Review of CITES Appendixes
Based on Resolution Conf. 9.24 (Rev.)

Totoaba macdonaldi (Mexican seabass)

Prepared by Scientific Authority CITES Mexico

1.Taxonomy

1.1 Class Osteichthyes
1.2 Order Perciformes
1.3 Family Sciaenidae
1.4 Genus, Species or Subspecies, Including Author and Year.

Totoaba macdonaldi (Gilbert)

1.5 Scientific synonyms

Cynocion macdonaldi (Gilbert 1891)

1.6 Common names

They are several common names used to identify this species in the literature end of common speech

In English:	In Spanish:
Mexican seabass	Cabicucho
Tutuaba	Curvineta
mexican weakfish	Curvina piedrera
jewfish.	Abanico
	Machorro

Although it is important to say that fishermen change names from one fishing season to another, so they don't get caught, and avoid being imposed a sanction. In general when small Totoaba are caught they are sold filled as "Cabicucho or Corvina", and when large fish are caught are caught they are sold mainly as grouper.

1.7 number and codes referred in CITES

This species is listed an appendix I, but has no assigned code.

2. Biological parameters

2.1 Distribution

The original distribution for this species *(Totoaba macdonaldi)* originated from the Colorado River mouth down to "Bahía Concepción" ,on the Peninsula Coast of the Sea of Cortez, and from the same River mouth down to the river known as "Rio Fuerte" in the state of Sinaloa (on the Continental Coast) (Berdegue 1955). Totoaba, has a characteristic migration pattern, it's known that during the winter season the reproductive population occupy deep waters around the big islands in the Golf (Angel de la Guarda and Isla Tiburon) (Arvizu y Chavez 1972, Flanagan y Hendrickson 1976, Barrea-Guevara 1990) and during early spring they migrate north to the area known as the Colorado River Delta where they spawn during April

and May (Berdegue 1955). The Delta area of the high Sea of Cortez is considered the nursery and refuge for the early life stages and juveniles, and it has been designated as the "The biosphere reserve of the high Sea of Cortez and a Colorado River Delta", mainly to protect endemic an endangered species like Totoaba and the Vaquita (Diario Oficial de la Federación 1993). Juvenile Totoaba remain in this nursery habitat two or three years before they join the reproductive population and migrate south during winter (Flanagan y Hendrickson 1976). The most recent distribution for this species based on accidental fishery observations, is that the South limit corresponds to the big islands and the North limit of the distribution to the Colorado Delta area in the high Sea of Cortez.

It's from this information that we can understand that the population is divided into two large groups, one that corresponds to a breeding subpopulation that occupy the southern limit of distribution, and another subgrouping composed by larval and juvenile stages that live in the North limit in the nursery grounds.

2.2 Available habitat

Today we can consider that the distribution range for Totoaba has been considerably reduced, because the southern limit has moved North to a latitude close to the big islands. It should also be taken into consideration that during the past century the high Sea of Cortez has suffered profound modifications to its hydrological condition. Only between 1910-1920 the mean discharge from the Colorado River was around 21.4×10^9 m^3/year, and by after 1952 the water flow from the Colorado River to the Delta had diminished to only 0.8×10^9 m^3/year because of the construction of the Hoover Dam in 1934, and the Glen Canyon Dam in 1952, so after the construction the flow only represents 4% of the mean discharge between 1910-1920 (Carbajal, *et al*., 1997). This reduction in the freshwater River flow has in consequence drastically modified the hydrology of the Colorado River Delta, it's changed from a normal estuary environment (0 ppt salinity at the head of the estuary to 20 ppt salinity at the Delta) to reverse estuary condition that generates saltwater (with amenities that increase towards the Delta) (Carbajal, *et al*., 1997). The salinity of this area is no longer affected by a significant outflow of freshwater from the Colorado and it normally averages around 35-37 ppt due to the evaporation caused by the dry and warm climate of this region (Barrera-Guevara, 1990; Carbajal, *et al*., 1997; Hernández-Ayón, *et al*., 1993). Normal estuary conditions only appear during years with a very high rainfall.

The negative impact on the Totoaba population due to the diminishment of the Colorado River flow has been questioned over the years, mainly because after 40 years of flow control of this River this species is still not extinct. However, the present abundance of Totoaba should be considered with a historic perspective, because the only data available for this species corresponds to the fishery data which can only give us an idea of the relative abundance during the time the fishery was established, and will never be possible to have an historic estimate of the population size (Cisneros-Mata 1995). During the early 1900s large adult Totoaba were so abundant in the high Sea of Cortez that it was possible to spearfish them (Berdegue 1955). The commercial fishery reached its maximum in the early 1940s and declined from there on, and the flow from the Colorado River diminished significantly during the mid-1930s, and although this cannot be considered strictly as a direct cause -- effect, the possibility that the Colorado River flow control had an adverse or negative impact on the Totoaba population should be considered (Cisneros-Mata et.al 1995). It's suggested that actual abundance, is much lower than in the past, for it was required to fish during two months to capture 11 broodstock to start a captive breeding program (True *et al* 1997). It has also been shown under laboratory conditions that one-year-old juvenile Totoaba have a lesser metabolical expenditure at salinities around 20 ppt (Ortiz-Viveros 1999), which could intern indicate that the control of the Colorado River could have significant consequences on the biology of this animal.

2.3. Status of the population

To date, after the 1975 moratorium, there has not been a new census, we only have the historical data of the Totoaba fishery. The fishery started during the late 1920s, and piqued with a record of 2,000 tons in 1943, and from there on the captures diminished to only 50 tons in 1975 (FH). It was this year that a total moratorium was imposed on this resource. Cinsneros-Mata et.al (1995) have estimated that the accidental capture of juvenile Totoaba by the shrimp fishery is around 120,834/year and that poaching of Totoaba broodstock was around 6,218 in the mid-80s. The previous indicates that the Totoaba population is president, but there's no estimate of its size. Rosales-Juarez y Ramirez-Gonzalez (1987) have suggested a slight recuperation of the natural population, and Roman-Rodriguez (1994), has studied the aged structure of the natural population with otoliths, concluding that the aged structure appears to be normal, but it should be taken into account that there is a block of information missing for organisms three to five years of age. From the prior information we must understand that there is no real estimate of the current size of the Totoaba population, and although commentary and rumors among the fishermen about accidental catching is on the rise, there's no evidence that there sufficiently high to support a fishery.

2.4 Population trends

There is no quantitative information in trends that shows that the population is healthy, however, fishermen have noticed that the Totoaba's population is worst than five years ago.

2.5 Geographical tendencies

It's habitat have had a lot of changes and several damages due to the elimination of the freshwater flow from the Colorado River since the 1960s and has caused an increase in salinity changing from an estuarine environment into the evaporation basin with salinities higher than seawater near Río Colorado Delta (Flanagan & Hendrickson 1976).

2.6 Species function in the ecosystem

Totoaba, is a high-level predator in the food chain in the Sea of Cortés. Broodstock and preadults feed primarily on crab and sardines (Roman-Rodrigues 1990). The relation between Totoaba and Vaquita (*Phocoena sinus)* has been documented in literature in many different ways, the fact is that the Vaquita was caught in the Totoaba nets (Brownell 1983, Vidal 1995), and it's possible that these species could share the same food source, mainly small finish, squid and crustaceans (Roman-Rodrigues 1990,Brownell 1982). The early life stages of Totoaba (larval and juveniles) depend primarily on the productivity (primary and secondary) that takes place in the high Sea of Cortez, their survival is directly linked to the carrying capacity of this area.

2.7 reasons to be at risk

The major reasons that Totoaba is currently an endangered species, correspond to those that caused its decline: the accidental catching of Totoaba juveniles by the shrimp fishery, over fishing of the broodstock population and alteration to the nursery and reproduction area caused by the Colorado River flow control to the northern Sea of Cortez.

Two decades after 1940 the shrimp fishery evolved and because of its rapid expansion it was finally acknowledged that it had a serious impact on Totoaba (Bergague 1955), primarily because juvenile Totoaba were caught by the trawl nets of the shrimping boats in the area of the northern Sea of Cortez. As time progressed the Totoaba and the shrimp fisheries turned

into complementary activities for the fishermen (Avalos-Hernandez 1974), and a unknown number of fishermen divided their activities, fishing from October to December Shrimp and from January to March Totoaba. This way of working, switching from one resource to another is true today, fishermen still dedicated their effort towards fishing several different species that are abundant in the high Sea of Cortés, and although there is a restricted access to the biosphere reserve of the high Sea of Cortez and Colorado River Delta, enforcement is not enough to maintain control over the shrimp fishing industry and sport fishing.

The fishery for adult Totoaba was a very important activity because of the high price that the Oriental market offered for the dried swim bladder "BUCHE", which commanded $5/lb in early '50s (Berdegué 1955), this made the fishermen to develop better ways to capture Totoaba, this was at this time that the gillnet called "Totoababera" was developed, it was a cotton 8 to 10 in. mesh gill net. Although there has been a moratorium on Totoaba fishing since 1975, poaching for this species store exists, Cisneros-Mata *et.al* (1995) estimate that in the mid-1980s the legal take was 6218 finish or 161.7 metric tons, and although currently there is no estimate of the illegal fishing, there are reports of several confiscations of Totoaba by PROFEPA, which indicates that there still is a black market for this species.

The profound hydrographical changes in the high Sea of Cortez caused by the construction of the dams in Southern California, has not been evaluated to its full extent. But it's clear that today's conditions are very different from those that were present in the 1930s, the elimination of the freshwater flow from the Colorado River by the 1960s has caused an increase in salinity and changed from an estuarine environment into the evaporation basin with salinities higher than seawater (Flanagan & Hendrickson 1976). This change with no doubt has caused an impact and detriment to the environment were the Totoaba reproduce and develop. A laboratory study with one-year-old Totoaba juveniles acclimated to different salinities determined that the metabolical expenditure was lowest at 20ppt (Ortiz-Viveros, 1999) which could suggest that this species is adapted to an estuarine environment.

3. Uses and trade

3.1 National use

There's no legal commerce of this species since 1975, however, it’s know that due to demand of fish’s swim bladder and the difficulty to identify the specie, are high probabilities to find Totoaba’s swim bladder in the market.

3.2 Captive breeding or artificial reproduction related to trade

Due to foreinger’s demand is just for swim bladder, the rest of Totoaba’s body is sell in the national market, majority en the northwest of Mexico.

4. Conservation

4.1 Species management

4.1.1 Species supervision

As a first measure for protection of this species in 1974 the Mexican government established a reserve area to prohibit the fishing activities primarily by shrimping boats in the Colorado Delta area. In order to reduce the trade/commerce of Totoaba, in 1975 the Mexican government established a permanent moratorium on Totoaba fishing and 1976 it was added to the list of species in CITES, and in 1979 it was also added to the list of endangered

species of the United States, federal registry 44 (99) (Barrera-Guevara, 1990). As an additional measure in 1993 the Mexican government decreed the biosphere reserve "high Sea of Cortez and Colorado River Delta" (Diario Oficial de la Federacion 1993), with the objective to promote research, protection and sustainable use of the biodiversity and natural resources of the region, based primarily on the protection of endemic species like: Totoaba and Vaquita.

4.1.2 Habitat conservation

Together with the decreeing of the biosphere reserve "high Sea of Cortez and Colorado were Delta" there is a management plan for such reserve, put together by a interinstitutional group with the intention to establish different measures for habitat conservation and species that live in it, participants are primarily the different levels of government and research institutes of both the Sonora and Baja California states.

4.1.3 Management measures

During the past several years a captive breeding program for this species has been initiated. Starting in 1995 an initial group of 11 broodstock were caught and transported to the installations of the Autonomous University of Baja California, in which a field technique was developed to solve the decompression of this species at capture (True et. al 1997). In the following years proper methods for maturing, spawning and reproduction in captivity have been developed (That et. al. 2001). Also for the first time the early life history of the species it has been described, both for the embryo and larval development, with emphasis on feeding and development on to four-month old juveniles (Morales-Ortiz 1999, Sandoval-Garibaldi et.al 2001). To understand the physiological capacities of Totoaba and fine-tune aquaculture procedures several experiments have been done; Ortiz-Viveros (1999) described the tolerance and effect of acclimation of Totoaba juveniles to different salinities, Jacome-Ibarra (2000) evaluated the effect of sustained exercise as a measure of energy expenditure under laboratory conditions, Talamas-Rohana et.al (2001)a,b. Studied the thermal preferendum of acclimated Totoaba juveniles to different temperatures and also evaluated their energy budget with three months old Totoaba juveniles acclimated to different temperatures, also Altamirano-Garcia y Lopez (2001) have evaluated the use of commercial feed with relation to growth and biochemical composition with one-year-old juvenile Totoaba.

To date it has been possible to construct a 400 square meter state-of-the-art facility, dedicated to develop culture protocols for this species (True 1999). As a result, a pilot program to start repopulation of this species was initiated, and to date it has released a total of 2250 eight-month-old juvenile Totoaba, with the final objective of releasing 10,000 juveniles per year by the end of 2002 (True 2000).

4.2 Measures of control

4.2.1 international trade

This species is regulated by Convention on International Trade in Endangered Species of Wild Fauna and Flora, it's listed in Appendix I of CITES

4.2.2 National measures

Totoaba macdonaldi is protected by NOM-ECOL-059-94 ranked as endangered of extinction. Although, in Mexico exists a presidential act that prohibit any kind of Totoaba's capture during any season of the year.

5. Information on similar species

This species can be sold as fillet, under the synonyms of "corvina", "cabicucho" and some times as grouper.

The Oriental market for dry seafood is very important, fish swim bladders known as belly or fish Maw commands very high prices, as high as $120/kg for premium quality and $40/kg of lesser quality ((Shawneen & Dong., 1998, Richmond Ltd, 1997)). Because it is very difficult or almost impossible to identify the species or source of the swim bladders it's very likely that Totoaba swim bladder "BUCHE" could be on the market, it should be noted that the Totoaba swim bladder is of the highest quality, and that other species related to Totoaba such as (*Cynoscion phoxocephalus*) have prices around $80/kg and that it only takes two broodstock fish to obtain a kilogram of swim bladder.

As a measure that could be adopted to distinguish between Totoaba and similar species, it would be an advantage to develop genetic markers that can be applied in the field and identify Totoaba flesh and swim bladders from others. On the other hand, a photo graphical catalog with emphasis on the different presentations of similar species (primarily others Sciaenids) like; fresh fillet on ice, fresh frozen fillet, cubed or diced presentation on ice, cubed or diced presentation on ice and the whole fish without head and fins, could help as a visual aid during inspection of seafood shipments by the required agencies where documentation or revision of of such shipments occur (port landings, international frontiers, open bid markets).

6. Complementary observations

A study to compare and evaluate the genetic variability of Totoaba raised in captivity vs. the natural population has started, with the main objective to determine the possible impact caused by the release of large numbers of fish reproduced from a small captive breeding population (De la Rosa 2000).

In summary, because of the unique characteristics of this species, being endemic and also the largest member of the family, considering its habitat modifications mainly due to the change in the Colorado River flow, the clear fragmentation or natural segregation into two it distinctive groups (broodstock, early life development and juveniles), the continued poaching of this species and the incidental by catch from shrimping industry, the high prices on the international market for fish maw (Buche), the difficulty to identify Totoaba flesh and swim bladders from those of other similar fish, and the state of development of the captive breeding program; it is recommended that this species remains an appendix I.

Particularly if we consider that there is no current estimate of the natural population size, and that the captive breeding program is just starting with its release effort, and it will take several years before it will be possible to ascertain its contribution. It should be considered that Totoaba has received important protection because of the appendix I listing, and that it this protection should remain until the status of the natural population is established in order to determine if this species could be subject once more to trade, considering both the fishing aspect and the possible aquaculture development that will develop from the captive breeding program.

7. Referencias

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Part I: **Appendix I criteria**

Criteria	A The wild population is small, and is characterized by **at least one** of the following (i-v):					B The wild population has a restricted area of distribution and is characterized by **at least one** of the following (i-iv):				C A decline in the number of individuals in the wild, which has been **either** (i-ii):		D If not included in AI species would satisfy A, B or C within five years	Trade criteria At least one of the following (i-iv):				Appendix I (Y/N)	Application problems
Taxon	i	ii	Iii	iv	v	I	Ii	iii	Iv	i	ii		i	ii	iii	iv		
Totoaba macdonaldi	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	N2	Y	Y	Y	Y	

Key: Y taxon satisfies the criteria
N1 taxon does not meet the criteria: sufficient information
N2 taxon does not meet the criteria: insufficient information
N3 taxon does not meet the criteria: no information

Appendix-I biological criteria

A. The wild population is small, and is characterized by **at least one** of the following:
i) an observed, inferred or projected decline in the number of individuals or the area and quality of habitat; or
ii) each sub-population being very small; or
iii) a majority of individuals, during one or more life-history phases, being concentrated in one sub-population; or
iv) large short-term fluctuations in the number of individuals; or
v) a high vulnerability due to the species' biology or behaviour (including migration).

B. The wild population has a restricted area of distribution and is characterized by **at least one** of the following:

i) fragmentation or occurrence at very few locations; or

ii) large fluctuations in the area of distribution or the number of sub-populations; or

iii) a high vulnerability due to the species biology or behaviour (including migration); or

iv) an observed, inferred or projected decrease in any one of the following:

– the area of distribution; or
– the number of sub-populations; or
– the number of individuals; or
– the area or quality of habitat; or
– reproductive potential.

C. A decline in the number of individuals in the wild, which has been **eithe**r:

i) observed as ongoing or as having occurred in the past (but with a potential to resume); or

ii) inferred or projected on the basis of any one of the following:

– a decrease in area or quality of habitat; or
– levels or patterns of exploitation; or
– threats from extrinsic factors such as the effects of pathogens, competitors, parasites, predators, hybridization, introduced species and the effects of toxins and pollutants; or
– decreasing reproductive potential.

D. The status of the species is such that if the species is not included in Appendix I, it is likely to satisfy one or more of the above criteria within a period of five years.