

# CASE STUDY 1

**Species:** *Gasterosteus* sp.

**Common Name:** Benthic Paxton Lake Stickleback

**Class:** ACTINOPTERYGII

**Order:** GASTEROSTEIFORMES

**Family:** GASTEROSTEIDAE

## **Taxonomy:**

The Benthic Paxton Lake Stickleback is one of a pair of stickleback species in Paxton Lake that currently are being described. Both species can be referred to by the museum number of the type specimens. There are five known Texada Island Stickleback species pairs. Each pair consists of a benthic species and a limnetic species that differ in appearance, diet and habitat.

## **Range:**

The Benthic Paxton Lake Stickleback is restricted to Paxton Lake, which is located on Texada Island, between Vancouver Island and mainland British Columbia. Paxton Lake is small (17 ha) and has a maximum depth of about 15 m. Paxton Lake is about 90 m above sea level and the only outlet, now dammed, drops about 80 m in a series of small falls before entering Malisipina Strait, thus isolating the lake and the upper portion of the creek from the sea. There is no permanent surface flow into the lake.

## **Population:**

Its population probably exceeds 100,000 individuals. Although no data exist on trends in population size, it is believed that the population is more or less stable at this time.

## **Habitat & Ecology:**

The fish lives near the bottom of the lake. Adults typically feed along the shallow lake margins predated on amphipods, midge larvae and dragonfly nymphs, snails, etc. Some small individuals feed partially on plankton. In the summer, the fish occupy the littoral zone in open, mud-bottomed situations above the deoxygenated zone, but smaller individuals (<50 mm) are usually found in shallower water. The fish prefer some cover and are often found around sunken logs. They disperse over the entire lake bottom in the winter. Spawning occurs in the shallower waters of the littoral zone and nests are usually found under cover in aquatic vegetation. Adults reach 90 mm in length. Relative to other species in the genus *Gasterosteus*, this species is stout, has a wide mouth, few gill rakers, and a reduced number of lateral plates and dorsal spines.

## **Threats:**

Previous disturbance due to mining near Paxton Lake affected the population numbers of the Benthic Paxton Lake Stickleback, but this has not been a threat since the mine closed. The potential introduction of exotic fish species into the lake is probably the major threat now facing the stickleback. The species of most concern are Brown Bullhead Catfish *Ameiurus nebulosus* and Pumpkinseed Sunfish *Lepomis gibbosus*, both of which are spreading on Vancouver Island through unauthorized public transplants. At least one species pair is already known to have gone extinct in the mid 1990s due to the introduction of catfish into Lake Hadley on Lasqueti Island.

## **Conservation Measures:**

The Benthic Paxton Lake Stickleback is protected under the federal *Species at Risk Act* (SARA). A Stickleback species recovery team has been formed and a recovery action group was formed for the Texada Island species pairs (Paxton Lake and Vananda Creek Sticklebacks) and development and implementation of a Recovery Strategy and Recovery Implementation (action) Plan is underway.

## **Sources:**

Environment Canada. 2007. *Benthic Paxton Lake Stickleback*. Species at Risk web site.

[http://www.speciesatrisk.gc.ca/search/speciesDetails\\_e.cfm?SpeciesID=544](http://www.speciesatrisk.gc.ca/search/speciesDetails_e.cfm?SpeciesID=544). Accessed 13<sup>th</sup> June 2007.

Acroloxus Wetlands Consultancy. 2007. Stickleback Recovery Planning. <http://www.acroloxus.com/stickleback-recovery-planning.html>. Accessed 13<sup>th</sup> June 2007.

<b>Assessment 1</b>	
<b>Is the taxon eligible for a Red List assessment?</b>	<b>YES</b>
Although this species currently is undescribed, a description is underway, a museum voucher reference is available, and the current range is well known.	
<b>Criterion A: Declining population in the past or future?</b>	<b>NO</b>
Although disturbance from mining affected population numbers in the past, there is no information on when this occurred. The causes of this disturbance are no longer present (the mine has now closed) and the current population appears to be stable. Therefore criterion A is not applicable in this case.	
<b>Criterion B: Small distribution, population fragmented or in few locations, and continuing decline or fluctuation?</b>	<b>NEARLY</b>
<p>Since the area of the entire lake is only 17 ha, both the extent of occurrence (EOO) and area of occupancy (AOO) thresholds for CR B1+2 are met (EOO &lt;100 km<sup>2</sup> and AOO &lt;10 km<sup>2</sup>).</p> <p>Although there seem to be no current threats to the species, the main potential threat is introduced species, which are known to be affecting species in other parts of the island. If these species were released into the lake, the entire population would be affected. Therefore the population occurs in only one location (CR B1a+2a).</p> <p>There is no continuing decline in range, habitat, locations or population size, therefore the “b” subcriterion does not apply in this case. Also, there is no information given on fluctuations; the population currently appears to be stable. Therefore subcriterion “c” cannot be used.</p> <p>Not all of the requirements are met for criterion B. But the species nearly qualifies: if alien invasive species were to be introduced into the lake, it would very quickly qualify for CR. So, the species could be given a <b>Near Threatened</b> status.</p>	
<b>Criterion C: Small population size and decline?</b>	<b>NO</b>
The population is estimated at more than 100,000 individuals, which clearly exceeds the threshold for the Vulnerable category (<10,000 mature individuals). There is also no evidence of a continuing population decline or extreme fluctuations. Therefore criterion C cannot be applied.	
<b>Criterion D: Very small or restricted populations?</b>	<b>YES</b>
The population size is clearly too large for criterion D or D1 to be used. But, the species is restricted to a very small range and only one location, and although there are no current threats, there is a real potential threat from introduced species. Therefore the species does qualify for <b>Vulnerable</b> under criterion D2.	
<b>Criterion E: Quantitative analysis?</b>	<b>NO</b>
No information is given on any quantitative analysis therefore criterion E cannot be applied.	
<p><b>Conclusion:</b></p> <p>The Benthic Paxton Lake Stickleback <i>Gasterosteus</i> sp. is <b>Vulnerable</b> <b>VU D2</b></p>	

## CASE STUDY 2

**Species:** *Ambystoma taylori* (Brandon, Maruska & Rumph, 1981)

**Common Name:** Taylor's Salamander

**Class:** AMPHIBIA

**Order:** CAUDATA

**Family:** AMBYSTOMATIDAE

**Taxonomy:**

Based on both allozymes and mtDNA, this is a very distinctive salamander. The *Ambystoma* salamanders occurring in other natural lakes around Alchichica are not closely related to this species.

**Range:**

Taylor's salamander is endemic to Lake Alchichica, a saline crater lake located in eastern Puebla, Mexico, at 2,290 m above sea level. The *Ambystoma* salamanders occurring in the other natural lakes around Alchichica are not closely related to this species. The surface area of the lake is 2.3 km<sup>2</sup>.

**Population:**

Even at its only known locality this is a rare species, although formerly it was common there. Divers deep in the lake have seen the species recently.

**Habitat and Ecology:**

This salamander usually does not metamorphose, and most individuals live permanently in water. But, occasional individuals have been known to metamorphose. It breeds in the lake, and is usually found in very deep water, often more than 30 m below the surface.

**Threats:**

The most serious threat to the species is water extraction and diversion resulting in the lake becoming even more saline. The water level has dropped many meters over the last two decades. Continued transformation and pollution of the lake is likely to result in the disappearance of this species. Attempts to introduce fish in the lake have failed because of its salinity.

**Conservation Measures:**

Taylor's salamander does not occur in any protected area. Captive breeding may be an essential short-term measure to save this species, if it is not too late. The protection of the Alchichica lake is an urgent priority. This species is protected under the category Pr (Special protection) by the Government of Mexico.

**Sources:**

Shaffer, B., Parra Olea, G. and Wake, D. 2004. *Ambystoma taylori*. In: IUCN 2004. *2004 IUCN Red List of Threatened Species*. <[www.redlist.org](http://www.redlist.org)>. Downloaded on 13 April 2005

IUCN, Conservation International, and NatureServe. 2004. Global Amphibian Assessment. <[www.globalamphibians.org](http://www.globalamphibians.org)>. Accessed on 15 October 2004.

Filonov, A., Tereshchenko, I., Alcocer, J., 2006. Dynamic response to mountain breeze circulation in Alchichica, a crater lake in Mexico. *Geophysical Research Letters* 33, L07404, doi:10.1029/2006GL025901.

<b>Assessment 2</b>	
<b>Is the taxon eligible for a Red List assessment?</b>	YES
Taylor's salamander <i>Ambystoma taylori</i> is a valid species (original description published in 1981).	
<b>Criterion A: Declining population in the past or future?</b>	NO
Although it is noted that the species was formerly common in its only known location and is now rare, there is no indication of the time period over which this population reduction has taken place; no data are given to be able to estimate the rate of population decline. Therefore, it is not possible (from the information given above) to estimate the rate of decline.	
<b>Criterion B: Small distribution, population fragmented or in few locations, and continuing decline or fluctuation?</b>	YES
<p>The total area of the lake is 2.3 km<sup>2</sup> therefore the Critically Endangered thresholds for extent of occurrence and area of occupancy are both met (EOO &lt;100 km<sup>2</sup> and AOO &lt;10 km<sup>2</sup>) (CR B1+2). The most serious threat to the species is water extraction and pollution, which is affecting the whole lake and hence the whole population. Therefore, the whole lake can be taken as one location only (CR B1a+2a).</p> <p>The quality of the species' habitat is declining through water extraction leading to increased salinity. It is also stated that the species was once common but is now rare. Given the ongoing habitat degradation, these population declines can be expected to continue unless some remedial action is taken (CR B1b(iii,v)+2b(iii,v)).</p> <p>So, the species qualifies for <b>Critically Endangered</b> under criterion B (<b>CR B1ab(iii,v)+2ab(iii,v)</b>)</p>	
<b>Criterion C: Small population size and decline?</b>	NO
Although the population is described as rare, it is difficult to estimate actual numbers of mature individuals from this.	
<b>Criterion D: Very small or restricted populations?</b>	YES
Again, actual numbers cannot be estimated from the information given, so criteria D and D1 cannot be applied. The species is restricted to only one small location (AOO <10 km <sup>2</sup> ). Therefore, the species qualifies for <b>Vulnerable D2</b> . However, it already meets the thresholds for Critically Endangered under criterion B, we can disregard this category.	
<b>Criterion E: Quantitative analysis?</b>	NO
A quantitative analysis has not been carried out.	
<p><b>Conclusion:</b></p> <p>Taylor's Salamander <i>Ambystoma taylori</i> is <b>Critically Endangered</b>  <b>CR B1ab(iii,v)+2ab(iii,v)</b>  <small>Current IUCN Red List status: CR B1ab(iii,v)+2ab(iii,v) (2004)</small></p>	

## CASE STUDY 3

**Species:** *Amblyrhynchus cristatus* Bell, 1825

**Common Name:** Marine Iguana

**Class:** REPTILIA

**Order:** SQUAMATA

**Family:** IGUANIDAE

**Taxonomy:**

The seven marine iguana subspecies described to date have been based on morphology. The taxonomic status of the ten subpopulations of *A. cristatus* is unclear.

**Range:**

*A. cristatus* is endemic to the Galápagos Islands, Ecuador. The species is known from ten islands, although the populations on seven of these islands have not yet been surveyed or studied. Extent of occurrence is less than 5,000 km<sup>2</sup> and area of occupancy is 500 km<sup>2</sup>.

**Population:**

The global population size is currently unknown because a complete population survey has never been carried out. However, populations are known to undergo dramatic fluctuations as a result of food shortages after El Niño events.

**Habitat & Ecology:**

*A. cristatus* is the world's only marine lizard species. The animals live in colonies on rocky coast and intertidal zones. Softer substrate is needed for egg laying. Adult females can be found nesting up to 2 km inland and adult males can be found in marine waters, up to depths of 20 m. The species feeds almost exclusively on marine algae. Average generation length is 5 years for females and 12 years for males.

**Threats:**

El Niño causes periodic dramatic mortalities. The increased rainfall that accompanies El Niño results in greater food availability for most terrestrial organisms in the Galápagos, but marine life generally suffers. Green and red algal species, which are the marine iguanas' preferred food, disappear and are replaced in intertidal areas by brown algae which the iguanas find hard to digest. Up to 90% of marine iguana populations on islands can die of starvation as a result of these environmental changes. The largest iguanas have the highest mortality because, they feed less efficiently than smaller individuals. Currently, *A. cristatus* appears to be able to cope with such events by increasing their reproduction rate when population densities are low. However, if the frequency of such events increases in future, the species may struggle to survive.

The 2001 "Jessica" oil spill had a particularly severe immediate effect on the Santa Fe subpopulation, comparable to the mortality caused by El Niño.

Introduced predators may be having a negative effect on some subpopulations. Iguanas have evolved anti-predator behaviour towards the native Galapagos Hawk *Buteo galapagoensis* but are not able to cope with introduced feral animals such as dogs. Predation by introduced cats, dogs, pigs and rats of iguanas and their eggs has decimated hatchling populations in many colonies.

**Conservation Measures:**

*A. cristatus* is included on CITES Appendix II. It is under "Special Law" in the Galápagos and occurs in three protected areas: Galápagos National Park and National Marine Reserve; Galápagos Islands Man and Biosphere Reserve (UNESCO); and Galápagos Islands World Heritage Site. Conservation actions recommended for the species include: further surveys of the islands, taxonomic and genetic research, and monitoring of the population.

Taxonomic/genetic research is recommended for the different island subpopulations to establish whether any of them should be reclassified. Additionally, the status of seven of the ten subpopulations is unknown. Populations on different islands face different threats and should be included in future surveys.

**Sources:**

Nelson, K., Snell, H. & Wikleski, M. 2004. *Amblyrhynchus cristatus*. In: IUCN 2006. 2006 IUCN Red List of Threatened Species. <[www.iucnredlist.org](http://www.iucnredlist.org)>. Downloaded on 14 June 2007.

Wikleski, M. and Thom, C. 2000. Marine iguanas shrink to survive El Niño. *Nature* 403: 37-38.

<b>Assessment 3</b>	
<b>Is the taxon eligible for a Red List assessment?</b>	<b>YES</b>
Although further taxonomic work is required on this species, it has been described (description published in 1825).	
<b>Criterion A: Declining population in the past or future?</b>	<b>NO</b>
The global population size is not known and no information is given about population trends. Dramatic fluctuations in population size are known to occur as a result of El Niño events.	
<b>Criterion B: Small distribution, population fragmented or in few locations, and continuing decline or fluctuation?</b>	<b>YES</b>
<p>Extent of occurrence and area of occupancy meet the threshold requirements for Endangered (EOO &lt;5,000 km<sup>2</sup> and AOO &lt;500 km<sup>2</sup>) (EN B1+2).</p> <p>The number of locations should be determined based on the distribution of the population and the area affected by the most serious threats to the species.</p> <p>The population occurs on ten separate Galápagos islands. A potential threat comes from El Niño events, which affects the whole population across its range: so far the species appears to be able to recover well from these events, but if the frequency of El Niño events increases, for example through the effects of climate change, this may pose a serious problem to the survival of this species. However, the relationship between El Niño and global climate change patterns is unknown, so considering El Niño as a major threat at present may be premature. So counting the entire range as one location may not be an appropriate application of the criteria.</p> <p>Other threats to the species include pollution events and introduced terrestrial predators. Both of these threats are likely to affect individual islands rather than the entire area in one sweep. So, each island could be seen as a location: 10 locations. This does not meet the Endangered threshold, but it does meet the <b>Vulnerable</b> threshold (VU B1a+2a).</p> <p>There is no information to say there is continuing decline in habitat, population size, range, etc. So subcriterion "b" cannot be used in this case.</p> <p>However, there is evidence of extreme fluctuations in population size caused by the consequences of El Niño events: populations can be reduced by as much as 90%. So subcriterion "c" can be used here (VU B1ac(iv)+2ac(iv)).</p>	
<b>Criterion C: Small population size and decline?</b>	<b>NO</b>
Current population size is not known, therefore criterion C cannot be applied in this case.	
<b>Criterion D: Very small or restricted populations?</b>	<b>NEARLY</b>
Again, there is no information on population size, so criteria D and D1 cannot be used. Although the species is apparently restricted to the Galápagos Islands, the AOO is not extremely small and there are 10 known locations. Criterion D2 would probably not be used in this case, but the species is quite close to meeting D2 (based on potential threats and limited locations), so in the absence of the above Vulnerable assessment, a Near Threatened assessment could be used here.	
<b>Criterion E: Quantitative analysis?</b>	<b>NO</b>
Quantitative analysis has not been carried out to determine the probability of extinction, therefore criterion E cannot be used.	
<p><b>Conclusion:</b></p> <p>The Marine Iguana <i>Amblyrhynchus cristatus</i> is <b>Vulnerable</b>  <b>VU B1ac(iv)+2ac(iv)</b>  <small>Current IUCN Red List status: VU B2ac(iv) (2004)</small></p>	

## CASE STUDY 4

**Species:** *Physella johnsoni* (Clench, 1926)

**Common Name:** Banff Springs Snail

**Class:** GASTROPODA

**Order:** BASOMMATOPHORA

**Family:** PHYSIDAE

**Range:**

*Physella johnsoni* is endemic to thermal springs on Sulphur Mountain, within Banff National Park (BNP), Alberta, Canada (Figure 1). Historic locations were the Upper Hot, Kidney, Middle, Cave and Basin, and Vermilion Cool Springs. Presently, the species survives in five thermal springs: Lower Middle, Cave, Basin, Upper C&B, and Lower C&B (locations circled in figure 1). The latter four of these springs occur in the Cave and Basin National Historic Site (C&BNHS). The Banff springs snail has been extirpated from three thermal springs (Upper Hot, Kidney, Upper Middle) and one cooler spring.

Although this snail is small and inconspicuous, the macrofauna of western North American springs is well studied. Given the human fascination with thermal springs and the human history and extensive use of BNP, it is extremely unlikely that unknown populations of the snail exist.

The current total area that this species occupies is around 170 m<sup>2</sup>.

**Population:**

Natural exchange of snails among the five presently inhabited thermal springs is unlikely.

From 1996 to 2000, population surveys were carried out every three to four weeks at all historic locations. Due to inaccessibility of some potential occurrence sites, snail numbers from these surveys are considered minimum population estimates.

Apparently natural seasonal fluctuations in population size occur, with maxima occurring in late inter/early spring and minima occurring from May to July; the causes of these fluctuations are unknown. Yearly averages from 1996 to 2000 (see figure 2) show a significant increase in total snail numbers between 1996 and 1997, with subsequent levels in 1998, 1999 and 2000 not significantly different from those of 1997. As these are the only population data in existence, it is impossible to indicate a most recent 10-year trend.

**Habitat & Ecology:**

The Banff springs snail is a small (approximately 5.0 mm shell length), inconspicuous freshwater mollusc. It lives in thermal springs, and even within these springs the species is limited to a restricted microclimate. The critical components of their habitat are unknown.

There are no publications on the reproductive biology and longevity of *P. johnsoni*. Most likely, they are hermaphroditic. It has been suggested that Banff springs snail may be a keystone species and that Banff's thermal spring ecosystems could shift with the loss of this important grazer.

**Threats:**

*P. johnsoni* is confined to very discrete, highly localized, and extremely small habitat patches. On a geological time scale, thermal springs are not permanent.

The hot springs have been a major tourist attraction over the past 100 years and all the historic and presently inhabited thermal springs have been affected by human activities to a varying degree. The least altered habitats are in the Middle Springs area. Since 1995, these springs have been located within areas closed to the public. Unfortunately, even with these restrictions human use of the Upper Middle Springs cave continues, including the construction of rock dams to increase the depth of the origin pool for soaking. Human use of the Kidney Spring also continues: people enjoy soaking in the concrete cistern. The Upper Hot Spring has experienced severe water flow reductions and flow cessations in recent years. During reduced flows, excess water is not shunted down the outflow stream, which may result in water near the spring's origin being too hot for the snail (~47°C).

Illegal swimming has, until recently, been a recurring problem at the Basin Spring pool. This activity can directly kill snails and eggs by crushing them, removing them from substrates, or stranding them above the water. Indirect mortality can result from the destruction or modification of microhabitat components. Potentially lethal substances (e.g., alcohol, body lotions, deodorants, sunscreens, insect repellents, perfumes, antimicrobial soaps, lantern fuels, human wastes, bacteria, etc.) are introduced to the water by swimmers and significant

changes in water physicochemistry and snail microdistribution have been detected in areas used by swimmers.

Less obvious than swimming, but certainly more prevalent, the dipping of feet or hands into the springs occurs with high regularity. The same potentially toxic substances can be introduced through this. Observations of visitor behaviour has found that, on average, 73% of visitors to the Cave Spring dipped their hands in the water. With nearly 165,000 people visiting the C&BNHS during 1998/99, this means potentially over 120,450 people per year dipping their limbs into the Cave Spring water.

Other forms of habitat alteration include littering with garbage and coins; throwing and kicking snow balls and pieces of ice; and removing and moving natural objects such as the microbial mat, twigs, logs, and rocks. These activities have killed adult snails and eggs. Littering with coins may be particularly damaging as copper sulphate was once used as a molluscicide; both the Canadian penny and nickle still contain copper.

Even the removal of garbage from the thermal springs by well-meaning visitors could result in the death of snails if the garbage is not first examined carefully for the small snails.

The effects of thermal spring flow cessations on the snail are unclear. However, *P. johnsoni* has been extirpated from the two thermal springs where water flow stoppages have been recorded: the Upper Hot and Upper Middle Springs. There is some concern that recent flow anomalies at the Upper Middle and Upper Hot Springs may signal the beginning of severe water flow problems in the thermal springs of Sulphur Mountain.

### **Conservation Measures:**

The Banff Springs Snail Research and Recovery Program began in 1996. A draft Resource Management Plan (RMP) for the recovery of the snail has been in place since 1998.

Data continue to be collected on the biology and ecology of the species in the thermal springs through periodic surveys. An environmental assessment under the guidelines of the Canadian Environmental Assessment Act has been written for snail reintroductions.

A communications strategy has been formalized by Parks Canada, with the objective of increasing understanding, awareness, and appreciation of the Banff springs snail amongst Parks Canada staff, local residents, Albertans, Canadians, and international visitors. Sectors of the public suspected of causing the most snail habitat disturbance will be specifically targeted in order to curb their activities.

Many of the provisions to ensure the continued survival of the species and the protection of its habitat are contained in the *National Parks Act*. The species is also protected by federal law under Schedule 1 of the *Species at Risk Act*.

### **Sources:**

Lepitzki, D.A.W. 2002. Status of the Banff Springs Snail (*Physella johnsoni*) in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 40, Edmonton, AB.

Image from Environment Canada web site:  
[http://www.speciesatrisk.gc.ca/species/search/SearchDetail\\_e.cfm?SpeciesID=311](http://www.speciesatrisk.gc.ca/species/search/SearchDetail_e.cfm?SpeciesID=311) (Accessed: 4 February 2003)

<b>Assessment 4</b>	
<b>Is the taxon eligible for a Red List assessment?</b>	<b>YES</b>
Originally description published in 1926.	
<b>Criterion A: Declining population in the past or future?</b>	<b>NO</b>
Population decline has occurred in the past, with at least two subpopulations disappearing entirely. However, population trend over the last ten years cannot be fully determined (data are available only up to January 2002). In fact, between 1997 and 2002, the population appears to have been stable to increasing (although not significantly increasing). Therefore, criterion A cannot be applied.	
<b>Criterion B: Small distribution, population fragmented or in few locations, and continuing decline or fluctuation?</b>	<b>YES</b>
<p>Both the extent of occurrence and area of occupancy meet the Critically Endangered thresholds (EOO &lt;100 km<sup>2</sup> and AOO &lt;10 km<sup>2</sup>) (CR B1+2).</p> <p>The species currently occurs in only five springs, with no natural interchange between subpopulations. Most of the threats to the species appear to be habitat degradation and human disturbance, which affect the sites individually; therefore based on current threats five locations can be counted, which does not meet the locations threshold for CR (1 location), but does meet the EN threshold (no more than 5 locations). Note that a potential threat comes from future water flow problems, which could quickly affect all springs in the area, therefore if this threat was considered it can be interpreted that there is one location: a precautionary, but less certain, assessment could indicate 1 location based on this.</p> <p>However, the population appears to be severely fragmented so this can be used to apply criterion B1a+2a for the Critically Endangered category.</p> <p>In spite of the apparently stable population trend, habitat degradation continues due to human activities in and around the springs. So, CR B1b(iii)+2b(iii) applies.</p> <p>The species undergoes natural seasonal fluctuations, which would not be considered to be extreme fluctuations, so subcriterion "c" cannot be used for this species</p> <p>The snail therefore qualifies for <b>Critically Endangered</b> (CR B1ab(iii)+2ab(iii)).</p>	
<b>Criterion C: Small population size and decline?</b>	<b>NEARLY</b>
<p>For species that undergo natural fluctuations in population size, a lower estimate should be used to determine the population size. Based on figure 2, a lower estimate (less than the mean) for population size would fall below the Vulnerable threshold of 10,000 for criterion C (VU C).</p> <p>However, the population appears to be at least stable, so the continuing decline requirement for criterion C is not met. However, with the potential for future population declines if the water flow of these springs declines, the species could be said to nearly meet this criterion so a Near threatened status could be used here. But the species already qualifies for CR under criterion B, so that status takes priority.</p>	
<b>Criterion D: Very small or restricted populations?</b>	<b>YES</b>
<p>The population size exceeds the thresholds for D and D1. However, the species is restricted to no more than five locations, therefore the D2 criterion can be used (VU D2).</p> <p>The species qualifies for <b>Vulnerable</b> under criterion D (VU D2). But, it already qualifies for CR under criterion B, and that higher category takes priority.</p>	
<b>Criterion E: Quantitative analysis?</b>	<b>NO</b>
A quantitative analysis has not been carried out.	
<p><b>Conclusion:</b></p> <p>The Banff Springs Snail <i>Physella johnsoni</i> is <b>Critically Endangered</b> <b>CR B1ab(iii)</b></p>	
Current IUCN Red List status: NE	

## CASE STUDY 5

**Species:** *Phycodurus eques* (Günther, 1865)

**Common Name:** Leafy Seadragon

**Class:** ACTINOPTERYGII

**Order:** GASTEROSTEIFORMES

**Family:** SYNGNATHIDAE

**Range:**

Leafy seadragons are endemic to Australia and are most abundant in South Australia (SA) and southern Western Australia (WA). Until recently, the range was considered to form a continuous stretch of coastline from near Perth on the southern west coast of WA to Wilson's Promontory in Victoria. Recent sightings of live animals by divers have extended the known range along the WA coastline as far north as the Abrolhos Islands, west of Geraldton. There are also unconfirmed reports of the species around the Bass Strait Islands of northwest Tasmania.

The length of coastline along which the species occurs is approximately 14,000 km and the width of the strip of habitat suitable for it to occupy along this coastline is on average around 0.1 km. Seadragons have been sighted at numerous locations within the range but it is impossible to determine how fragmented the population is. The depth range of leafy seadragons is not well documented; most sightings are by divers in waters of less than about 20 m, however seadragons have been recorded down to 30 m in some areas.

**Population:**

There are no direct data for population estimates for *P. eques*. However, the density of leafy seadragons around West Island, in Encounter Bay (SA) based on a mark/re-sighting method and a capture/recapture algorithm indicates that the density of larger juveniles and adults at this site at 57 fish per ha. Since this study site was chosen because of relatively frequent sightings of the species, it can be assumed that densities elsewhere in the range would be lower. So, taking just 10% of this estimate (5 fish per ha), and a total range area of 1,400 km<sup>2</sup> (140,000 ha), the total global population estimate would be approximately 700,000 (based on quite loose assumptions).

**Habitat & Ecology:**

Leafy seadragons were, until recently, thought to occur predominantly near rocky reefs supporting stands of kelp or other macroalgae, where they have been observed feeding on mysids and other crustaceans. However, more recent data has shown that this species is just as prevalent over shallow (5 to 15 m depth) *Posidonia* seagrass meadows and patches of sand amongst seagrass.

Individuals typically remain within well-defined home ranges of up to 5 ha. As with other syngnathids, male seadragons carry the fertilized eggs. For Leafy Seadragons, the male carries about 200 eggs on the exposed surface of the underside of its tail (there is no pouch). It can survive for at least two to three years in aquaria if supplied with its specific live food requirements. Longevity *in situ* is not known. Mating reportedly occurs during summer months. The genetic structure of populations has not been measured, nor has any aspect of reproduction been quantified.

*Phycodurus eques* is particularly well camouflaged, with a number of frond-like appendages that resemble kelp. The species also rocks back and forth with wave action, increasing its resemblance to coastal algae swept by coastal surge.

**Threats:**

Leafy Seadragons lack a caudal fin and are weak swimmers; in conjunction with a lack of a dispersive egg phase, this potentially makes them vulnerable to habitat loss and degradation as well as to incidental harvesting during commercial fishing. These are the two main threats. The species is associated with seagrass beds and reefs supporting macroalgae. These habitats have been adversely affected by human activities and loss in quality and quantity of habitat has been documented. The loss of habitat is most severe near major urban centres, where discharge of storm water and treated sewage leads to eutrophication and increased sedimentation. Losses of seagrass have been particularly severe along the metropolitan coasts.

There is anecdotal evidence that leafy seadragons are killed as incidental bycatch in the trawling industry in SA. Fishers have indicated that on occasions they catch "large numbers"

of the species. However neither the rate nor distribution of incidental catch have been substantiated.

The current legal collection of wild specimens is unlikely to cause long-term changes in population sizes. The small numbers taken under legally issued permits could result in the reduction or loss of groups of animals at particular sites, but this is unlikely to result in measurable effects on regional populations. If demand increases substantially, illegal collection could threaten local and perhaps regional populations, although this possibility should remain unlikely given the difficulties associated with illegal international export.

This species is a major attraction for the dive industry in southern Australia, and it has been made the official fish emblem in South Australia. Recreational divers often harass or disturb individuals. Suitable protocols for divers should be encouraged to protect local populations, but the disturbance probably does not harm the long-term prospects for regional populations.

**Conservation Measures:**

The species is protected species in South Australia, Victoria, and Western Australia Waters. It is subject to export controls in the Commonwealth Wildlife Protection (Regulation of Exports and Imports) Act 1982 and is listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

All states of Australia are currently implementing systematic series of Marine Protected Areas (MPAs). The most important development for Leafy Seadragons is that a new MPA is close to being declared (it was released as a draft plan earlier in 2005) in southern Gulf St Vincent in the state of SA. The proposed MPA will include areas (e.g., Encounter Bay and northeastern Kangaroo Island) in which a large proportion of public sightings of seadragons occur. The protection of these areas could substantially decrease the perceived vulnerability of the species to human activities, in particular to commercial fishing.

**Sources:**

Connolly, R. 2006. *Phycodurus eques*. In: IUCN 2006. *2006 IUCN Red List of Threatened Species*. <[www.iucnredlist.org](http://www.iucnredlist.org)>. Downloaded on **15 June 2007**

<b>Assessment 5</b>	
<b>Is the taxon eligible for a Red List assessment?</b>	YES
The original description of this species was published in 1865.	
<b>Criterion A: Declining population in the past or future?</b>	NO
There is no information available to be able to determine population declines, so criterion A cannot be used.	
<b>Criterion B: Small distribution, population fragmented or in few locations, and continuing decline or fluctuation?</b>	<b>NEARLY</b>
<p>The extent of occurrence is the total area of coastline the species occurs in: 1,400 km<sup>2</sup>. This falls within the threshold for Endangered under criterion B1 (&lt;5,000 km<sup>2</sup>). There is insufficient information to be able to give an estimate of area of occupancy, so criterion B2 cannot be used. Locations are noted as “numerous”, and the degree of fragmentation is not known, so criterion B2a cannot be used.</p> <p>Habitat loss and degradation is ongoing at least in parts of the species’ range (declining quality and quantity of seagrass beds and reefs with macroalgae are documented), so there is continuing decline in habitat area and quality (EN B2b(iii)).</p> <p>There is no information to support the occurrence of extreme fluctuations, so criterion B2c cannot be used.</p> <p>The species does not quite meet all the requirements for criterion B, but almost meets Endangered under this criterion. Therefore, a <b>Near Threatened</b> status can be given to the species.</p>	
<b>Criterion C: Small population size and decline?</b>	NO
There are no direct data on population size, but an estimate of 700,000 has been made which is well above the 20,000 threshold for Vulnerable under criterion C. So this criterion does not apply.	
<b>Criterion D: Very small or restricted populations?</b>	NO
Both population size and range are too large for criterion D to apply.	
<b>Criterion E: Quantitative analysis?</b>	NO
No quantitative analysis has been carried out as far as we know. So criterion E cannot be used.	
<p><b>Conclusion:</b>  The Leafy Seadragon <i>Phycodurus eques</i> is <b>Near Threatened</b>  <b>NT</b></p>	
Current Red List status: NT (2006)	

## CASE STUDY 6

**Species:** *Tubastraea floreana* Wells, 1982

**Common Name:** Floreana Coral

**Class:** ANTHOZOA

**Order:** SCLERACTINIA

**Family:** DENDROPHYLLIIDAE

**Range:**

*Tubastraea floreana* is a rare endemic species to the Galapagos Islands. The species is presumed to have been widespread and not uncommon prior to 1983 because it was recorded at six sites during a time of very little underwater survey activity. Since then, colonies have disappeared from all six known sites, and despite intensive searches the species is recently only known from two sites. At one of these sites, the species has not been seen since 2001.

**Population:**

Before 1983 it was known from Caleta Iguana, **Isabela**; Buccaneer Cove, **Santiago**; **Cousins** near Santiago; **Pinzón**; Playa Prieta, **Floreana**; and **Gardner Islet** near Floreana. However, after El Niño 1982/83, the species was not reported from any site until the early 1990s, when three colonies were observed at Cousins, near Santiago. These colonies were observed annually until 2001, but have not been seen since. Despite targeted searches throughout the Archipelago, the only colonies found during the past decade were located at Gardner Islet, near Floreana in 2004.

**Habitat & Ecology:**

*Tubastrea floreana* occurs in cryptic habitats; on ceilings of caves, ledges and rocks overhangs. It has been reported at depths of 2 to 46 m depth. Generation length is not known but is likely to be more than 10 years.

**Threats:**

Despite a lack of information on the thermal tolerances of *Tubastrea floreana*, the dramatic reduction in the distribution of the species immediately after the 1982/83 El Niño event suggests that El Niño was the cause of this reduction. Presumably climate change is an additional threat.

**Conservation Measures:**

The species occurs inside one protected area in the Eastern Tropical Pacific region: Ecuador: Galapagos Marine Reserve (IUCN category VI); Galapagos Archipelago Particularly Sensitive Area (PSSA); Galapagos Island World Heritage Site (UNESCO N (i)(ii)(iii)(iv), and Galapagos Island Man and Biosphere Reserve (UNESCO). It is also included with corals in CITES appendix II.

**Sources:**

Global Marine Species Assessment (GMSA). 2006. Eastern Tropical Pacific Corals and Macroalgae Assessment Workshop. Galapagos Islands, Ecuador, 27-30 May 2006.

Assessment 6	
Is the taxon eligible for a Red List assessment?	YES
A description of the species was published in 1982.	

<b>Criterion A: Declining population in the past or future?</b>	<b>YES</b>
<p>Generation length is probably more than 10 years, therefore the rate of population reduction should be viewed over a period of at least 30 years (three generations).</p> <p>There are no direct data on population size. However, there is some information on the range of the species before and since the El Niño event in 1982/83. Prior to this event, the species was recorded from six sites on a range of islands in the Archipelago and it is assumed that it is inferred to have been widespread and not uncommon at that time. After El Niño, the species had disappeared from six of those sites, and later it disappeared from another site, leaving only one site where the species' occurrence has been confirmed over recent years, despite "intensive searches".</p> <p>So, in spite of the lack of direct population data, a population decline of at least 80% within the last three generations can be inferred from the observed reduction in the species' range. Therefore, the species qualifies for <b>Critically Endangered</b> under criterion A2 (CR A2ac).</p>	
<b>Criterion B: Small distribution, population fragmented or in few locations, and continuing decline or fluctuation?</b>	<b>YES</b>
<p>The range area is not given. However, it is currently known from only two sites in the Galápagos Islands, and at one of these it has not been recorded since 2001. It is unlikely that these sites together would constitute more than 10 km<sup>2</sup> area of occupancy for the species therefore it meets the threshold for Critically Endangered under criterion B (CR B2).</p> <p><i>[if a map was available, it may be found that the two sites are within an area of 100 km<sup>2</sup>, in which case criterion B1 would also be used]</i></p> <p>The main known threat to the species (and the reason for the population reduction) is El Niño, which affects all known populations. Therefore, the entire range can be viewed as one location* (CR B2a).  <i>[Note that for the marine iguana (case study 3) the threat from El Niño was regarded as insufficient to consider the entire range of the species as being one location – this is because the marine iguana appears to be able to recover relatively quickly from El Niño events, and the potential for El Niño increasing in future through climate change currently is very uncertain. So, the most serious threats for that species were more localised habitat degradation and invasive species which are likely to affect populations on different islands separately, therefore that species occurs at &gt;1 location. For the Floreana coral, El Niño currently is the only known threat, and the population has not recovered since the last event, therefore 1 location].</i></p> <p>Given the past decline in range and the more recent possible loss of the species from a further site, it could be inferred that there is continuing decline in area of occupancy, number of subpopulations, and perhaps even number of mature individuals. Therefore, subcriterion B2b could also be applied (CR B2b(ii,iv)).</p> <p>Therefore, <b>Critically Endangered</b> could also be used under criterion B (CR B2ab(ii,iv)).</p>	
<b>Criterion C: Small population size and decline?</b>	<b>NO</b>
<p>There are no direct data available to be able to estimate the actual population size, therefore criterion C cannot be used.</p>	
<b>Criterion D: Very small or restricted populations?</b>	<b>YES</b>
<p>Again, there are no data available to be able to estimate population size, therefore criteria D and D1 cannot be used. However, the species has a restricted range (known from &lt;5 locations) and the potential threat of El Niño is still present, therefore the species does qualify for Vulnerable under criterion D2 (VU D2). But, since it already qualifies for Critically Endangered under A and B, the higher category takes priority in the assessment.</p>	
<b>Criterion E: Quantitative analysis?</b>	<b>NO</b>
<p>No quantitative analysis has been carried out, therefore criterion E cannot be used.</p>	
<p style="text-align: center;"><b>Conclusion:</b>  Floreana Coral <i>Tubastraea floreana</i> is <b>Critically Endangered</b>  <b>CR A2ac; B2ab(ii,iv)</b>  Current Red List status: NE (but submitted for 2007 as CR A2a)</p>	

## CASE STUDY 7

**Species:** *Mergus octosetaceus* Vieillot, 1817

**Common Name:** Brazilian Merganser

**Class:** AVES

**Order:** ANSERIFORMES

**Family:** ANATIDAE

### **Range:**

*Mergus octosetaceus* occurs in extremely low numbers in a few, highly disjunct localities in south-central Brazil. The strongholds are a recently discovered population on tributaries of the rio São Francisco in west Bahia, and in and (mostly) around Serra da Canastra National Park, Minas Gerais, where there were six pairs in 1996.

In Goiás, there are records from Emas and Chapada dos Veadeiros National Parks. In 1995, a small population was discovered on the rio Tibagi, Paraná, but searches in 1998 were unsuccessful. 2002, another small population was discovered on the rio Novo, in Jalapão State Park, Tocantins. It is believed to be regionally extinct in Mato Grosso do Sul, Rio de Janeiro, São Paulo, and Santa Catarina. Despite extensive surveys, there is only one recent record from Misiones, Argentina (recorded in 2002). In Paraguay, it was last recorded in 1984 and there is little (if any) habitat left. However, local reports indicate that a few individuals may still survive.

### **Population:**

The population is likely to be lower than the 250 birds estimated in 1992. The species has an extent of occurrence of 32,000 km<sup>2</sup>, but the area of occupancy is less than 2,000 km<sup>2</sup>. The range currently continues to decline.

Only six subpopulations are known with fewer than 50 mature individuals in each. The population decline is estimated at 30 to 50% in the last 10 years, with a predicted decline of 30 to 50% over the next 10 years.

### **Habitat & Ecology:**

The species inhabits shallow, fast-flowing rivers, requiring rapids and clear waters. It occurs especially in the upper tributaries of watersheds, but ranges into small rivers with patches of gallery forest surrounded by campo cerrado vegetation. Pairs have used 8 to 14 km stretches of rivers. It nests in tree-cavities and possibly rock-crevices.

The breeding season is probably June-August, but may vary geographically. The diet comprises fish, small eels, insect larvae, dobson flies (*Corydalid* sp.) and snails. In Serra da Canastra it eats mainly *Astyanax fasciatus*.

### **Threats:**

The species is threatened mainly due to perturbation and pollution of rivers resulting largely from deforestation, agricultural expansion and, in the Serra da Canastra area, diamond-mining. Mining has ceased in the immediate area in Serra da Canastra but there is no habitat available for dispersing birds. Dam building has flooded suitable habitat, especially in Brazil and Paraguay. In Argentina, hunting and collection of exhibition specimens were presumably contributory factors for threat.

### **Conservation Measures:**

The species occurs in three Brazilian national parks. There is a draft species action plan.

#### **Sources:**

BirdLife International. 2000. *Threatened Birds of the World*. Lynx Edicions and BirdLife International, Barcelona and Cambridge, UK.

BirdLife International. 2004. Species factsheet: *Mergus octosetaceus*. Downloaded from <<http://www.birdlife.org>> on 4/22/2005

<b>Assessment 7</b>	
<b>Is the taxon eligible for a Red List assessment?</b>	YES
Described species, published in 1817.	
<b>Criterion A: Declining population in the past or future?</b>	YES
Population estimates are available from 1992 and 1999. An estimated rate of decline of at least 30% over the last ten years is noted. With ongoing habitat loss and degradation, it is expected that the population will decline by at least 30% over the next ten years (VU A2c+3c). The species qualifies for Vulnerable (VU A2c+3c).	
<b>Criterion B: Small distribution, population fragmented or in few locations, and continuing decline or fluctuation?</b>	YES
Extent of occurrence does not meet the threshold for Vulnerable B1. However, area of occupancy is estimated at less than 2,000 km <sup>2</sup> (VU B2). Range is fragmented (a few, highly disjunct localities). There may also be fewer than 10 locations (only six subpopulations, with habitat loss and degradation likely to affect the populations separately) (VU B2a). Both range area and habitat continue to decline (VU B2b(ii,iii)). Therefore, the species qualifies for <b>Vulnerable</b> (VU B2ab(ii,iii)).	
<b>Criterion C: Small population size and decline?</b>	YES
The species has a very small and declining population, estimated at fewer than 250 birds (CR C). There are no more than 50 mature individuals in each of the six subpopulations (CR C2a(i) and further declines expected). The species therefore qualifies for <b>Critically Endangered</b> (CR C2a(i)).	
<b>Criterion D: Very small or restricted populations?</b>	YES
Population size is less than 250 (EN D). Although this low population size qualifies the species for <b>Endangered</b> (EN D), it has already been established above that a Critically Endangered category is merited under criterion C.	
<b>Criterion E: Quantitative analysis?</b>	NO
A quantitative analysis has not been carried out.	
<b>Conclusion:</b> The Brazilian Merganser is <b>Critically Endangered</b> <b>CR C2a(i)</b>	
Current Red List status: CR C2a(i) (2006)	

## CASE STUDY 8

**Species:** *Aspideretes nigricans* (Anderson, 1875)

**Common Name:** Black Soft-shelled Turtle

**Class:** REPTILIA

**Order:** TESTUDINES

**Family:** TRIONYCHIDAE

**Range:**

This species is only known to exist in an artificial pond (Baizid Bostami shrine) near Chittagong, Bangladesh. In 1912, its distribution was given as in between the Brahmaputra river system and the Arakan streams, but this may have been an incorrect assumption based on the distributions of *A. gangenticus*, *A. leithi*, and *A. hurum*.

**Population:**

The total population is approximately 400 individuals and is dependant upon artificial food supplied by visitors and pilgrims.

**Habitat & Ecology:**

The species is a large freshwater, soft-shelled, carnivorous turtle. Males are larger than females. The specific natural habitat of this species is not known, since it has not been recorded outside of the shrine pond.

**Threats:**

The very confined distribution, reduction of potential nesting grounds, and egg predation are major threats to its survival. Fungal infection is also suspected to be a further stress.

**Conservation Measures:**

The species is completely dependent upon food supplied by humans.

**Sources:**

Ahsan, M.F. The Bostami or Black Softshell Turtle, *Aspideretes nigricans*: Problems and Proposed Conservation Measures In: *Conservation, Restoration, and Management of Tortoises and Turtles — An International Conference*. Proceedings of the 1993 International Conference 11–16 July 1993, State University of New York, USA.

<b>Assessment 8</b>	
<b>Is the taxon eligible for a Red List assessment?</b>	YES
Description published in 1875.	
<b>General rationale:</b>	
The species is known only from one artificial pond. The species has not been recorded in the wild. Since the IUCN Categories and Criteria should only be applied to “wild populations inside their natural range, and to populations resulting from benign introductions” only, this population cannot be included in an assessment. Since it has not been recorded in the wild, it can be assumed that it no longer exists there. The species is <b>Extinct in the Wild</b> .	
<b>Conclusion:</b>	
The Black Soft-shelled Turtle is <b>Extinct in the Wild</b> <b>EW</b>	
Current Red List status: EW (2002)	
<b>IF THE ONLY KNOWN LOCATION HAD BEEN IN THE WILD, THEN:</b>	
<b>Criterion A: Declining population in the past or future?</b>	NO
No data are given for population sizes or declines. Therefore criterion A cannot be used.	
<b>Criterion B: Small distribution, population fragmented or in few locations, and continuing decline or fluctuation?</b>	YES
The area of the pond is not given. However, it can probably be assumed that extent of occurrence is <100 km <sup>2</sup> , and area of occupancy is <10 km <sup>2</sup> (CR B1+2). Only one location is known (CR B1a+2a). It is stated that there is a reduction in potential nesting ground in the area. This could be interpreted as decline in habitat quality (possibly CR B1b(iii)+2b(iii)). There is no information on fluctuations. Therefore, the species could qualify for <b>Critically Endangered B1ab(iii)+2ab(iii)</b> .	
<b>Criterion C: Small population size and decline?</b>	NO
No data are available on population size therefore criterion C cannot be used.	
<b>Criterion D: Very small or restricted populations?</b>	YES
There are no data on population size, therefore criterion D for CR or EN and criterion D1 for VU cannot be used. BUT, the species is known from only one location and area of occupancy is probably less than 10 km <sup>2</sup> (VU D2). The species qualifies for <b>Vulnerable D2</b> .	
<b>Criterion E: Quantitative analysis?</b>	NO
A quantitative analysis has not been carried out.	
<b>Conclusion: If the location was in the wild, the Black Soft-shelled Turtle would be at least <b>Vulnerable D2</b>, or at most <b>Critically Endangered B1ab(iii)+2ab(iii)</b></b>	

## CASE STUDY 9

**Species:** *Sargassum setifolium* (Grunow) Setchell

**Common Name:** String Sargassum

**Class:** PHAEOPHYCEAE

**Order:** FUCALES

**Family:** SARGASSACEAE

### **Taxonomy:**

Taylor (1945) doubted the validity of this species because it is difficult to distinguish from *S. galapagense*. He favoured varietal status: *Sargassum galapagense* var. *setifolia*. However, the species is accepted as valid by current algae taxonomists.

### **Range:**

*Sargassum setifolium* is endemic to the Galápagos Islands. Prior to 1983, it was reported from **Fernandina** (Punta Espinosa), **Isabela** (Caleta Black and Caleta Tagus), **Floreana** (Champion and Black Beach Anchorage), **San Cristobal** (Wreck Bay), **Santiago** (Bartolome), and **Santa Cruz**. Since 1983, it has been recorded only from drift material collected from Santa Cruz (Tortuga Bay in 1995) and one drift specimen collected from Isabela (Las Marielas in 2001). Currently it is impossible to tell whether these drift specimens are from populations near the collection sites or from further afield.

### **Population:**

Population trend: unknown over the past decade; decline over the past three decades. There is little information on population trends for *S. setifolium*, although in 1975 it was reported as one of the most prevalent brown algae at Punta Espinosa. At present, populations seem to be restricted to the western archipelago. Recent surveys (2000 to 2004) have failed to find populations from San Cristobal, Bartolome, and Santa Cruz. This represents a contraction of available habitat from about 20,000 km<sup>2</sup> to one small area; estimated to be substantially less than 500 km<sup>2</sup> in area of occupancy, and less than 5,000 km<sup>2</sup> in extent of occurrence.

### **Habitat & Ecology:**

The species has been reported from the low intertidal to 7.2 m depth. Nothing is known about generation length.

### **Threats:**

Presumably El Niño and climate change are the main threats to the species. Ecosystem interactions involving these two factors appear to have caused widespread decline in algal populations because of an increase in density of grazing sea urchins and other herbivores, following overexploitation of predators along with El Niño Southern Oscillation (ENSO) disturbances. The locations where this species was previously found in the central archipelago are no longer suitable *Sargassum* habitat as a consequence of herbivore overgrazing.

### **Conservation Measures:**

*S. setifolium* is present within the Galapagos Marine Reserve (IUCN category VI); Galapagos Archipelago Particularly Sensitive Sea Area (PSSA); Galapagos Island World Heritage Site (UNESCO N (i)(ii)(iii)(iv)), and Galapagos Island Man and Biosphere Reserve (UNESCO).

### **Sources:**

Global Marine Species Assessment (GMSA). 2006. Eastern Tropical Pacific Corals and Macroalgae Assessment Workshop. Galapagos Islands, Ecuador, 27-30 May 2006.

<b>Assessment 9</b>	
<b>Is the taxon eligible for a Red List assessment?</b>	YES
Although there was some doubt about the validity of this species in 1945, currently it appears to be accepted as valid. Even if this was only valid at the level of variety, the IUCN Red List does accept assessments at this level <u>provided the species-level assessment has also been done.</u>	
<b>Criterion A: Declining population in the past or future?</b>	NO
The population has clearly declined within the last 30 years: the seaweed formerly was relatively abundant (recorded from six locations), but it has only been collected once in recent years (2001) and there has been an obvious decline in suitable habitat for the species. However, nothing is known about generation length, so the appropriate time period over which to measure population declines is not known. Over the minimum time period (10 years for species with three generations being less than 10 years) the population trend is unknown. So, it is difficult to justify using criterion A under these circumstances, even though there has been an apparent dramatic reduction in population size since 1982/83.	
<b>Criterion B: Small distribution, population fragmented or in few locations, and continuing decline or fluctuation?</b>	YES
<p>The current range area is difficult to define due to the current collections being drift material rather than directly from established populations. But the area of suitable habitat available for the species has decreased: locations in the central archipelago are no longer suitable habitat because of herbivore overgrazing. Based on this, AOO is estimated as less than 500 km<sup>2</sup>, and EOO as less than 5,000 km<sup>2</sup>, which qualifies the species for <b>Endangered</b> (EN B1+2).</p> <p>The most serious threat to the species appears to be the effects of El Niño, therefore the entire range can be counted as one location (&lt;5 locations, therefore EN B1a+2a). There is also an apparent continuing decline in EOO, AOO, and habitat (EN B1b(i,ii,iii)+2b(i,ii,iii)). Nothing is known about extreme fluctuations therefore subcriterion “c” cannot be used under criterion B. The species qualifies for <b>Endangered</b> (EN B1ab(i,ii,iii)+2ab(i,ii,iii)).</p>	
<b>Criterion C: Small population size and decline?</b>	NO
There are no data available to be able to estimate population size, therefore criterion C cannot be used.	
<b>Criterion D: Very small or restricted populations?</b>	YES
There are no data available to be able to estimate population size, therefore criteria D and D1 cannot be used. However, the species has a restricted range (<5 locations) and the potential threat from El Niño is present therefore the species does meet the requirements for Vulnerable (VU D2). But, the higher category of Endangered under criterion B takes priority.	
<b>Criterion E: Quantitative analysis?</b>	NO
No quantitative analysis has been carried out.	
<p><b>Conclusion:</b>  The String Sargassum <i>Sargassum setifolium</i> is <b>Endangered</b>  <b>EN B1ab(i,ii,iii)+2ab(i,ii,iii)</b>  Current Red List status: NE (but submitted as EN B1ab(i,ii,iii)+2ab(i,ii,iii) for 2007</p>	