the final rule listing the species under the Endangered Species Act, the Recovery Plan, peer-reviewed literature, unpublished field observations and reports by Commonwealth, Territorial and Service biologists, and communications from other qualified biologists and experts.

B. Reviewers

Lead Region: Kelly Bibb, Southeast Region. (404) 679-7132.

Lead Field Office: Carlos Pacheco, Caribbean Field Office, Boquerón, Puerto Rico, (787) 851-7297, extension 229.

C. Background

1. FR Notice citation announcing initiation of this review: September 12, 2005; 70 FR 53807.

2. Species Status: 2008 Recovery Data Call; Stable. The population of the VI boa on Cayo Diablo and Cayo Ratones (cays off the northeast coast of Puerto Rico) were last surveyed in 2004. Miguel García and Alberto Puente-Rolón with the Puerto Rico Department of Natural and Environmental Resources (DNER) conducted a rapid assessment in 2007 providing a snapshot of the species habitat at these cays and suggested that the VI boa should be considered stable (García 2008 pers. comm.). Rats were eradicated from these cays and food source species (i.e., Anolis lizards) were abundant (García 2008 pers. comm.). Surveys of reintroduced VI boa on Steven Key (between St. Thomas and St. John) in 2004 indicated that this population was thriving

and stable. The population was composed mostly of adult boas; indicative of substantial food sources (primarily young *Iguana iguana*) and low predation pressure from yellow-crowned night herons. Rats were also eradicated from this cay (Tolson 2004b). Other populations in Puerto Rico and the U.S. Virgin Islands have not been surveyed.

3. Recovery Achieved: 3 (3=51-75%) of species' recovery objectives achieved.

4. Listing History

Original Listing
FR notice: 44 FR 70677
Date listed: December 7, 1979
Entity listed: Species
Classification: Endangered

5. Associated rulemakings: None

6. Review History: The VI boa was originally listed as a subspecies of the Puerto Rican boa (*Epicrates inornatus*) on October 13, 1970. During a review of the status of various animal species listed as endangered or threatened prior to 1975, the Service discovered that the scientific nomenclature of the VI boa had been revised by Sheplan and Schwartz in 1974. Sheplan and Schwartz (1974, p.101) found that this taxon was erroneously identified as a subspecies of Puerto Rican boa and demonstrated that it is more related to the Mona Island boa (*Epicrates monensis*). This could have created confusion over its endangered status. The VI boa was listed as endangered in 1979 (44 FR 70677), due to its restricted and fragmented distribution, increased predation by feral mammals, and habitat disturbance.

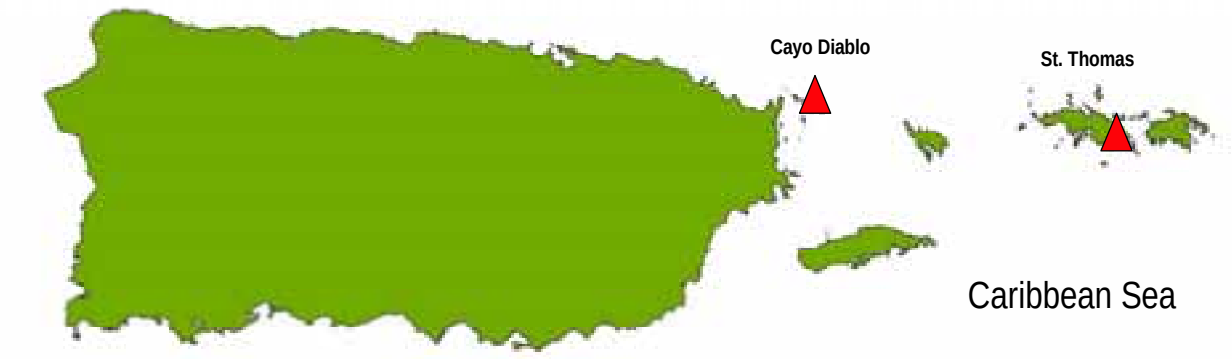
The Recovery Plan (hereafter the "Plan") for the VI boa was approved and signed on March 27, 1986. The recovery objective is to attain a population level at which point the species can be delisted. When the Plan was approved, the species was known only from two populations: one population at St. Thomas in US Virgin Islands (USVI) and another at Cayo Diablo, Puerto Rico (PR) (Figure1). At that time, abundance or density information for these populations was limited. Only 71 specimens were recorded in the literature by Tolson and Piñero (1985) and USFWS (1986). Nellis et al. (1983) considered the VI boa as one of the rarest taxa found in the genus *Epicrates.*

Every year the Service reviews the status of listed species and updates species information in the Recovery Data Call. In 2005 through 2008, we described the status of the species as stable based on age distribution and composition of boas in Cayo Diablo, Cayo Ratones and Steven Key. The species' stability may be the result of rat eradication, and high abundance of food resources (i.e. Anolis lizards, Iguana).

The Service conducted a five-year review for the VI boa in 1991 (56 FR 56882). In this review, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors or threats as they pertain to the individual species. The

notice stated that the Service was seeking any new or additional information reflecting the necessity of a change in the status of the species under review. The notice indicated that if significant data were available warranting a change in a species' classification, the Service would propose a rule to modify the species' status. No new information or additional data was received. Therefore, no change in the boa's listing classification was found to be appropriate.

Figure 1. Historical distribution of the Virgin Island tree boa (*Epicrates monensis granti*) in Puerto Rico and U.S. Virgin Island (USFWS 1986, p.9)



7. Species' Recovery Priority Number at start of review (48 FR 43098): 3c.
At the time of listing, the VI boa was recognized as a species with high degree of threat, high recovery potential and some degree of conflict.

8. Recovery Plan:

Name of plan: Virgin Islands Tree Boa Recovery Plan.
Date issued: March 27, 1986.

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy

1. Is the species under review listed as a DPS? No

2. Is there relevant new that would lead you to consider listing this species as a DPS in accordance with the 1996 policy? No

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria? No. The VI boa has a final recovery plan, but it is outdated and does not contain measurable criteria. The Plan describes the recovery objective as to attain a population level at which point the species can be delisted. It only describes a

objective to reduce the classification of the species from endangered to threatened within a 10 year period. No quantitative recovery level was defined due to the absence of information on population sizes and limiting factors. The Plan recommends conducting comprehensive status surveys and ecological studies of the species before determining specific recovery levels for the VI boa.

2. Adequacy of recovery criteria

a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? No. When the Service approved the Plan, additional information about the species biology and habitat was needed, precluding the formulation of quantitative recovery criteria (USFWS 1986).

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? No.

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 interim recovery objective of the plan was to reclassify the VI boa from endangered to threatened. The plan suggested that recovery be defined in the following terms:

a) Maintenance of a stable or growing population of VI boa at selected major locations during a 5 to 10 year period.

b) Introduction as necessary of the VI boa to mongoose-free uninhabited islands within its theorized historical range

c) Effective control or eradication of VI boa predators such as feral mammals located in VI boa habitat.

Based on the information we gathered for this review, the interim reclassification criteria have been accomplished as follows:

a) At present, the populations of the VI boa at Cayo Diablo, Cayo Ratones and Steven Key are considered stable because of the age distribution and population composition (Tolson 2004a; Tolson et al. 2008). According to the information summarized in this review (Table 1), the population in these three cays and St. Thomas is at around 1,300 boas, an 18 fold increase from the 1985 population levels. Although the number of individuals at Río Grande (PR) and Culebra Island (PR) has not been determined, individuals have been sighted (Puentes-Rolón 2008 pers. comm.). Similarly, the species has been sighted in St. Thomas and the population estimated by Tolson (1991) is about 400 individuals.

b) Two populations of the VI boa were successfully established by the reintroduction of the species from captive breeding programs in mongoose and rat-free habitat. The first population was established in Cayo Ratones (PR) in 1993 and the second was established

in Steven Cay (USVI) in 2002. These two populations are considered by Tolson et al. (2008) as thriving populations.

c) In 1985, a rat control program was started in Cayo Ratones (PR), Congo Key and Steven Key, (USVI) which was identified as potentially suitable for the reintroduction of the species. Rats have been eliminated on Cayo Ratones and on Steven Key in USVI (Tolson et al. 2008) and VI boas are established at Cayo Ratones and Steven Key.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Species' 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 VI boa is nocturnal, secretive, and cryptic, therefore difficult to find. It is difficult to estimate population abundance since it depends on the searcher's ability to locate the species (García 1992). At the time the Plan was approved, the information on the abundance of the species throughout its historical range was limited. Only 71 individuals were reported from Puerto Rico and the U.S. Virgin Islands (USFWS 1986).

Nellis et al. (1983) considered the VI boa uncommon and reported that only 13 specimens were found in USVI; however, he did not attempt to estimate the abundance for this population in St. Thomas, USVI. Tolson and Piñero (1985) estimated 58 VI boas in Cayo Diablo. Most authors (Tolson and Piñero 1985; Tolson 1986a; Tolson 1991; Tolson 2004a; García 1992; Puente-Rolón 2001; Tolson et. al 2008) have tried to provide an estimate of density or abundance of the species. However, some authors expressed population density in terms of individuals per unit area and others expressed abundance in terms of individuals per time search area. Table 1 summarized estimates in terms of density or effort for the VI boa population throughout its range.

Table 1. Estimated abundance, density, estimated effort and source of information for VI tree boa populations in Puerto Rico and the US Virgin Islands

Location	Estimated Abundance or Density	Estimated effort	Source of Information
Puerto Rico:			
Cayo Diablo	3 boas 1.5 boas/ha 0.6 boas/acres	Not determined	Nellis et al (1983)
Cayo Diablo	58 boas 29 boas/ha 12 boas/acres	Not determined	Tolson and Piñero (1985)
Cayo Diablo	104 boas 52 boas/ha 21boas/acres	Not determined	Tolson (1986a)
Cayo Diablo	210 boas 105 boas/ha 42 boas/acres	Not determined	Tolson (1991)
Cayo Diablo	200 boas 100 boas/ha 40 boas/acres	Not determined	Tolson (1996)
Cayo Diablo	250 boas 125 boas/ha 50 boas/acres	Not determined	Tolson (2004a)
Rio Grande	Num. of boas *	0.27 boas per hour/man	García (1992)
Rio Grande	2 boas *	0.05 boas per hour/man	Puente-Rolón (2001)
Culebra	14 boas *	Not determined	Tolson (1991)
Culebra	3 boas *	0.72 boas per hour/man	García (1992)
Culebra	2 boas *	0.01 boas per hour/man	Puente-Rolón (2001)
Cayo Ratones	41 boas *	Not determined	Tolson (1995)
Cayo Ratones	500 boas *	Not determined	Tolson (2004b)
Cayo Ratones	500 boas *	Not determined	Tolson et al. (2008)
USVI:			
St. Thomas	12 boas *	Not determined	Nellis et al (1983)
St.Thomas	400 boas *	Not determined	Tolson (1991)
Steven Key	42 boas (2003) *	Not determined	Tolson (2004b)
Steven Key	168 boas 202 boas/ha 84 boas/acres	Not determined	Tolson (2004b)
Steven Key	170 boas *	Not determined	Tolson et al. (2008)
BVI:			
Tortola Island	(common snakes) *	Not determined	Lazell (2005)

* Density not determined

In Puerto Rico, the species is known in Cayo Diablo, Cayo Ratones, Culebra and Río Grande. Tolson (1991) reported Cayo Diablo as the area of highest density of VI boas

with 210 boas or 105 snakes/ha. Recent estimates suggest that this cay supports even higher densities of VI boas with 250 boas or 125 boa/ha (50 boas/acre) (Tolson 2004a). In Cayo Ratones, a total of 34 captive born boas were released in 1993. Tolson (1995) reports that these released VI boas had a survival rate of 88.9 % for the first year. By 2008, Tolson et al. (2008) estimated the population of VI boas on Cayo Ratones at 500.

On Culebra Island, Tolson (1992) observed that the boas appear to be most numerous along a road running through a cattle pasture just down hill and east from the desalinization plant facility, on private land. He found one boa in 30 minutes of night searching at Punta Soldado, (i.e. 2 boas/hr) in a human altered area adjacent to the shoreline. This level of occurrence within one hour is considered high. García (1992) estimated at Culebra Island the ratio of boas per person/hour of searching (effort) at 0.72/hr or one boa per 1.4 hours of search. In addition, Puente-Rolón (2001) captured two VI boas in Culebra estimating the searching (effort) at one boa per 100 hours of search. Based on the information from the reports, the lack of consistency in reporting (density versus searching efforts), and limited information about the methodology used during searches, this limits the determination of a population estimate of the species in Culebra. However, Tolson (1992) and García (1992) considered the VI boa population on this island as one of the most significant of all the disjunctive demes (a local population of organisms of one species that actively interbreed with another and share a distinct gene pool) of this species.

The VI boa population located in Río Grande was first reported by Richard Thomas (Thomas 1988,in litt.). Tolson (1991) observed 3 VI boas in a single night. García (1992) conducted a survey here and estimated the ratio of boas per person/hour of searching (effort) at 0.27/hr, or one boa per 3.7 hours of searching. Puente-Rolón (2001) conducted an additional survey in the Rio Grande area and estimated its searching effort at 0.05/hr, or one boa per 20 hours of searching. Tolson (2003) conducted searches on areas with similar habitat in the northeast coast of PR and close to a Río Grande area. However, no VI boas were observed. At present, the number of VI boas in the Río Grande area is uncertain.

In the U.S. Virgin Islands, the species is currently known from St. Thomas and Steven Key. Tolson (1991) made a conservative estimate of 300 to 400 individuals for the St Thomas population. However, most of this population is located on private lands which are considered to be dwindling habitat (Tolson 1991). The USVI Department of Planning and Natural Resources (DPNR), Division of Fish and Wildlife (DFW) reported 131 VI boas in St. Thomas between 1986 and 2006 (DFW, unpublished data 2006). However, a density number was not presented and many of the reported boas were dead.

Aside from this information, no scientific data regarding the abundance of the species in St. Thomas was located. The most recent and accurate density estimates for the VI boa populations in USVI were made by Tolson (2004b) in Steven Key were he estimated a population of 168 VI boas on the cay and a density of 202 boas/ha (84 boas/acre).

On Tortola (BVI), the VI boa is considered as a common snake (Lazell 2005). Mr. Clive Petrovic, director of Econcerns Ltd in BVI, recently reported that the VI boas are frequently found in houses, gardens and dumpsters (Petrovic pers. comm. 2009). Even when the boa is considered by some authors as common, no information about abundance or density is found.

Based on the information gathered in this review and summarized in Table 1, we estimate the total population of the species throughout its range is between 1,300 and 1,500 individuals in Puerto Rico and the U.S. Virgin Islands.

The Recovery Plan (USFWS 1986) explains that the VI boa has a longevity that can exceed 10 years with an annual reproductive cycle. However, Tolson (1986a) found that the VI boa had a biannual reproductive cycle and found that the longevity of this species may exceed 20 years (Tolson 1996). Consequently, a female VI boa has the potential to produce 50-75 offspring during her lifetime.

The Plan (USFWS 1986) suggests that the growth and size class data indicate that the species can reach reproductive maturity in as little as three years. However, Tolson (1986a) reports one marked and released female that reached the size close to sexual maturity in only one year. According to Tolson (1986a), the smallest gravid female reported in the wild was an individual with a mass of 84g (3 oz) and snout-vent lengths of 521mm (20.5 in) in the Cayo Diablo population and she gave birth to 4 young boas while in captivity.

The largest snout-vent lengths (SVL) recorded for a VI boa came from Steven Key. Tolson (2004b) captured a large male with a SVL of 1112 mm (43.8 in) and a tail length of 237mm (9.3 in), as well as a large female with a SVL of 1066 mm (41.96 in) and a tail length of 137 mm (5.39 in). Both specimens were trans-located from St. Thomas to the cay on an unknown date. Data collected from the body mass of individuals indicates that the reintroduced/trans-located Steven Key boas have a much higher body mass/unit SVL than the unmanaged wild population of the same taxon. Tolson (2004a) found in Cayo Diablo and Steven Key the age structure of the snakes is indicative of a healthy population, with a preponderance of boa less than or equal to three years of age. Demographic trends for populations in Rio Grande, Culebra Island and St. Thomas are unavailable.

During surveys conducted on wild and re-introduced VI boa populations, biologists have made observations about the demographic features of the species. Tolson (1986a) estimated a (male:female) sex ratio of 1:1 for the Cayo Diablo population and estimated a sex ratio of 1:2 for the Steven Key population (Tolson 2004b). The sex ratio at Cayo Diablo and Steven Key indicated that these two populations are stable and thriving. Data for the sex ratio of the St. Thomas, Rio Grande, Culebra Island and Cayo Ratones populations are not available.

Tolson (1986a) also recorded information of cloacae temperature of the species and reported the highest cloacae temperature in a gravid female (33.4ºC (92.12ºF)).

According to Tolson (1986a) gravid females prefer the use of termite nests for thermoregulation and refuge in Cayo Diablo.

b. Genetics, genetic variation, or trends in genetic variation (e.g. loss of genetic variation, genetic drift, inbreeding, etc)
Demographic research demonstrated that this species can exist in high densities on small islands and with a probable high degree of inbreeding (Tolson 1996). Tolson (1996) considers the probability of inbreeding to be high in several of the wild populations due to isolation and/or the founder effect, but because no indications of genetic anomalies or inbreeding depression have been observed on VI boa populations, the genetic load probably is not excessive. However, the degree of heterozygosity within populations and the degree of relatedness between isolated populations are unknown at this time, but Tolson (1996) believes that small clutch size renders its population highly vulnerable to inbreeding threats.

Tolson (1996) mentioned that the populations from Puerto Rico and St. Thomas have exhibited differences in mtDNA restriction cleavage sites. In addition, Tolson (1996; 2004b) made observations of the two VI boa populations and found a distinct difference in coloration and the USVI population appears to be more robust than their Puerto Rican counterparts. Additional or detailed information regarding genetic features of the species is unavailable.

c. Taxonomic classification or changes in nomenclature. There is no new information regarding taxonomy for the VI boa.

d. Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species within its historic range, etc)
The VI boa is considered endemic to Puerto Rico and the Virgin Islands. The historical distribution of the VI boa suggests that this species was widely distributed throughout Puerto Rico and the Virgin islands, including the northeastern side of Puerto Rico, the offshore cay of Cayo Diablo, Culebra Island, St. Thomas in USVI; Tortola, and Virgin Gorda in British Virgin Islands (BVI) (Grant 1932; Sheplan and Schwartz 1974; Nellis et al. 1983; Tolson and Piñero 1985; USFWS 1986; Mayer and Lazell 1988; Tolson 1989). The available data suggests that VI boa currently exhibits a fragmented distribution within its range and is restricted to few islands within the region (USFWS 1986; Tolson 1986b; García 1992; Tolson 1996; Tolson 2004a). Tolson (1996) hypothesizes that the current distribution is the result of a long history of species decline and local extirpations.

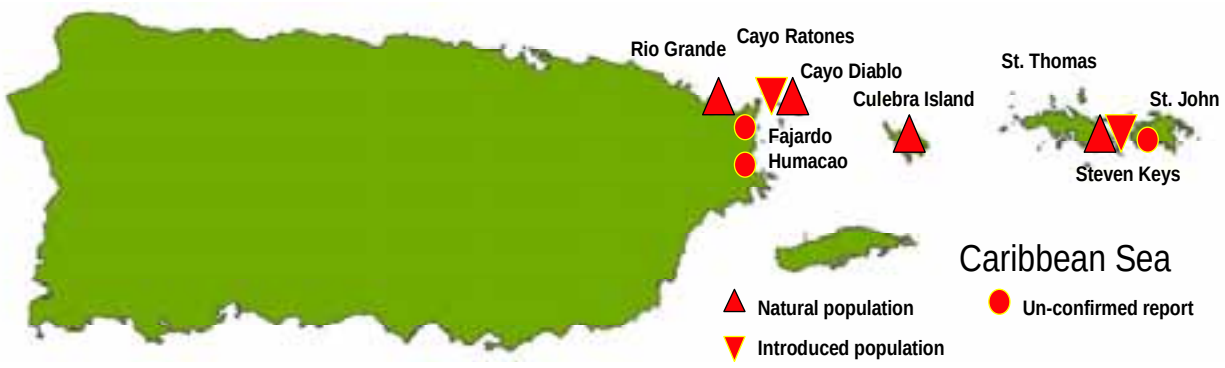
Surveys to locate additional VI boa populations were conducted on several islands and cays of Puerto Rico and Virgin Islands. Cornish (1986) searched for the VI boa at nine locations at the eastern side of the St. Thomas Island previously considered by Nellis et al. (1983) as boa habitat. However, he did not find VI boas during his surveys but reported one shed skin of the VI boa at Turtle Cove. Tolson (1991) searched for the VI boa from 1986 to 1989 in 10 locations in Puerto Rico and 10 small islands in USVI. García (1992) and Puente-Rolón (2001) also surveyed additional areas in Puerto Rico.

Only two additional populations of VI boas were found in these areas; one in Rio Grande by Thomas (1988, unpublished data) and another on Culebra Island by Tolson (1991; 1992) and García (1992). VI boas were released in 1993 at Cayo Ratones, an offshore cay in east Puerto Rico in an effort to expand its distribution.

In the Virgin Islands, the VI boa is apparently restricted to the dry eastern end of St. Thomas, the most xeric part of the island. Although, there is one record from the Crown Bay area in the south-southwestern side of St. Thomas and another from French Town, located at the west side of Charlotte Amalie. The USVI Division of Fish and Wildlife (DFW) maintain records of sightings and locations of the VI boas in USVI (DFW unpublished data 2006) which supports this eastern distribution first described by Nellis et al. (1983) and Tolson (1991). VI boas were also released at Steven Key (USVI) in an effort to establish new population (Tolson 2004b).

Some of the known locations of the species were derived from anecdotal reports and not from scientific studies (USFWS 1986). Tolson and Piñero (1985) had anecdotal reports that suggest the presence of the VI boa on some areas surrounding "Las Croabas" in Fajardo. Local fisherman in the "Las Croabas" area refer to the VI boa as the "Culebrón de la Sabana" because it seems the species was limited to dry savanna-like habitats on the islets off the eastern coast of Puerto Rico. In 2006, Puente-Rolón reported that two VI boa individuals were received by a PRDNER Ranger officer at their regional office in Humacao. The exact locations where the individuals were found were not reported, but one of the specimens apparently was found near the Humacao area. In addition, Tolson (1996; 2003) and A. Puente-Rolón (2009 pers. comm.) believe that based on the characteristic of the area and the suitable habitat available, that additional populations may be found in southern Puerto Rico, in the Guánica State Forest, and in the east coast, surrounding the Las Cabezas de San Juan Natural Reserve in Fajardo and at Humacao Natural Reserve in Humacao.

Figure 2. Currently distribution of the Virgin Island tree boa (*Epicrates monensis granti*) in Puerto Rico and U.S. Virgin Island



In Tortola (BVI), the species is found from the sea level to Sage Mountain, in all habitats from mangrove forest to the moist forest in higher elevation (aprox. 290 m) guts and it is considered a common species (Petrovic 2009 in litt.).

e. New information addressing habitat or ecosystem condition (e.g. amount, distribution, and suitability of the habitat or ecosystem)

The VI boa's habitat has been described from two forest associations: subtropical dry forest (USFWS 1986, Tolson 1991) and subtropical moist forest (Tolson (2003). The subtropical dry forest zone is the driest life zone found in Virgin Islands, Vieques, southwestern Puerto Rico, plus all of Mona Island, Culebra Island and Desecheo (Ewel and Whitmore 1973). This life zone covers approximately 14% (1,284.2 Km^2 (317,332.73 acres) (128420 ha.)) of Puerto Rico and USVI (Ewel and Whitmore 1973). The dry forest habitat is characterized by small (<5m/ 15 ft) deciduous trees with small, coriaceous or succulent leaves and thorns, spines, and secondary defensive compounds, with high density of inter-digitating branches and vines greater than 1 cm (0.4 in) in diameter connecting adjacent tree canopies, and with a rainfall less than 750 mm (30 in) per year (Ewel and Whitmore 1973).

Tolson (2003) reported the VI boa from the subtropical moist forest in the northeastern side of Puerto Rico. This life zone covers approximately 58% (5,381.3 Km^2 (1,329,748.19 acres) (538130 ha.) of the Puerto Rico and USVI area (Ewel and Whitmore 1973). This habitat is characterized by low variability in annual temperature and high levels of rainfall (>1100 mm / 43.0 in annually), forest composition dominated by semi-evergreen and evergreen deciduous tree species, and sizes up to 20 m (60 ft) tall, with rounded crown.

Tolson (2003) reports the species in mangrove forests including Button wood *(Conocarpus erectus)* and red mangrove, *(Rhizophora mangle)* on Culebra Island and Cayo Ratones. He also found the VI boa in disturbed lower vegetation and artificial structures. Foraging boas are not restricted to trees, as they also use salt-tolerant shrub lands just above the high tide line in Cayo Diablo (Tolson 1996).

Tolson (1991) mentions that although suitable habitat for the VI boa is widely distributed throughout Puerto Rico and the Virgin islands, the species uses less than 0.05% of this habitat. The amount of unused suitable habitat may be a reflection of where the species have been found and that the species may have more specific requirements. On small islands like Cayo Diablo and Steven Cay, the species exist in high densities (Tolson 1996) with few or no exotic predators, and a sustained high density of *Anolis* (>60 Anolis/100m^2 or >60 Anolis/1,076.4 ft^2) (Tolson 1991). These conditions appear essential for foraging success and survival (Tolson 1996). Tolson (1991), García (1992) and Puente-Rolón (2001) suggest that the absence of the VI boa on most of the smaller islands is not due to the size of the island but to local extirpation resulting from habitat degradation, deforestation and the continued colonization of habitat by nonnative species and potential predators (e.g. rats).

f. Other relevant information

Species Behavior:
The VI boa is considered a nocturnal or crepuscular (active at twilight or sunrise) species. The earliest reported activity was at 19:20 hrs and the latest time was at 0700 hrs (USFWS 1986; Tolson 1986a). However, Tolson (1986) did find one large non-gravid female and one large male eating one *Anolis cristatellus* during daylight hours. An additional boa was found in the afternoon in a refuge structure that had been unoccupied that same morning. Tolson (1986) considers these events as strong evidence that this species is sometimes active during daylight hours.

Captive breeding program:
The captive breeding for the VI boa started in 1985 with a cooperative breeding program between the Service, the DNER, the DFW, and the Toledo Zoological Garden. At that time, ten VI boa were collected from wild populations in Cayo Diablo and St Thomas for the purpose of breeding in captivity. The objective was to release the offspring into the wild to establish additional populations thereby increasing the distribution of the species in Puerto Rico and USVI. In December 1990, the American of Zoological Parks and Aquariums Association (AZAA) developed the Species Survival Plan (SSP) for the VI boa and the Mona boa (Tolson 1991b). According to Tolson (1996), the environmental and social parameters necessary to induce reproduction can be duplicated fairly easily in captivity, the husbandry of the species is not difficult, and the survivorship of captive neonates is extremely high, exceeding 83% at the Toledo Zoological Garden.

Two populations of VI boas were established by the reintroduction of the species from the captive breeding program. The first reintroduction was conducted in Cayo Ratones in Puerto Rico in 1993. Twenty eight captive born boas were released from seven different zoological gardens (Buffalo, Denver, Ft. Worth, Milwaukee, San Antonio, Virginia and Toledo). An additional six boas were released later for a total of 34 individuals. The boas released were offspring of adults captured by Tolson (1986a) in Cayo Diablo.

From August 2002 to September 2003, a total of 42 VI boas were released at Steven Key, USVI. Eleven boas came from the captive breeding program from the Toledo Zoo and 31 boas came from St Thomas as part of the translocation program conducted by the DWF. Nine boas from the DFW translocation program were implanted with AVID or Trovan passive integrated transponders for easy identification in the future. Surveys conducted by Tolson et al. (2008) on the Key determined that the release was successful and documented recruitment.

2. Five Factor Analysis (threats, conservation measure, and regulatory mechanisms)-

(a) Present or threatened destruction, modification or curtailment of its habitat or range:
When the species was listed in 1979, little was known about the suitable habitat for the VI boa, or amount and distribution in PR and USVI. At that time, the Service identified habitat destruction and modification as one of the most significant factors affecting the species.

VI boa habitat occurs in subtropical dry forest and subtropical moist forest. Today, we know that the VI boa apparently uses less than 0.05% of this suitable habitat available in PR and USVI. In contrast, in Tortola, BVI the species is common and found in habitats ranging from mangrove to moist mountain forest at elevations less than 300 m (984.25 ft) (i.e. Sage Mountain 290m (951.44 ft)).

In Puerto Rico and the USVI, some of the locations where the species has been described are threatened by habitat modification and habitat fragmentation by urban developments. Some VI boa habitat within the island of St. Thomas, and the municipality of Río Grande and Culebra in Puerto Rico is threatened with urban development pressure. (Tolson 2008 in litt; Puente-Rolón 2001; Kojis 2008 in litt; and Platenberg 2008 unpublished data). In St. Thomas, habitat may be declining due to the development for resorts, condos, and related infrastructure; becoming more constricted and isolated (Tolson 2008 in litt; Platenberg 2006 unpub. data). However, most offshore cays are part of the Territorial government and / or protected as wildlife refuges. In Culebra Island, the VI boa habitat in privately owned land is currently under pressure for urban and tourism development and habitat modification by deforestation. However, more than 1000 acres of VI boa suitable habitat is protected within the Service's Culebra National Wildlife Refuge. The Service is providing technical assistance to project developers to modify project plans to avoid destruction of suitable VI boa habitat and ensure conservation of these areas.

It is important to note that 65% of known boas occur in small offshore islets managed for conservation. Cayo Ratones and Cayo Diablo are included as part of DNER La Cordillera Natural Reserve and Steven Key in USVI is managed and protected by the DPNR. The protection of these islets is ensured by local laws and regulations, and ultimately by the ESA.

We believe that the imminence of this threat is low because the majority of the currently known populations are in islands managed for conservation; some VI boa occur in lands in a National Wildlife Refuge; and federally funded or permitted projects on private lands may require ESA section 7 consultation.

(b) Over-utilization for commercial, recreational, scientific, or educational purposes:
At the time of the listing of this species, overutilization was identified as a factor contributing to the decline of the species. Rivero (1998) reported that boa species were hunted to extract its fat to obtain oil and used as a folk remedy. However at the present time, information regarding the illegal hunting or collection for commercial, recreational,

scientific or educational purposes for the VI boa is unavailable. Therefore, based on existing information, we do not believe this factor is a threat to the VI boa at this time.

(c) Disease or predation:
Disease or parasitism for the wild populations of VI boa has not been reported. Tolson (1986a) reported low levels of *Coccidia* infection and no evidence of parasitism by cestodes, trematodes or nematodes on the Cayo Diablo population. Puente-Rolón (2001) sampled one VI boa at Río Grande and identified nine (9) bacteria species from the ventral area of the specimen. The genus *Staphylococcus* was the dominant bacteria of the sample, but other bacteria were isolated such as *Nesseria spp*. which has been related to human presence. Predators that could affect the VI boa population include black rats (*Rattus rattus*) and feral cats (*Felis catus*). Tolson (1996) and US VIDFW (Platenberg 2006 unpub. data) supports that cats prey on the VI boa in St. Thomas, USVI. Tolson (1986c) found that VI boas are not present on islands or cays with high densities of black rats. Evidence of boas killed by rats has not been documented but this may be an artifact of the feeding behavior of rats where they macerate their food items making it difficult to identify traces of its diet. The presence of rats may also be a competitive factor for the VI boa as the rat also preys on the same food source (Anolis spp.). In 1985, a rat control program started in Cayo Ratones (PR), Congo Key and Steven Key, (USVI) as potential reintroduction sites of the species. Rats have been eliminated on Cayo Ratones and on Steven Key in USVI (Tolson and García, 1997) where the species is thriving.

Predation by the small Indian mongoose (*Herpestes javanicus*) was listed as one of the causes of the VI boa population decline (USFWS 1986). However, Tolson (1991) mentioned that he doubts that the small Indian mongoose directly threatens VI boa, and that this risk is often exaggerated. The VI boa is nocturnal and arboreal. In contrast, Small Indian mongoose is strictly diurnal and terrestrial predator. Mongoose stomach content analyses demonstrated that this species is an opportunistic predator with an extremely generalized diet (Henderson 1992). Mongooses kill and eat snakes (Henderson 1992) but evidence of predation on VI boas by mongoose has yet to be documented.

Based on the information mentioned above, predation by cats should be considered as a current threat to the species. Since rat control projects have been conducted in the islands where the species is present, rats are not to be considered a threat at these areas. Documented predation by cats has been limited. Hence, the Service considers predation by cats and rats to be reduced at this time.

(d) Inadequacy of existing regulatory mechanisms:
When the VI boa was listed, the inadequacy of existing regulatory mechanisms to protect the species was identified as a threat. However, in 1999, the Commonwealth of Puerto Rico approved the Law # 241 known as the "Nueva Ley de Vida Silvestre de Puerto Rico" (New Wildlife Law of Puerto Rico). The purpose of this law is to protect, conserve and enhance both native and migratory wildlife species; declare property of Puerto Rico all wildlife species within its jurisdiction, regulate permits, regulate hunting activities, and regulate exotic species among others. The Puerto Rico Department of Natural and Environmental Resources approved in 2004 the "Reglamento para Regir el

Manejo de las Especies Vulnerables y en Peligro de Extinción en el Estado Libre Asociado de Puerto Rico" (Regulation 6766 to regulate the management of threatened and endangered species in Puerto Rico). The VI boa has been included in the list of protected species and designated as "critically endangered." Article 2.06 of this regulation prohibits collecting, harassing, hunting, removing, among other activities, of listed animals within the jurisdiction of Puerto Rico. Under this article, VI boa habitat is also protected because habitat is deemed as essential to the survival of the species.

The VI boa is currently protected in USVI by the Virgin Island Code, Title 12 – Chapter 2; Protection of Indigenous, Endangered and Threatened Fish, Wildlife and Plants of the Endangered and Indigenous Species Act of 1990. The purpose of this Chapter is to protect, conserve and manage indigenous fish, wildlife and plants, and endangered or threatened species for the ultimate benefit of all Virgin Islanders, now and in the future. The Section 105 of this Chapter prohibits the harassment, injury or killing, or the attempt to do the same, or sell or offer for sale any specimen, or parts or products of an endangered or threatened species.

All subspecies of *Epicrates monensis* are listed on Appendix I of the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES). This subspecies is also protected by the Lacey Act (P.L. 97-79, as amended; 16 U.S.C. 3371 et seq.) which makes it unlawful to import, export, transport, sell, receive, acquire, or purchase any wild animal (alive or dead including parts, products, eggs, or offspring) under this Act.

Based on the presence of local and Federal laws and regulations protecting the species, we believe that the inadequacy of existing regulatory mechanisms is not a threat to the VI boa in Puerto Rico and USVI.

(e) Other natural or manmade factors affecting its continued existence:
At the time of the listing of the VI boa, this factor was identified as a threat for the species. New information reveals that the species currently occupies discrete locations in PR and USVI, and possible natural and manmade factors such as an increase in vehicular traffic, intentional killing, and catastrophic events may affect the VI boa and contributed to the decline of the species. The proximity of roads and housing to suitable habitat for the VI boa augments the risk of road fatalities and increases encounters with humans.

USVI DPNR-DFW (Platenberg 2006 unpub. data) suggests that increases in vehicular traffic in areas adjacent to suitable habitat for the VI boa may contribute to the decline of the species in St. Thomas, USVI. Nineteen percent (N=25 individuals) of species recorded in St Thomas results were road kills. However, such data is unavailable for PR.

Intentional killing of genus Epicrates due to innate fear or superstitious beliefs is well documented in the literature (Bird-Picó 1994; Puente-Rolón and Bird-Picó 2004; Joglar 2005). According to USVI DPNR-DFW (Platenberg 2006 unpub. data), about ten percent (N=13 individuals) of the VI boa records in St Thomas are from dead boas killed by humans on their properties. Likewise, the first report for Culebra Island and Humacao

was from dead boa killed by a local. However, most of those records came from anecdotal reports. No systematic studies have been conducted to determine the effects of intentional killing on the VI boa. The Service is not aware of a law enforcement case related to VI boa in PR or the USVI.

The habitat where the species have been found in PR and USVI is mostly coastal dry forest. This type of forest is susceptible to human-related catastrophic events such as fires. The rapid growth of grass can increase fuel build-up that may further the impact of fire. In Culebra Island, Cayo Ratones and Cayo Diablo, the VI boa occurs in areas with easy public access and a high potential of being negatively impacted by human activities such as intentional fire. In Cayo Ratones and Cayo Diablo, DNER personnel implement a management and educational program during the dry season to prevent fires. In Culebra Island, the Culebra National Wildlife Refuge and DNER implements a fire-prevention and management program during the dry season. Because the Service and the DNER implement a fire-prevention and management program during the dry season, this factor should be considered as a threat, but low and non-imminent.

Climate change and sea level rise is a possible threat for the VI boa in the future. Increase in sea level may affect the species and its habitat in coastal areas and offshore islets. New information reveals that 65% (N=920 individuals) of the known population occurs on offshore islets (less than 2 acres) with a maximum elevation of 15 meters (42 ft). However, because the change in sea level is a long term process and may occur a long period of time, this threat should be considered as very low and non-imminent.

Tolson (1991) considers that the fragmented distribution of the VI boa into several small demes by the stochastic events (such as hurricanes, storms, etc.) coupled with genetic drift or founder effects, may have left several populations without the genetic resources to survive changing environments. In addition, Tolson (1991) noted reproductive problems can arise that would further add to the extirpation of isolated populations. These factors may explain the absence of the species on some islets and island areas with suitable habitat and adequate food sources and has probably contributed to the original decline of this taxon (Tolson 1996).

Based on the above information, the VI boa is currently threatened by natural and manmade factors. However, because the species also occur in areas where these factors do not apply and the imminence of the factors are low; we consider these threats to be low to moderate for the VI boa.

3. Synthesis

The VI boa was listed as an endangered species in 1979, due to its restricted and fragmented distribution, increase of exotic mammal predators, and habitat disturbance. The species had a high degree of threat but a high recovery potential. In 1986, 71 individuals were reported in two populations: eastern side of St. Thomas in the USVI and at Cayo Diablo, an offshore islet in PR.

Since the Plan was approved, extensive searches have been conducted throughout PR and USVI. At the time of this 5-year review, the VI boa is known from six populations in Puerto Rico and the U.S. Virgin Islands: Río Grande, Culebra Island, Cayo Diablo and Cayo Ratones in Puerto Rico; and eastern St. Thomas and Steven Key in the US Virgin Islands. Four are wild populations (Río Grande, Culebra Island, Cayo Diablo and St. Thomas) and 2 are reintroduced populations (Cayo Ratones and Steven Key). The Cayo Diablo, Cayo Ratones and Steven Key are managed by local authorities for conservation. Another thriving population occurs in Tortola, BVI. Although information about size, stability and threats are not available, the species is considered as common.

Currently, the abundance of the species in its range within the US jurisdiction is estimated to be at approximately 1,300 - 1,500 boas, an 18 to 20 fold increase from the known population after 22 years. The populations of the VI boa at Cayo Diablo, Cayo Ratones and Steven Key have been stable for more than 5 years. The VI boa abundance or density for Culebra Island (PR) is unknown but was described as high. While the density for Rio Grande (PR) and St. Thomas remains unknown, the VI boa in Tortola, BVI is considered a common species. We believe that the population status is increasing.

Currently, the VI boa is found in subtropical dry forest and subtropical moist forest. These two types of forest are found widely distributed in PR and USVI. Information from habitat use in Tortola, BVI, suggests that habitat availability is not a constraint to the species. Therefore, we believe that additional boas may be in other areas the east coast of Puerto Rico and in St John, US Virgin Islands.

The VI boa Recovery Plan contains criteria for reclassification: the maintenance of a stable or growing population of VI boa at selected major locations during a 5 to 10 year period; the introduction as necessary of the VI boa to mongoose-free uninhabited islands within its theorized historical range; and the effective control or eradication of boa predators such as feral mammals located in VI boa habitat.

Based on the information gathered and analyzed during this review, these interim criteria have been met. During the last 5 years, the VI boa populations located at Cayo Diablo, Cayo Ratones and Steven Key have been considered as stable. Two populations of the VI boa were successfully established in mongoose and rat-free habitat: Cayo Ratones (PR) in 1993 and Steven Key (USVI) in 2002 and are thriving.

In non-managed habitats, the VI boa is threatened by natural and human factors, including urban and tourism development, non-native predators (feral cats and rats), and habitat modification by catastrophic events (hurricanes, storms, climate change). However, 65% of the population is found in managed areas, with additional individuals and habitat protected by conservation and regulatory practices. The scope and imminence of the three listing factors (factors a, c, and e) are considered low

The ESA defines an endangered species as any species which is in danger of extinction throughout all or a significant portion of its range. Therefore, based on the information

gathered during this review, we believe that the VI boa no longer meets the definition of endangered and we recommend it to be reclassified to threatened status.

III. RESULTS

A. Recommended Classification:

__X_Downlist to Threatened
____ Uplist to Endangered
____ Delist
____ No change is needed

New information gathered and reviewed during this 5-year review shows an increase in the numbers of populations and individuals throughout Puerto Rico and the USVI. Currently, the abundance of the species in occupied areas is estimated to be at approximately 1,300 - 1,500 boas. Additionally, general interim downlisting criteria established in the Recovery Plan have been met. The 5-listing factor analysis shows that the degree of factor "a" , factor "c" and factor "e" are considered low; factors "b" and "d" are no longer considered threats. Therefore, we are recommending downlisting the VI boa to Threatened.

B. New Recovery Priority Number _9c_

Based on the information gathered and analyzed in the five factors analysis conducted in this review, the overall current degree of threat is moderate instead of high and the species has a high recovery potential.

C. If a reclassification is recommended, indicate the Listing and Reclassification Priority Number (FWS only): _4_

We have determined that the degree of management impact on the VI boa is moderate; the petition status is an unpetitioned action. Therefore, we recommend the priority number of 4.

IV. RECOMMENDATIONS FOR FUTURE ACTION-

Based on the information available, we recommend the following actions:

- Revise the recovery plan to include new information on the biology of the species and the development of measurable criteria for delisting the species.

- Develop a Population Viability Analysis (PVA) for the VI boa to determine the minimum viable population size needed to sustain the species over 50 years.

- Conduct quantitative efforts to estimate relative abundance of the species at Rio Grande and Culebra Island in PR; and at St. Thomas in USVI.

- Conduct additional surveys in traditional and nontraditional areas with suitable habitat for the species in PR and USVI, which include Vieques and St. John, to determine density and distribution.

- Refine habitat description and suitability based on GAP analysis and other geographical related mechanisms.

- Assess VI boa predator/prey relationships on non-islet environments.

- Conduct comparative DNA analysis within populations distinct and between other populations, including that of Tortola, BVI to determine possible genetic differences or possible genetic threats.

- Continue to support predator eradication (cats and rats) from offshore cays and other VI boa habitat.

- Reinitiate the captive breeding program and reintroduction program of the species in protected and predator-free areas. Captive breeding and release activities were conducted in the 1990's. At the present time, VI boas are still in captivity.

- Develop public education and outreach programs for the VI boa at Rio Grande and Culebra Island in PR, and at St. Thomas, USVI.

- Develop cooperative agreements with local jurisdictions and private landholders for the conservation and protection of suitable habitat for the VI boa in PR and USVI.

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U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW West Virginia Island [illegible]

Current Classification: Endangered

Recommendation resulting from the 5-Year Review

X Reclassify to Threatened
Reclassify to Endangered
Delist
___ No change is needed

Appropriate Listing/Reclassification Priority Number ___5___ .

Review Conducted By [illegible]

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve [illegible] Date [illegible]

REGIONAL OFFICE APPROVAL:

___ Lead Regional Director, Fish and Wildlife Service

Approve [illegible] 5/14/[illegible]