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## A TORTOISE

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**Class:** REPTILIA  
**Order:** TESTUDINES  
**Family:** TESTUDINIDAE  
**Year assessed:** 2008



### **Distribution:**

Native to Madagascar, this species has a very small distribution. It is known from the Baly Bay region in northwestern Madagascar, over an area of approximately 700 km<sup>2</sup>; its range within this area is 25 to 60 km<sup>2</sup> (Durrell *et al.* 1989, Glaw and Vences 1994, Bour 2007). As a result of historical exploitation and habitat loss, the species is now restricted to five small subpopulations which are discontinuous from each other. The area of suitable habitat may extend up to 70-92 km<sup>2</sup> (DWCT survey results 1999-2000), while the area of occupancy may be restricted to just 12.4 km<sup>2</sup> (Pedrono 2008).

### **Countries of Occurrence:**

Madagascar

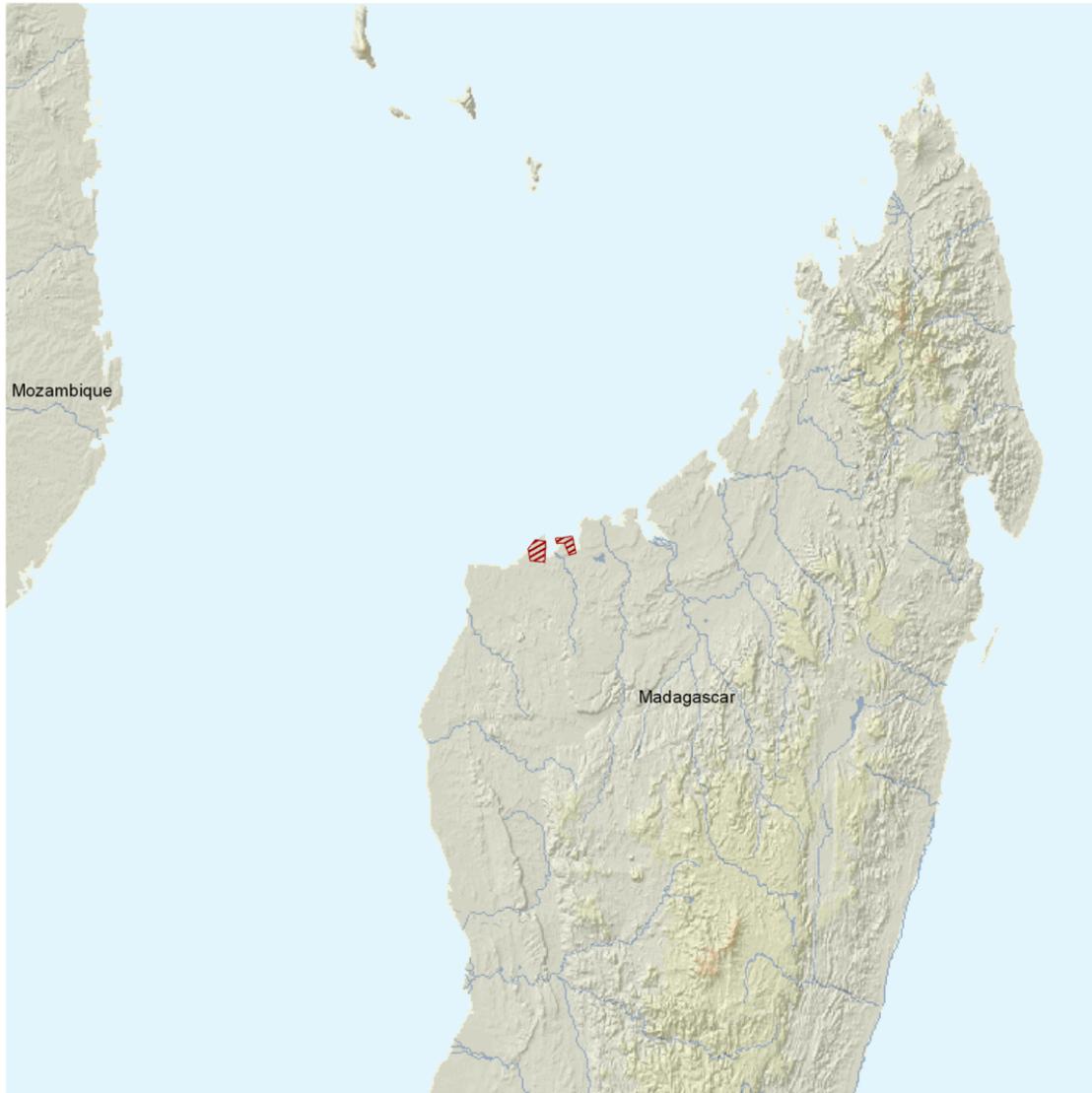
### **Population:**

Historically, the population of this tortoise has been depleted to less than 1,000 animals for several decades since about 1941, as a result of local/regional consumption and habitat burning. In the late 1990s, the total wild population was estimated to be about 600 individuals (with a possible range of 440 to 770), found within five subpopulations: two to the east of the Andranomavo river (Sada and Beheta) and three to the west of the river (Ambatomainty, Betainalika, Andrafiafaly) (Smith *et al.* 1999, Pedrono 2000). Based on distance sampling surveys and the extent of suitable habitat, by 2005 DWCT estimated a maximum of 800 wild animals.

However, recent impacts (illegal collection for the international pet trade) have reduced the estimated population substantially, causing sharp declines. The population is currently estimated to possibly be as low as 400 individuals, of which 200 are adults (G. Pedrono pers. comm. 2008).

Based on a Population Viability Analysis performed for this species (Pedrono *et al.* 2004) and recent level of poaching for international trade, and by analogy with a similar species in the same genus, this tortoise is at extreme risk of extinction in the wild within 10 to 15 years, a time period far less than one generation length of 42 years. It is nearly certain to go extinct within the next generation if current threats continue unabated.

**Population trend:** ↓ Decreasing



range type

-  native (resident)
-  native (breeding)
-  native (non breeding)
-  reintroduced
-  introduced
-  origin uncertain
-  possibly extinct
-  extinct

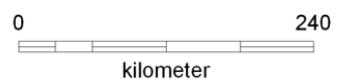
-  national boundaries
-  subnational boundaries
-  lakes, rivers, canals
-  salt pans, intermittent rivers

data source:  
 IUCN (International Union for Conservation of Nature)



azimuthal equal area central point: 0° E, 0°

map created 09/30/2008



THE IUCN RED LIST  
 OF THREATENED SPECIES™

### **Habitat and Ecology:**

The species is found in the Baly Bay region, over an area of approximately 700 km<sup>2</sup>, though only 66 km<sup>2</sup> of this is considered suitable habitat. This region is comprised of dry deciduous forest, savanna, and mangrove swamps. The climate is tropical with a distinctly seasonal rainfall patterns. These tortoises utilize bamboo-scrub habitat, which is considered to be a secondary stage of the dry deciduous forest (Curl *et al.* 1986). Bamboo-scrub habitat consists of a mosaic of shrubs, bamboo, savanna grasses, and open, non vegetated areas. The shrubs are generally less than 2 m tall and the dominant species include *Bauhinia* sp. and *Terminalia* sp. Bamboo (*Perrierbambos madagascariensis*) occurs in dense thickets within the habitat. Andrianandrasana (2000) estimated there are 7,975 ha (79.75 km<sup>2</sup>) of suitable habitat of which 6,669 ha (66.69 km<sup>2</sup>) have tortoises occupying them. Elevation is less than 50 m above sea level (Smith *et al.* 1999a and b).

Adult male tortoises are larger and heavier than females. Mean adult male length and weight is 414.8 mm (range 361-486 mm) and 10.3 kg (range 7.2-18.9 kg) respectively. Mean adult female length and weight is 370.1 mm (range 307-426 mm) and 8.8 kg (range 5.5-12 kg) respectively (Pedrono and Maxwell 2001).

According to Smith (1999), grasses and forbs in open rocky areas of bamboo scrub habitat appeared to be important food items. Feeding was observed from October through May. Tortoises were observed to feed upon herbs, forbs and shrubs (*Bauhinia* sp. and *Terminalia* sp.) rather than grasses. Tortoises were never observed feeding on live bamboo; however, on several occasions they consumed leaf litter that included dead bamboo leaves. Tortoises were also observed feeding on dried carnivore and African bush pig feces (Smith 1999).

Smith (1999) estimates sexual maturity at a minimum of 15 years old. A study by Pedrono *et al.* (2001) showed the reproductive period was from 15 January to 30 May and tortoises produced 1-6 eggs (mean 3.2) per clutch and up 4 (mean 2.45) clutches per season. Despite low densities the egg fertility rate was 71.9% and resulting hatching success was 54.6% (Pedrono *et al.* 2001). This yields an estimated annual production of  $3.2 \times 2.45 \times 54.6\% = 4.3$  hatchlings per reproducing female. By analogy with a similar species in the same genus, the average age of reproducing animals per generation time is estimated as being 42 years (Madagascar WS 2008).

### **Use and Trade:**

The species is harvested from the wild for food and for sale in the pet trade. Poached wild animals and stolen captive-bred juveniles have been reported in the international pet trade.

### **Threats:**

The tortoise's restricted distribution and threatened status are believed to result from exploitation in historical times and from frequent human-caused fires, which were deliberately started to create and improve grazing conditions for Zebu cattle (Juvik *et al.* 1981, Curl *et al.* 1985). This threat is being addressed; according to Lewis *et al.* (2005), "since 1995, the local communities, with the assistance of the Water and Forests Department and Durrell Wildlife, have annually burnt the savannah fringes during the wet season creating a system of natural firebreaks". Outbreaks of fires within tortoise habitat have continued to decrease annually. Less than 50 ha (0.5 km<sup>2</sup>) of tortoise habitat was burnt in 2004, though larger areas of habitat were burnt in other years.

The other major and ongoing threat comes from illegal collection for the international pet trade (Lewis *et al.* 2005, Pedrono 2008); marked wild animals have been recorded from pet trade in Asia and the threat of poaching is increasing. Despite some successful enforcement and confiscation actions, the species remains in extremely high demand in the global illegal pet trade, which severely threatens the remaining wild animals. A 25% population decline over one generation (42 years) would be met by poaching levels as low as three animals every two years; current (2008) documented confiscation numbers exceed this.

### **Conservation Measures:**

The species is protected under Madagascar national law and is also included in CITES Appendix I (Lewis *et al.* 2005). The species' area of occurrence at Soalala (area west of Baly Bay; 113,000 ha) was considered a "Site of Biological Interest" but it held no legal protection status (Nicoll and Langrand 1989), until in 1997 the Baly Bay area was gazetted as a national park (Lewis *et al.* 2005). The parks authority has had a permanent presence (eight personnel) at Soalala since 2001. There is also a network of 40 village 'para-rangers' who actively watch out for possible smugglers and fire outbreaks.

Durrell Wildlife Conservation Trust established a conservation program for the tortoise in 1986 that strongly integrated local people (Durbin *et al.* 1996). A summary of early research concerning the species was provided by Bour (2007). The history of Durrell Wildlife Conservation Trust's 'Project Angonoka' was described by Lewis *et al.* (2005): Project Angonoka began in 1986 as a project to safeguard this species. The project was established as collaboration between Durrell Wildlife Conservation Trust (then known as Jersey Wildlife Preservation Trust) and the Water and Forests Department of the Government of Madagascar, together with support from the Worldwide Fund for Nature (WWF). Given the extreme rarity of the species, the initial goal was the establishment of a captive-breeding project. This was successfully achieved. In December 2004, the captive project had 224 captive-bred juveniles from 17 founder adults (10 males, 7 females). From the 1990s, work progressed to ecological research on the species in the wild, and developing conservation strategies with the surrounding local communities. The latter work formed the basis of community-led firebreaks and with the communities themselves proposing the creation of a park to safeguard the tortoise and the remaining forests.

Ongoing monitoring of the species' occurrence in the global pet trade is needed, along with effective enforcement and repatriation and/or safe, conservation-oriented maintenance of confiscated animals in appropriate facilities.

<b>A TORTOISE</b>	
<b>Criterion A: Declining population in the past or future?</b>	<b>YES</b>
<ul style="list-style-type: none"> <li>The generation length is estimated to be 42 years, so population declines are measured over a three-generation time period of 126 years (though only 100 years into the future).</li> <li>A1: Although human-induced fires are less frequent, they have not ceased entirely, and the species is still heavily poached, so A1 cannot be used.</li> <li>A2: There are no population estimates from 126 years ago (3 generations in the past); population declines have only been measured since 1941 (slightly less than 2 generations ago). However, since the population declined to &lt;1000 animals for several decades after 1941, we know the population was &gt;1000 animals prior to the 1940s. We don't know what percentage of this total population of &gt;1000 animals was made up of mature individuals, but given the current population structure of 50% adults, we can suppose it was likely around 50% adults in the past. So, assuming 50% of the population were adults and the population size was &gt;1000, we can assume a historic population size of &gt;500. The population has continued to decline since monitoring began, and current population size is estimated to be as low as 200 mature individuals (a 60% decline from 500 mature individuals). Although there is a great deal of uncertainty in the numbers, a past population reduction of at least 50% is likely, based on direct observation (a), a decline in the AOO, EOO and habitat quality (c) and actual levels of exploitation (d), thus qualifying for <b>Endangered A2acd</b>. The past reduction might have been 80% or greater (which would meet the threshold for CR A2), but this would require a historic population size of at least 1000 mature individuals, which we cannot confirm based on the available data.</li> <li>A3: Based on an index of abundance (b) and current levels of exploitation (d), this species is nearly certain to go extinct within the next generation if current threats continue unabated, and the threat of poaching is actually increasing. This implies a future population reduction of up to 100% within 1 generation, thus meeting <b>Critically Endangered A3bd</b>.</li> <li>A4: We can measure a population decline over a 3-generation time period including both the past and the future: we have data indicating a past population decline from 1941-present, a time period of 67 years (1.6 generations), and we can project 59 years (1.4 generations) into the future using the PVA. Assuming the past population structure was around 50% adults, the population size in 1941 was likely about 500. The PVA indicates a future population decline of nearly 100% within 1 generation, so the total decline over this 3-generation time period is certainly <math>\geq 80\%</math>, and may be nearly 100%. So, <b>Critically Endangered A4abd</b> is met.</li> </ul> <p>This species can be listed as <b>Critically Endangered A3bd;A4abd</b>.</p>	
<b>Criterion B: Small distribution, population fragmented or in few locations, and continuing decline or fluctuation?</b>	<b>YES</b>
<ul style="list-style-type: none"> <li>The species is known from an area of approximately 700 km<sup>2</sup>, so its extent of occurrence (EOO) can be estimated to be 700 km<sup>2</sup>, which meets the threshold for EN B1.</li> <li>Although the area of suitable habitat may extend up to 70-92 km<sup>2</sup> and the range is estimated to be 25-60 km<sup>2</sup>, the area of occupancy may be as low as just 12.4 km<sup>2</sup>. The AOO is estimated to be 12-60 km<sup>2</sup>, which meets the threshold for EN B2. Taking the lower estimate, it very nearly qualifies for CR B2.</li> <li>It is known from 5 small subpopulations which are discontinuous from each other, indicating that there is little to no genetic exchange between these subpopulations. It can thus be considered severely fragmented, meeting B1a+2a for all categories.</li> <li>The 5 subpopulations can each be treated as separate locations, as the current principle threat is poaching (outbreaks of fire have decreased annually) and one</li> </ul>	

single poaching event would likely target each subpopulation separately, thus meeting EN B1a+2a.

- A continuing decline in the number of mature individuals is expected due to the ongoing threat of losses of animals from poaching, thus meeting B1b(v)+2b(v) for all categories. Although historical habitat loss and degradation were serious, fire outbreaks are decreasing and there is no indication of a continuing decline in EOO; AOO; area, extent and/or quality of habitat; or number of locations or subpopulations.
- There is no evidence of any extreme fluctuations, so B1c+B2c is not met.

Although the species very nearly meets Critically Endangered B2ab(v), it undoubtedly qualifies for **Endangered B1ab(v)+2ab(v)**. However, since it already meets the threshold for Critically Endangered under criterion A, criterion B is not listed.

**Criterion C: Small population size and decline?**

**YES**

- The population is currently estimated to possibly be as low as 400 individuals, of which 200 are adults. Population size is therefore estimated to be 200 mature individuals, which meets the Critically Endangered threshold for number of mature individuals.
- With a high threat of removal for the illegal pet trade, a 25% population decline over one generation (42 years) is met by poaching levels as low as three animals every two years; current documented confiscation numbers exceed this. Thus criterion C1 is met for Critically Endangered.
- There is clear evidence of a continuing population decline, but there are 5 subpopulations and none of them holds > 90% of the individuals, so C2a(i) is not met. There is no evidence that all subpopulations have < 50 mature individuals, so C2a(ii) is not met, either.

This tortoise therefore qualifies for **Critically Endangered C1**.

**Criterion D: Very small or restricted populations?**

**YES**

- The lower population estimate is 200 mature individuals, which meets the threshold for **Endangered D**.
- Area of occupancy (AOO) may be as small as 12.4 km<sup>2</sup> and there are current threats acting on the species that could cause it to become CR or even EX within a very short time (1-2 generations). Hence the species qualifies as **Vulnerable D2**.

Using only criterion D, the species would be listed as **Endangered D**. However, it already qualifies for Critically Endangered under criteria A and C.

**Criterion E: Quantitative analysis?**

**YES**

- Based on a Population Viability Analysis (PVA) performed for this species (Pedrono *et al.* 2004) and recent level of poaching for international trade, the species is at extreme risk of extinction in the wild within 10 to 15 years.
- It is nearly certain to go extinct within the next generation if current threats continue unabated.
- With a generation length of 42 years, 3 generations would be 126 years; however, the probability of extinction is measured up to a maximum of 100 years into the future.

Although no specific percentage of probability of extinction is given, the fact that it is nearly certain to go extinct within the next generation indicates that the probability of extinction is ≥ 50% within 100 years, thus qualifying for **Critically Endangered E**.

**Summary:**

This species meets the following categories and criteria:

- EN A2acd, CR A3bd and CR A4abd
- EN B1ab(v)+2ab(v)
- CR C1
- EN D and VU D2
- CR E

**Conclusion:** This tortoise is listed **CR A3bd+4abd;C1;E**

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## A STURGEON

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**Class:** ACTINOPTERYGII  
**Order:** ACIPENSERIFORMES  
**Family:** ACIPENSERIDAE  
**Year assessed:** 2009



### **Taxonomic Notes:**

This sturgeon is restricted to the main channel of the Yangtze and the Pearl Rivers and the East and South China Seas. Though there is still disagreement about the taxonomy of the Pearl and Yangtze River populations, Chinese scholars commonly divide this species into two populations; one is the Pearl River Sturgeon, which spawns in spring, and is close to dying out. The other is the Yangtze River Sturgeon, which spawns in autumn and still maintains a certain amount below the Gezhouba Dam.

### **Distribution:**

This sturgeon is the most southerly distributed of the Acipenseriformes. It was historically recorded in southwestern Korea and in western Kyushu, Japan. In China this species was historically found in the Yellow, Yangtze, Pearl, Mingjiang, and Qingtang rivers. However, it is now considered extirpated in the Yellow, Mingjiang, Qingtang and Pearl rivers (Chen 2008). This species has also recently been extirpated from the upper reaches of the Yangtze River, above the Three Gorges dam. It currently occurs in the middle and lower reaches of the Yangtze River, below the Gezhouba dam, and close to shore in the Yellow and East China Sea (The Changjiang Aquatic Resources Survey Group 1988, Chen 2008). Currently, there is just one remaining spawning ground (a 4 km stretch of river), which is situated below the Gezhouba dam.

### **Countries of Occurrence:**

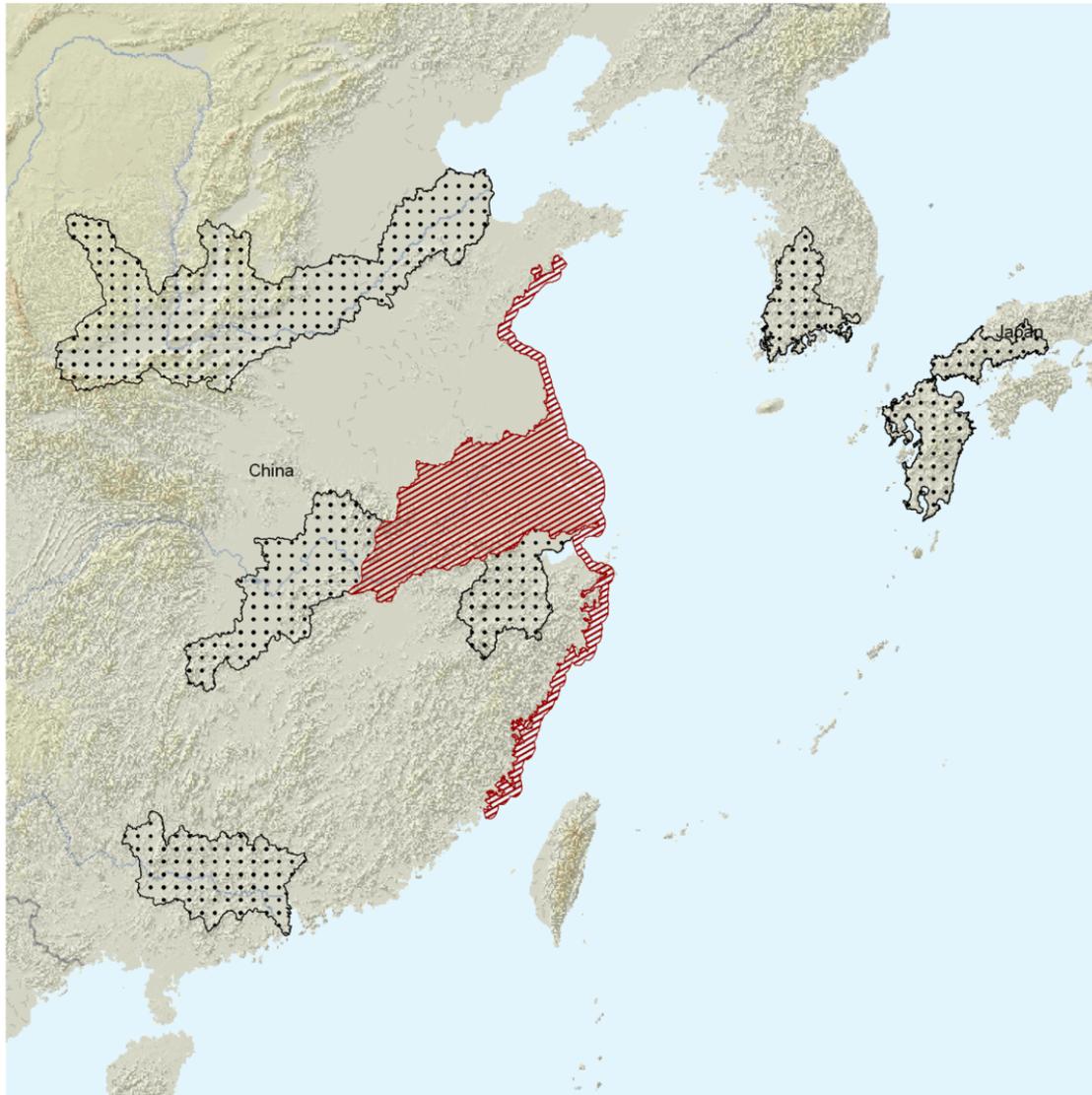
Possibly Extinct in China; Japan; Democratic People's Republic of Korea; Republic of Korea

### **Population:**

In the 1960s, this stock supported a major commercial fishery, but catches in the late 1970s had declined to about 500 fish per year (The Changjiang Aquatic Resources Survey Group 1988).

In the 1970s, the total spawning population of this species was estimated at 10,000 individuals. In 1981, the construction of the Gezhouba dam isolated the upper reaches of the Yangtze River. In 1983 and 1984, the mean spawning stock size was estimated at 2,176 individuals (946 and 4,169 as 95% confidence intervals). Available data from acoustic surveys show that between 2005 and 2007, the total spawning stock of this species was 203-257. This data indicates a 97.5% reduction in the total spawning population over a 37 year period. This decline is expected to continue.

During 1996-2001, studies using tag-recapture methods, population structure analysis and sonar counting indicated that the spawning stock in the Yichang spawning area (mid-lower reaches of the Yangtze River) had decreased since the completion of the Gezhouba Dam. Annual estimates of



range type

-  Historical
-  Native (resident)

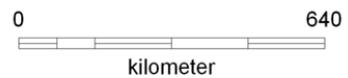
-  national boundaries
-  subnational boundaries
-  lakes, rivers, canals
-  salt pans, intermittent rivers

data source:  
 IUCN Sturgeon Specialist Group



azimuthal equal area central point: 0°, 0°

map created 03/03/2010



spawning adults within the 40 km (including the 4km long spawning area) ranged from 199 to 473 (Chang 1999, Wei 2003).

Between 1983 and 2007, more than 9 million juveniles were released into Yangtze River to increase wild stocks. Prior to 1996, only the larvae were released as techniques had not been developed to cultivate fry, so survivability is expected to be very low (Wei 200, Chen 2008). After 1999, improvement in hatchery techniques allowed juveniles to be raised and the released, but the contribution to wild stocks is considered to be less than 10% (Wei 2003, Zhu 2003).

**Population trend:** ↓ Decreasing

### **Habitat and Ecology:**

This species is large and anadromous (spending at least part of its life in salt water and returning to rivers to breed). Young of this species live in estuarine and nearshore habitats. When the species becomes sexually mature, it migrates up-river. Nearly mature adults (early stage III) arrive at the mouth of the Yangtze River in June or July. The adults do not feed while in the river.

Adults reach the middle sections of the river in September or October, where they overwinter. Ripe individuals were formerly found as far inland as the Jingsha River during the following October and November, where they spawned. Prior to construction of the Gezhouba Dam, the migration distance was as long as 2,500 to 3,300 km. Spawning sites often occur in turbulent sections of the river with rocky substrate and steep cliffs on both banks.

The roe is very large and it sinks and sticks to gravel until hatching. The hatched fries descend from the river to sea near the coast where they grow. They feed mainly on zoobenthos and other bottom invertebrates.

Juvenile sturgeon of 7 to 38 cm tail length occur in the Yangtze River estuary from the middle of April through early October. These are presumably one-year-old individuals. Juveniles weighing a few kilograms can be found in coastal waters near the river mouth. Individuals from 25 to 250 kg in weight were registered in some fishing grounds of East China Sea and Yellow Sea. This species attains a length of more than 3 metres.

The age at first maturity for males is 10-16 years and for females, 14-26 years. If 50% of the males are mature for the first time at roughly 16.5 years and females at 20 years, and longevity is 40 years, generation length can be estimated to be 16.5-20 years.

### **Use and Trade:**

This species is harvested in the wild for food at a national and international scale. It is also collected for research and artificial breeding programmes.

### **Threats:**

This species has been historically overfished. In the 1970s, fishing was unlimited, but seasonal (occurring mostly between October and November). Gear types include gill nets (upper reach) and row hooks (middle reach). Due to its life history characteristics, once depleted, stocks of this species take a long time to recover. Fry are also captured by traditional Chinese fishing methods (drift nets in the river and set nets at the river mouth).

Habitat fragmentation, alteration, destruction and changes to hydrological conditions also significantly impact this species. The construction of the Gezhouba dam in 1981 blocked the migration routes of this species, making it impossible for it to reach spawning sites in the upper reaches of the river. Currently, there is just one remaining spawning ground (a 4 km stretch of river), which is situated below the Gezhouba dam.

In 2003, the Three Gorges dam was constructed 40 km upstream of the Gezhouba dam. This has changed the hydrological regime (lowering the water level of the river in autumn and winter) and affected the water temperature.

Additionally, an increase in the amount of shipping traffic in the Yangtze River could be detrimental to this species.

New evidence shows that water pollution is a potential factor causing the decline of this sturgeon species. Synthetic chemicals in water could contribute to the population decline of this species by significantly decreasing both the quality and quantity of eggs and spawning frequency of fish (Hu 2009).

### **Conservation Measures:**

Current conservation measures in the Yangtze River include the strict limitation of harvest, the establishment of protected areas and ongoing restocking programmes.

Commercial fishing has been closed since 1983, and now just small numbers (less than 40 individuals in recent years) are caught for scientific or propagation purposes.

In 1988, this species was listed a Class I State protected animal. In 1996, a Nature Reserve was established, protecting the spawning population. In 2002, a Nature Reserve in the Yangtze River estuary was established to protect juvenile sturgeons gathering there. This species was listed on CITES Appendix II in 1998.

In 1983, the Yangtze River Fisheries Institute artificially spawned this species (Fu et al. 1985). From 1983 to 2007, more than 9 million sturgeon (including larvae) were released into Yangtze River to increase the stock (Xiao *et al.* 1999, Chen 2007).

Currently, adult sturgeons are captured on spawning ground to be used for artificial breeding. Efforts are being made to rear and breed this species in captivity so that captive adults can be used for stocking in the future.

<b>A STURGEON</b>	
<b>Criterion A: Declining population in the past or future?</b>	<b>YES</b>
<ul style="list-style-type: none"> <li>• Generation length is estimated to be 16.5-20 years, so population declines are measured over a three-generation time period of 49.5-60 years.</li> <li>• A1: The causes of the population decline have not ceased, so criterion A1 cannot be used.</li> <li>• A2: There is no data on the population size from 1949-1960 (49.5-60 years in the past). However, we do know that this stock supported a major commercial fishery until the 1960s, so we can assume the population did not decline too significantly between 1949 and the 1960s. By the late 1970s major declines in catch were recorded. The population was estimated at 10,000 mature individuals in the 1970s, but had declined to 203-257 mature individuals by 2007, indicating a 97.5-98% population decline in 37 years. We can assume that the population three generations ago was larger than the population in the 1970s, so the population decline over the three-generation time period would be even higher than that from 1970-2007. This decline is based on catch data (an index of abundance), declines in extent and quality of habitat, and actual harvest levels. The species therefore meets <b>Critically Endangered A2bcd</b>.</li> <li>• A3: Although we have data on past population declines and these declines are expected to continue into the future, we have no information with which to project or even suspect a future rate of population decline. The future population trend also depends on the success of recent conservation efforts. We cannot therefore use criterion A3.</li> <li>• A4: Without data to inform a future projected decline, we cannot apply criterion A4, as it requires a time period including both the past and the future.</li> </ul> <p>This species meets the thresholds for listing as <b>Critically Endangered A2bcd</b>.</p>	
<b>Criterion B: Small distribution, population fragmented or in few locations, and continuing decline or fluctuation?</b>	<b>YES</b>
<ul style="list-style-type: none"> <li>• There are no estimates given for the extent of occurrence (EOO), so we cannot use criterion B1. Given a digital map we could draw the minimum convex polygon around its range and calculate EOO, but this information has not been given.</li> <li>• Area of occupancy (AOO) can be the smallest area essential at any stage to the survival of existing populations (see the <i>Guidelines for Using the IUCN Red List Categories and Criteria</i>), which for this species would be the spawning grounds: a 4 km stretch of river. Laying a 2x2 km grid over this stretch of river would give an AOO of 8 km<sup>2</sup>, thus meeting CR B2.</li> <li>• There are several serious threats to the species, including overfishing, habitat fragmentation, alteration, destruction and changes to hydrological conditions due to dam construction, increased shipping traffic and pollution. All of these can affect the entire population very quickly, so we can say the species is found in only one location. This qualifies the species for B2a for all categories.</li> <li>• The species has been extirpated from a large portion of its historic range and there are many threats causing continuing habitat degradation and loss. This decline in EOO, AOO, habitat extent and quality, and number of locations can be expected to continue unless the recently enacted conservation measures are fast-acting and effective. Population declines are also expected to continue, so B2b(i,ii,iii,iv,v) is met for all categories.</li> <li>• There is no evidence of extreme fluctuations, so B2c is not met.</li> </ul> <p>This species therefore qualifies for <b>Critically Endangered B2ab(i,ii,iii,iv,v)</b>.</p>	
<b>Criterion C: Small population size and decline?</b>	<b>YES</b>

- Available data from acoustic surveys show that between 2005 and 2007, the total spawning stock of this sturgeon species was 203-257. Although the highest estimates exceed the population size threshold of < 250 mature individuals for Critically Endangered C, being precautionary we can emphasize the lower range of the population size estimate. Another option if we had less confidence in the data or were less precautionary would be to use the Endangered threshold of <2500 mature individuals.
- Although the population decline is expected to continue into the future, we don't have enough data to indicate at what rate this decline might occur, so we cannot use criterion C1.
- There is a continuing decline in the number of mature individuals and the only subpopulation contains 203-257 mature individuals, which meets the thresholds for **Endangered C2a(i)**. Although the species meets the initial population size threshold for CR, it doesn't meet the CR threshold for C2a(i), so it would be listed under EN for this criteria.
- There is a continuing decline in the number of mature individuals and 100% of the individuals are in one subpopulation, so **Critically Endangered C2a(ii)** is met.
- There is no evidence of extreme fluctuations in the number of mature individuals. Being precautionary, we can list the species as **Critically Endangered C2a(ii)**.

**Criterion D: Very small or restricted populations?**

**YES**

- Available data from acoustic surveys show that between 2005 and 2007, the total spawning stock of this sturgeon species was 203-257.
- Taking the lower of these estimates, **Endangered D** is met. If we are less precautionary and take the higher of these estimates, the species qualifies for **Vulnerable D1**.
- The area of occupancy (AOO) is just 8 km<sup>2</sup> and the species is found in only 1 location. The species faces several threats that could cause it to become CR or even EX within a very short time period, so **Vulnerable D2** is also met.

Using only criterion D, this fish would be listed as Endangered D. However, since it since it already meets the thresholds for Critically Endangered under criteria A, B and C, we can disregard this criterion.

**Criterion E: Quantitative analysis?**

**NO**

A quantitative analysis has not been carried out.

**Summary:**

This sturgeon meets the following categories and criteria:

- CR A2bcd
- CR B2ab(i,ii,iii,iv,v)
- EN C2a(i) and CR C2a(ii)
- EN D or VU D1 (depending on how precautionary we are) and VU D2

**Conclusion:**

This Sturgeon is **Critically Endangered A2bcd;B2ab(i,ii,iii,iv,v);C2a(ii)**

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## A CYCAD

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**Class:** CYCADOPSIDA  
**Order:** CYCADALES  
**Family:** ZAMIACEAE  
**Year assessed:** 2009



### Distribution:

This cycad species occurs in South Africa in the biodiversity hotspot region known as the Maputaland-Pondoland-Albany hotspot, which is an important centre of plant endemism. It is uncertain how widespread or abundant this species was prior to human settlement, but there are historic records of populations being scattered through the Albany and Bathurst districts of the Eastern Cape Province. This scattered distribution could be because these plants often grow on rocky outcrops, habitats that are naturally widely spaced within the landscape (Kemp 1986, Norstog and Nicholls 1997, Whitelock 2002) or it could be an artifact of habitat transformation, i.e. the cycads have persisted in areas least affected by land use. The altitude at which the plants are found varies between 200 and 600 m asl.

The extent of occurrence for this species is estimated to be 560 km<sup>2</sup>. Because of its widely scattered distribution, the species is estimated to occupy a total area of only 9 km<sup>2</sup>. A continuing decline in the area of occupancy is likely, as there is intense collection pressure on the species and harvesting of individuals from the wild is expected to continue into the future.

### Countries of Occurrence:

South Africa (Eastern Cape Province)

### Population:

The current wild population is estimated to number between 60 and 100 mature individuals. The actual number is uncertain because the last official count was done more than 10 years ago, when microchips were inserted into all remaining plants. Since then, not all plants have been monitored and, in a recent survey of plants to gather DNA material, there seemed to be less than 60 plants in the wild (da Silva et al. MS). The population is extremely fragmented, as plants are widely scattered, with most individuals separated from each other by >1 km.

This cycad is in a precarious state with no natural seed set, and populations continue to decline. Based on plants in collections and studies of matched photographs, the population is estimated to have declined by 80-85% over the past 100 years. Data prior to this time period are not available.

The sex ratio is ca. four males to one female, so that the effective population size is extremely small. All subpopulations comprise less than 20 plants, which is non-viable for supporting pollinators; there appears to have been no recruitment for more than 50 years. A further population decline of at least 30% is expected to take place within the next 30 years.

*E. latifrons* is a very slow-growing, extremely long-lived species. Females reach maturity at 30 years of age, while males reach maturity at 25 years. Longevity can be 300 years. Based on these figures, the generation length is estimated to be at least 100 years.

**Population trend:** ↓ Decreasing

### **Habitat and Ecology:**

Plants grow on rocky outcrops and hill slopes, usually amongst scrub bush vegetation, but also in open grassland. They can also be found along dry river courses. The distribution area of *E. latifrons* occurs in the following vegetation units: Kowie Thicket, Suurberg Quartzite Fynbos and Suurberg Shale Fynbos.

The soils in this region are mainly Glenrosa and Mispah forms. Other soils may occur. Lime soils are rare or absent. The underlying geology of this area is quartzitic sandstone, shale and micaceous siltstone.

The annual rainfall varies between 600-1,250mm and is fairly evenly distributed during the year, though a summer peak in rainfall usually occurs. Frost does not normally occur. The summers may be hot and fairly dry.

### **Use and Trade:**

This species is highly prized by cycad collectors, and is frequently taken illegally from the wild. Captive bred individuals that are replanted into the wild are often illegally collected as well, and are sometimes illegally sold as individuals and/or seeds.

### **Threats:**

This cycad now occurs in areas where the predominant land uses are cultivation (pineapples and chicory) as well as stock farming. The impact of land use on *E. latifrons* is difficult to assess, but the early reports of Pearson (unpublished letters) and Chamberlain (1919) imply that at least some habitat was lost as a result of agricultural activity. Repeat photography, using photographs first taken between 1906 and 1945, indicated that all the plants occurring at seven different sites had disappeared by 1996 (Donaldson and Bösenberg 1999). However, the disappearances at these sites cannot be attributed directly to land use as, in most cases, the areas in which the plants occurred were neither ploughed nor cleared. Nonetheless, in other sites plants have likely disappeared due to habitat clearing.

Trade in cycads is currently the greatest threat and probably explains the decline observed in the repeat photography study (this species became popular among collectors in the late 1800s/early 1900s). The removal of relatively large numbers of plants by collectors has been recorded with some plants recovered by law enforcement and conservation agencies. The demand for wild collected plants remains high because this species is regarded as scarce and it is one of the most highly valued species in the cycad trade. Based on collection patterns and the species' distribution, experts consider there to be 2 locations.

Population modelling of other species of *Encephalartos* showed that species such as *E. latifrons* are extremely sensitive to the removal of adult plants, as population persistence over long periods relies on adult survival and not seedling recruitment (Raimondo and Donaldson 2003). As a result, the species is very vulnerable to trade in mature plants.

It also seems likely that the natural pollinators are extinct. No natural seed set has been recorded in recent years and the current cohort of adult plants indicates that the last recruitment event was more than 50 years ago.

### **Conservation Measures:**

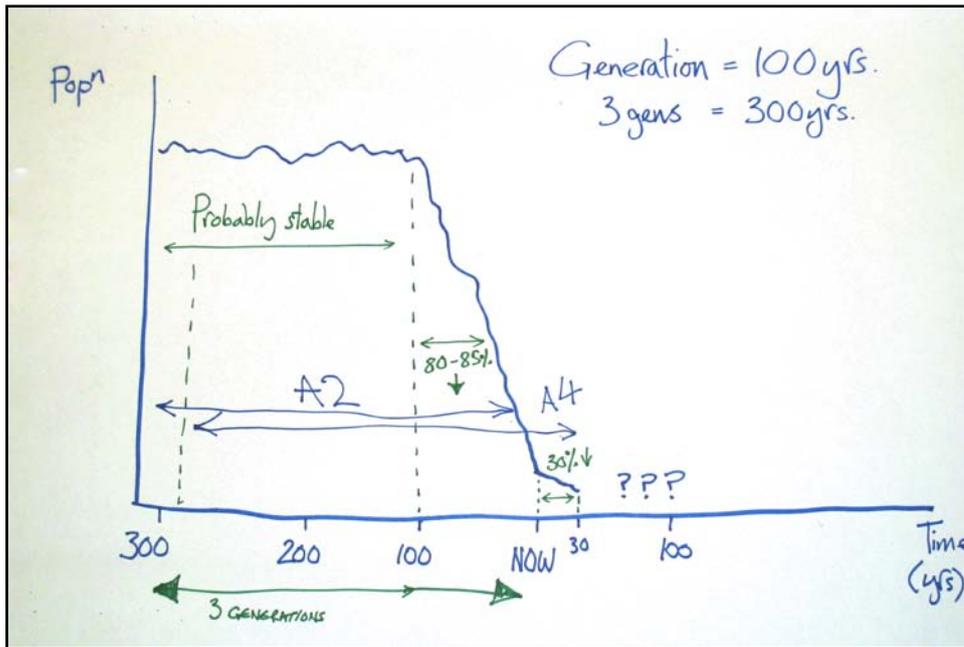
This species is listed on Appendix I of the CITES Appendices and is listed in the national Threatened or Protected Species regulations, which prohibit trade in wild plants. None of the plants occur naturally within any reserves but plants have been introduced to two small nature reserves within the original distribution range. At one site, mature plants were replanted in the reserve after they were illegally removed from the wild. In the second case, a trial planting of seedlings was also undertaken to establish a new population.

A Population and Habitat Viability Assessment was developed in July 2006 and this was followed by the development of a species management plan in 2009. The plan will be implemented in 2010.

*Ex situ* conservation collections have also been established at several botanic gardens. One of the largest, is at Kirstenbosch National Botanical Garden, which has 19 mature plants. Genetic studies showed that the Kirstenbosch collection has similar levels of genetic diversity to wild stocks and represents all wild genotype groups.

## A CYCAD

<b>Criterion A: Declining population in the past or future?</b>	<b>YES</b>
<ul style="list-style-type: none"> <li>• Generation length is estimated to be at least 100 years, so population declines are measured over a three-generation time period of 300 years into the past and 100 years into the future.</li> <li>• A1: The causes of the population decline have not ceased, so criterion A1 cannot be used.</li> <li>• A2: Population data are available from as far back as the early 1900s. There is no information on the population size prior to 1906, so we only have data for one generation into the past, during which the population declined by 80-85%. However, although early reports indicate that some habitat loss was already taking place in the early 1900s, the population was undoubtedly more abundant before farming, cultivation and other activities that lead to habitat loss became widespread, and before the species became popular among cycad collectors. We can therefore assume that the population in the early 1700s (3 generations ago) was at least as large as it was in the early 1900s, if not even larger. The population decline over the three-generation time period would thus be equal to or even higher than that from 1906-2009. This decline is based on direct observation (repeat photography and monitoring surveys), declines in extent and quality of habitat, and intensive exploitation (collection of wild and captive-bred individuals). The species therefore meets <b>Critically Endangered A2acd</b>.</li> <li>• A3: If the population were left unmanaged, it would without doubt quickly go extinct. However, although we have data on past population declines and these declines are expected to continue into the future, we can only project with some degree of confidence 30 years into the future. Beyond this timeframe, the future population trend depends heavily on the outcome of current conservation efforts. As we cannot predict what the population size will be 100 years from now, we cannot use criterion A3.</li> <li>• A4: The population has declined by 80-85% in the past 100 years and is expected to decline by at least 30% in the next 30 years. Assuming as we did for A2 that the population size was relatively stable prior to the early 1900s, we could measure a population decline over a 3-generation time period including 30 years in the future and 270 years in the past. Even without calculating population sizes at different times, we know that the overall population decline over this 3-generation time period will be greater than 80-85%, so the species can be listed under <b>Critically Endangered A4acd</b>. If we want to be more specific, we could use current population estimates and the decline rates given to calculate that the population size 100 years ago was 300-667 individuals (300 if the current population size is 60 individuals and the population has declined by 80%, 667 if the current population size is 100 individuals and the population has declined by 85%). The population size in 30 years will be 42-70 individuals. Thus, the population will have declined by 86-89.5% over this 130 year time period. Assuming the population size in 1739 was similar to that in the early 1900s, the decline over the 3-generation time period is at least 86-89.5%, which meets Critically Endangered A4acd.</li> </ul>	<p><b>YES</b></p>



This species meets the thresholds for listing as **Critically Endangered A2acd+4acd**.

**Criterion B: Small distribution, population fragmented or in few locations, and continuing decline or fluctuation?**

**YES**

- The extent of occurrence (EOO) is estimated to be 560 km<sup>2</sup>, which meets the threshold for EN B1.
- The area of occupancy (AOO) is estimated to be 9 km<sup>2</sup>, thus meeting CR B2.
- Most individuals are separated from each other by >1 km. None of the subpopulations are large enough to be viable for supporting pollinators; viability of these small subpopulations is therefore extremely questionable, especially as there has been no recruitment for over 50 years. The population can thus be considered severely fragmented. This qualifies the species for B1a+2a for all categories.
- As trade in cycads is currently the greatest threat, based on collection patterns and the species' distribution, experts consider there to be 2 locations. This meets the threshold for EN B1a+2a.
- Repeat photography has shown that all the plants occurring in seven different sites disappeared by 1996, resulting in a decline in the AOO as well as the number of mature individuals. Habitat transformation and loss has been taking place for decades, and at least in some cases the areas where plants formerly occurred have been cleared. Neither collection pressure nor habitat degradation is expected to diminish, so the decline in AOO, habitat extent and quality, and number of mature individuals can be expected to continue. B1b(ii,iii,v)+2b(ii,iii,v) is therefore met for all categories.
- There is no evidence of extreme fluctuations, so B1+2c is not met.

This species meets the thresholds for EN B1ab(ii,iii,v)+2ab(ii,iii,v) and CR B2ab(ii,iii,v). Under criterion B, this species would be listed as **Critically Endangered B2ab(ii,iii,v)**.

**Criterion C: Small population size and decline?**

**YES**

- The current wild population is estimated to number between 60 and 100 mature individuals, which meets the initial population size threshold for CR C.
- The population has declined by >25% within the last 1 generation and this decline is continuing (decline of at least 30% expected within the next 30 years). Therefore the thresholds for CR C1 is met.

- There is a continuing decline in the number of mature individuals and there are less than 20 plants in each subpopulation, which meets the thresholds for **Critically Endangered C2a(i)**.
  - No single subpopulation holds 90-100% of the mature individuals, so it does not qualify for C2a(ii).
  - There is no evidence of extreme fluctuations in the number of mature individuals.
- This cycad can be listed as **Critically Endangered C1+2a(i)**.

**Criterion D: Very small or restricted populations?**

**YES**

- The current wild population is estimated to number between 60 and 100 mature individuals. This meets the criteria for **Endangered D**.
- The area of occupancy (AOO) is just 9 km<sup>2</sup> and the species is found in only 2 locations. Collection pressure is strong enough that it would not be difficult to harvest most of the individuals in a very short time period. In addition, as the subpopulation sizes seem to be too small to support pollinators and there has been no recruitment for over 50 years, the species may already be on the path to extinction. These threats could easily cause it to become CR or even EX within a very short time period, so **Vulnerable D2** is also met.

Using only criterion D, this cycad would be listed as Endangered D. However, since it since it already meets the thresholds for Critically Endangered under criteria A, B and C, we can disregard this criterion.

**Criterion E: Quantitative analysis?**

**NO**

A quantitative analysis has not been carried out.

**Summary:**

This cycad meets the following categories and criteria:

- CR A2acd+4acd
- CR B2ab(ii,iii,v) and EN B1ab(ii,iii,v)+2ab(ii,iii,v)
- CR C1+C2a(i)
- EN D and VU D2

**Conclusion:**

This cycad is **Critically Endangered A2acd+4acd;B2ab(ii,iii,v);C1+2a(i)**