Seafood Watch
Seafood Report

MONTEREY BAY AQUARIUM®

Chilean Seabass

Patagonian Toothfish
(Dissostichus eleginoides)

Antarctic Toothfish
(Dissostichus mawsoni)

Final Report

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About Seafood Watch® and the Seafood Reports

Monterey Bay Aquarium's Seafood Watch® program evaluates the ecological sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch® defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. Seafood Watch® makes its science-based recommendations available to the public in the form of regional pocket guides that can be downloaded from the Internet (seafoodwatch.org) or obtained from the Seafood Watch® program by emailing seafoodwatch@mbayaq.org. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Each sustainability recommendation on the regional pocket guides is supported by a Seafood Report. Each report synthesizes and analyzes the most current ecological, fisheries and ecosystem science on a species, then evaluates this information against the program's conservation ethic to arrive at a recommendation of "Best Choices", "Good Alternatives", or "Avoid". The detailed evaluation methodology is available upon request. In producing the Seafood Reports, Seafood Watch® seeks out research published in academic, peer-reviewed journals whenever possible. Other sources of information include government technical publications, fishery management plans and supporting documents, and other scientific reviews of ecological sustainability. Seafood Watch® Fisheries Research Analysts also communicate regularly with ecologists, fisheries and aquaculture scientists, and members of industry and conservation organizations when evaluating fisheries and aquaculture practices. Capture fisheries and aquaculture practices are highly dynamic; as the scientific information on each species changes, Seafood Watch's sustainability recommendations and the underlying Seafood Reports will be updated to reflect these changes.

Parties interested in capture fisheries, aquaculture practices and the sustainability of ocean ecosystems are welcome to use Seafood Reports in any way they find useful. For more information about Seafood Watch® and Seafood Reports, please contact the Seafood Watch® program at Monterey Bay Aquarium by calling (831) 647-6873 or emailing seafoodwatch@mbayaq.org.

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Table of Contents

I. Executive Summary

Two species of toothfish are marketed in the U.S. as "Chilean seabass." Both inhabit deep waters of the Southern Ocean surrounding Antarctica. Both have natural lifespans of several decades and are slow-growing species with low fecundity. Despite efforts by an international management body, the fishery is plagued with high levels of illegal and unreported fishing. There is international concern that the resource is seriously overfished. There are also grave concerns about bycatch of seabirds, including endangered albatrosses, in the bottom longline fishery.

A portion of this fishery – the South Georgia Patagonian toothfish longline fishery and the Ross Sea Toothfish longline fishery – are certified as sustainable to the standard of the Marine Stewardship Council (MSC). The MSC is an independent non-profit organization that has developed an environmental standard for sustainable and well-managed fisheries. It uses a product label to reward environmentally responsible fishery management and practices (http://www.msc.org/). This report does not specifically evaluate the MSC-certified portions of the Chilean seabass fishery; therefore, this recommendation applies only to the portions of the fishery that are not certified (see Appendix I).

Table of Sustainability Ranks

	Conservation Concern			
Sustainability Criteria	**Low**	**Moderate**	**High**	**Critical**
Inherently Vulnerability			√	
Status of Stocks		√		
Nature of Bycatch				√
Habitat Effects			√	
Management Effectiveness				√

About the Overall Seafood Recommendation:

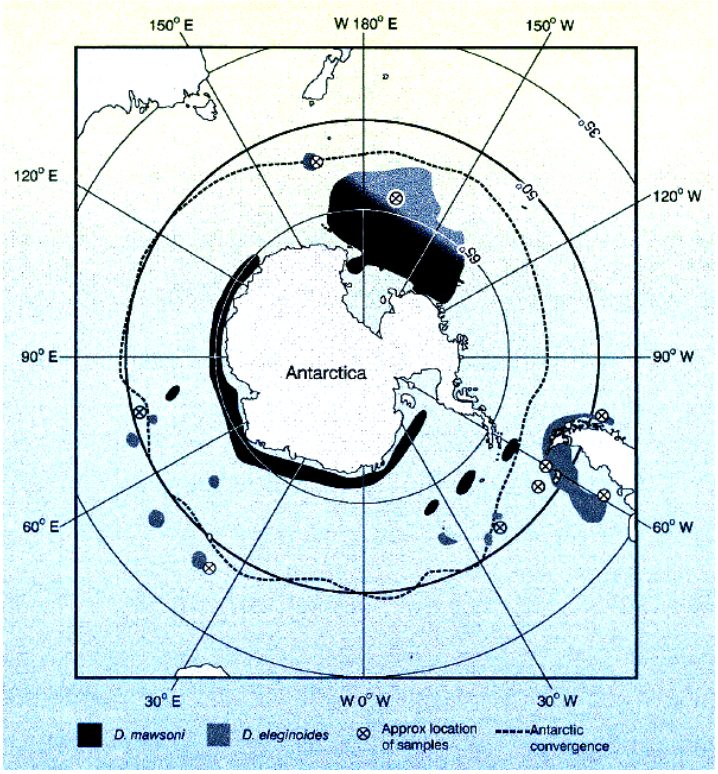
- A seafood product is ranked Best Choice if three or more criteria are of Low Conservation Concern (green) and the remaining criteria are not of High or Critical Conservation Concern.
- A seafood product is ranked **Good Alternative** if the five criteria "average" to yellow (Moderate Conservation Concern) OR if the "Status of Stocks" and "Management Effectiveness" criteria are both of Moderate Conservation Concern.
- A seafood product is ranked **Avoid** if two or more criteria are of High Conservation Concern (red) OR if one or more criteria are of Critical Conservation Concern (black) in the table above.

Overall Seafood Recommendation:

Best Choice | Good Alternative | **Avoid**

I. Introduction

Scientific Names:
Patagonian toothfish, *Dissostichus eleginoides*
Antarctic toothfish, *Dissostichus mawsoni*



Map 1: Range of *D. mawsoni* (black area) and *D. eleginoides* (blue area). *Source: NEPA*

While Patagonian toothfish are generally found further north than Antarctic toothfish (Map 1), the ranges of the two species overlap between New Zealand and Antarctica [2]. Both species are suspected to make seasonal migrations [58], further mixing their ranges.

Species Biology:
Two closely-related species known as the Patagonian toothfish and the Antarctic toothfish live in the remote Southern Ocean. Both have sharp teeth [1] and both are marketed in the U.S. as "Chilean seabass" (21). They are not related to the true sea basses (family Serranidae) [14]. Thought to descend from deepwater benthic fishes that lacked swim bladders [5], toothfishes have evolved to re-colonize the water column.

They have unusual adaptations to achieve neutral buoyancy, including lightly-mineralized bones and abundant lipids in their flesh [4]. The largest predatory fishes in the midwaters of the Antarctic Ocean [4, 5], toothfishes are heavily muscled with white, "slow-twitch" muscle tissue used for short bursts of speed [5; 58]. The combination of firm, white musculature and oil-rich flesh has made "Chilean Sea Bass" popular with U.S. chefs and diners [13].

Patagonian Toothfish, *Dissostichus eleginoides*

The Patagonian toothfish is a midwater species occasionally found on the seafloor [1]. *D. eleginoides* ranges throughout the southernmost portions of the Atlantic, Pacific, and Indian Oceans, with commercially-exploited stocks being found off southern Chile, Patagonia, the Falkland Islands, South Georgia Island, and Macquarie Island [1]. This species occurs mostly in latitudes between 40˚ and 60 ˚south (DeWitt et al 1990, as cited in [2]). The Patagonian toothfish has been taken in bottom trawls at depths between 70 and 1500 meters [1]. It is not found in water colder than 2˚C and lacks antifreeze (Eastman, as cited in [1]). Larvae first feed on krill and gradually shift to fishes as they grow [1]. The diet of adults consists of fishes and an Antarctic bay shrimp (*Crangon antarcticus*) [1].

Patagonian toothfish are thought to reach sexual maturity at 9-10 years of age and about 90-100 cm in length [1]. Eggs are few [11] and both eggs and larvae are large [1, 9]. Patagonian toothfish share with most Antarctic fishes a reproductive strategy characterized by low fecundity and large egg size [11], indicating a relatively large maternal investment in each egg. Chikov and Melnikov (1990) found that individual mature females contained between 48,900 and 528,900 eggs; larger females produce significantly more eggs per gram of body weight [11]. In the Atlantic sector of the southern ocean, Patagonian toothfish spawn over the continental slope from June to September, in water 2200-4400 meters deep [9]. Their peppercorn-sized* eggs float in the midwater about 500 meters below the surface [9]. It is believed that the larvae hatch from these pelagic eggs after approximately 3 months [9].

Occasionally, Patagonian toothfish are found well north of their native range. A single Patagonian toothfish was caught off the Atlantic coast of Uruguay, some 6,000 miles (9657 km) north of Antarctica [55]. In 2000, another Patagonian toothfish was caught off the west coast of Greenland [55]. Such long-distance travels by this cold-water fish lead scientists to speculate that there may be a very cold, deepwater current running beneath the warm waters at the Equator. The existence of such a transequatorial current could explain not only the survival of these anomalous toothfish, but also the occurrence of certain coldwater species in both the Arctic and Antarctic oceans [55].

While age-validating techniques are still being explored, recent research suggests that Patagonian toothfish can live at least 40 years [3]. Like many other deepwater fishes, they seem to put on most of their size in their first decade and grow more slowly after that. In 2000, a sampling of 177 Patagonian toothfish caught near South Georgia seemed to bear this out: fish less than 90 cm in length were generally younger than 10 years; fish 90-110

cm ranged from 8 to 37 years old [3]. Individuals ranged from a 56-cm fish that was 2.5 years old to a 170-cm fish that was 42 years old [3].

Antarctic Toothfish, *Dissostichus mawsoni*

The Antarctic toothfish is found only around mainland Antarctica, its range circumpolar at latitudes south of 60˚ (DeWitt et al. 1990, as cited in [2]). *D. mawsoni* is usually caught near the bottom in depths of 88-1600 meters [1]. It is thought to make long migrations from its feeding grounds at the continental edge to its spawning grounds near the Antarctic Polar Front [19]. It has an antifreeze chemical in its blood [8] and thrives at mean annual water temperatures of –1.9˚C [6]. Antarctic toothfish feed mostly on midwater fishes and mysid shrimps, though in some areas they also take large amounts of squid [5]. Although little is known of their role in the food web [5], they are eaten by orcas and Weddell seals [5,16] and have been found in the stomachs of sperm whales [15,19]. One Weddell seal observed for 18 days in McMurdo Sound ate approximately 150 lbs. of Antarctic toothfish per night [16].

Image 1: An Antarctic toothfish, *D. mawsonii*, weighs in at 120 pounds. Photo by Kev Hoefling, courtesy Luke Hunt—used with permission.

Mark and recapture studies of 5,000 Antarctic toothfish between 1972 and 1988 suggested sexual maturity at 8-9 years [17]. Juveniles are marked with a barred pattern that fades with age [1]. They grow slowly—about 2 cm and 2 pounds per year [17]. One 130-lb. fish was approximately 30 years old [17]. They can reach at least 205 lbs. in McMurdo Sound [18]. In 1988, DeVries noted that "juvenile and immature fish are of a catchable size (90 cm, 20 lbs); commercial fishing would therefore have a significant adverse impact on the stock" [17]. As with *D. eleginoides*, the eggs of *D. mawsoni* are about the size of peppercorns; they take two years to mature inside the female before being released and fertilized [19].

Statement on the Availability of Science
Researchers are just beginning systematic study of these singular fishes and their remote habitat. Life history, age at maturity, population structure, and other basic measurements required for effective and sustainable management remain largely unknown [3].

Antarctica is unique in that no nation holds sovereign rights to its land mass. The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) is an international body created to monitor and regulate exploitation of marine resources in the Antarctic region [22]. Created in 1982, this body's Scientific Committee conducts research on toothfish and collects catch and effort data from fishing vessels of the 24 CCAMLR member nations. CCAMLR also conducts independent fisheries research and estimates the abundance of harvested species via acoustic surveys and trawl surveys [22].

Accurate age data is critical for effective management of any fishery [10,24]: knowledge of age structure is fundamental for estimating a stock's growth rate and for modeling its population dynamics and productivity [3]. CCAMLR's current stock assessments of *D. eleginoides* rely heavily on age and growth information [10]. Such basic management parameters as length-at-age and recruitment rate are based on estimates of toothfish age [10].

Recent questions about the sustainability of the fishery have led to new interest in how to tell the age of a toothfish [10]. Scientists often attempt to calculate the age of a fish by counting growth rings on body scales. This is a convenient method, as scales can be easily obtained and the fish can be released for further growth and study [3]. However, recent research reveals that this method can result in underestimates of the age of long-lived fishes, as the scale rings become compressed with increasing age, making them indiscernible [3]. A more accurate but more invasive method is to count growth rings on the ear bones (otoliths). To obtain otoliths, the fish must be dissected. While it is not yet certain that toothfish lay down an otolith ring each year [10], it is presumed to take at least one year for each ring to form.

As recently as 2000, the CCAMLR used age data based on both otoliths and scales in its management models [10], sometimes combining estimates obtained by both methods [10]. Concerned about the variabilities and uncertainties in the data, the CCAMLR Working Group on Fish Stock Assessment encouraged researchers to compare the two methods [3, 10]. When scales and otoliths are taken from the same fish, scale data tends to significantly underestimate the individual's age [3], especially in larger, older fish [3]. One researcher concluded that the difference between the two methods becomes significant in fish older than 16 years (Young et al. 1995, as cited in 3).

Stock Structure:
D. eleginoides occurs in the Southern Ocean and on the South American Plateau. Within the Southern Ocean, populations are scattered around various islands and seamounts [20]. In 2000, genetic analysis carried out by New Zealand's National Institute of Water and Atmospheric Research (NIWA) indicated major genetic differences between Southern

Ocean populations and those of the South American Plateau. The Antarctic Polar Front seems to cut off gene flow between the two populations. Furthermore, significant differences were found between populations around Southern Ocean islands. The authors conclude that the *D. eleginoides* population is comprised of several geographically and genetically distinct stocks, which ought to be managed separately [20].

Before 1990, some had claimed that *D. eleginoides* taken in the South Georgia fishery were senescent and no longer contributing to the breeding population [49]. In 1990, examination by CCAMLR-affiliated scientists showed this to be false [49]; after reaching adulthood, toothfish continue to breed all their lives, and the largest females produce the most eggs [9,11].

Although *D. mawsoni* has been less studied, there is genetic evidence that its circumpolar population is a single stock [22*; 57].

Market Information

Market Names: Both *D.eleginoides* and *D. mawsoni* are marketed in the United States as "Chilean Sea Bass". They may also be called Antarctic cod, black hake [43], Antarctic or Patagonian blenny, and icefish [12, 19].

In 2002, the North Pacific Corporation of Kirkland, Washington, a commercial fishing corporation, began marketing a north Pacific flatfish as "Pacific Seabass™, the Non-Endangered Replacement for Chilean Seabass™" [56]. Also called snow fish, this fish is described in industry literature as a hybrid between the Kamchatka flounder *Atherestes evermanni* and the Greenland halibut *Reinhardtius hippoglossoides* [56]. Seafood Watch has discovered little about this species, other than that it is caught with bottom longlines in the Sea of Okhost [56].

Seasonal Availability:
"Chilean Seabass" is available year-round. Actual fishing is concentrated in May-July, during the Antarctic winter [35].

Product Forms:
Patagonian toothfish is sold in the U.S. as frozen whole fish (headed and gutted), frozen fillets, and fresh fillets [21]. Antarctic toothfish is available only as frozen whole fish and frozen fillets [21].

Import/Export Sources and Statistics:
There is no U.S. fishery for toothfishes, so all "Chilean Seabass" appearing in U.S. markets is imported [21]. In 2003, the U.S. imported approximately 9,820 metric tons of toothfish (Patagonian and Antarctic combined), worth approximately $103 million [21]. Major source

nations included Argentina, Chile, New Zealand, Seychelles, and Uruguay [21]. This is down slightly from 2002, when the U.S. imported about 10,463 metric tons of toothfish, worth $101 million. However, note that the price per pound rose between 2002 and 2003.

Table 1: U.S. toothfish imports, 1998-2003

Year	Metric Tons	Worth, Million $U.S.
1998	5,552	30
1999	6,771	60
2000	9,530	93
2001	9,620	88
2002	10,463	101
2003	9,820	103

Data source: NMFS Statistics, 2004 [21]

Because toothfish appeared on the international market only recently, NMFS import-export records only go back to 1998 [21]. Since then, imports have increased every year (Table 1).

Consumption Trends:
Worldwide, the major markets for the toothfishes are the United States and Japan, with Canada and the European Union also importing significant quantities [35].

Breaking onto the restaurant scene in the early 1990's, "Chilean Sea Bass" quickly became a best-seller in the United States [41]. It is now firmly established as an upscale restaurant favorite—about 70% of the toothfish sold in the United States goes to restaurants [29].

II. Fishery Information

Fishery Range and Distribution:
Because of their remote habitat, the toothfishes were not commercially exploited until the late 1990's [24, 22, 35]. While both species are marketed as Chilean Sea Bass, about 95% of these are Patagonian toothfish (*D.eleginoides*), only 5% being Antarctic toothfish (*D. mawsoni*) [35].

Both species are fished in the area south of New Zealand where their ranges overlap. This commercial fishery has been developing since the mid-1990's [2]. In 2000, reported landings for this area were approximately 750 mt, primarily identified as Antarctic toothfish [2].

Patagonian toothfish are fished along the southern shelf of South America, and wherever they can be located in the Antarctic and subantarctic (Figure 3). South Africa's fishery has been developing since 1997 [47]. The Australian fishery is concentrated around

Macquarie, Heard, and McDonald Islands [38, 39]. Australia was still discovering new fishing grounds within its territorial waters as late as 1997 [39].

Figure 1: Map of the Southern Ocean showing principle fishing grounds for Patagonian toothfish, *D.eleginoides*. *Source: TRAFFIC, 2001*

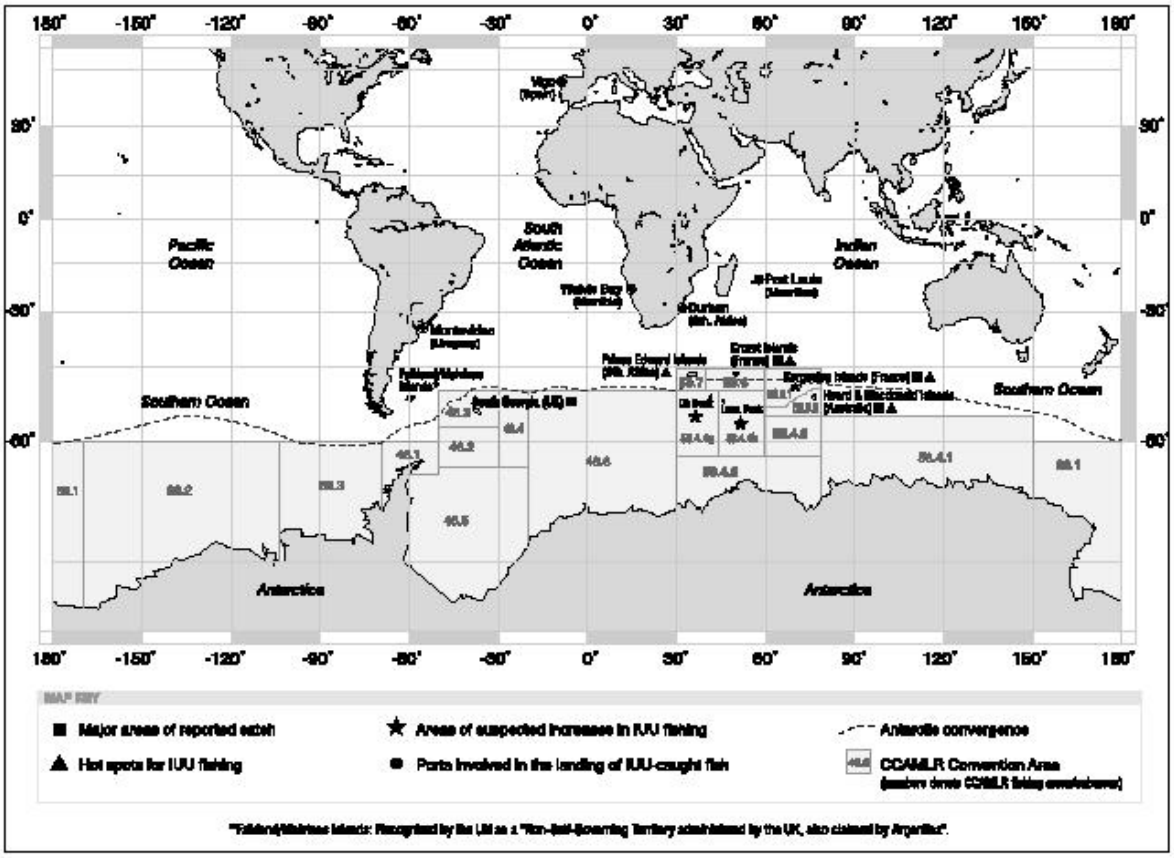


Figure 1. Map of the Southern Ocean showing principal Patagonian Toothfish fishing grounds. *Map created by: hiwire.com.au*

Fishing Methods:

Most toothfish is taken by bottom longlines [35]. Some is taken by demersal trawling. A small amount of Australia's South Georgia catch is taken by traps [32].

The rapid expansion of the toothfish fishery in the early 1990s is linked to the introduction of new longlining techniques [24], which allowed fishers to work deeper, rougher waters. At least one shipbuilding firm, Fiskevegn, produces longline vessels specially outfitted for toothfish longlining and processing [48].

Seabirds, including petrels and albatrosses, approach toothfish longline vessels to eat the bait [42]. They sometimes get caught on hooks and are dragged underwater and drowned [42]. Several of these species, including the wandering albatross and grey-headed albatross, are internationally endangered. Conservationists fear the impact of this kill on the survival of these wide-ranging, slow-breeding birds [44]. CCAMLR recommends

several practices to limit the impact of longlining: setting the lines at night, rather than during the day when birds are most active [42,45]; starting the fishing season after March 1, when most birds are done breeding; dumping any fish offal so as to lure birds away from the vicinity of the hooks and lines; and deploying plastic streamers to scare birds away from the danger [45]. CCAMLR also requires an international observer on each boat [45]. Australia has banned longlining for toothfish within its EEZ to protect seabirds [38, 35]; all of its catch is taken by demersal trawl [38]. In 2001, seven fishing nations (Australia, Brazil, Chile, France, Peru and the United Kingdom) signed an agreement to mitigate the impacts of longline fishing on albatrosses and petrels [43]. However, CCAMLR and environmentalists agree that illegal longlining still takes a heavy toll on seabirds [44,45].

Fishing Effort and Trends:

The toothfish fishery is in the midst of a "boom" phase that began in the early 1990's [35]. A major issue is illegal, unregulated and unreported ("IUU") fishing . Toothfish is very valuable on the world market, and its habitat is remote and vast. International bodies define "illegal" fishing as commercial catch that takes place at times and in places closed by fisheries management plans, ignoring approved fishing methods, catch limits, and/or conservation practices [35]. Although the fish is caught in violation of management rules, the tonnage caught is often included in landings reports, with the origin of the fish hidden or undisclosed."Unreported" fishing is fishing never included in landings reports[35].

Fourteen nations reported legal catches of toothfish in 2000 [35]. These include Australia, Argentina, Chile, France, South Africa, the United Kingdom, New Zealand and Japan [35]. Many of these catch toothfish only in the CCAMLR region, but Chile and Australia each have toothfish grounds within their own territorial waters [52].

An analysis by TRAFFIC, a U.N.-affiliated, independent trade monitoring organization, estimated the 1999-2000 worldwide trade in toothfish at 59,000 mt [35]. For 2000, CCAMLR's catch quota was approximately 13,634 mt [52]. The legal catch reported by Chile and Australia (outside CCAMLR waters) totalled approximately 12,000 mt [52]. That leaves an estimated 33,000 mt of toothfish caught illegally in 2000 (Figure 2) [35].

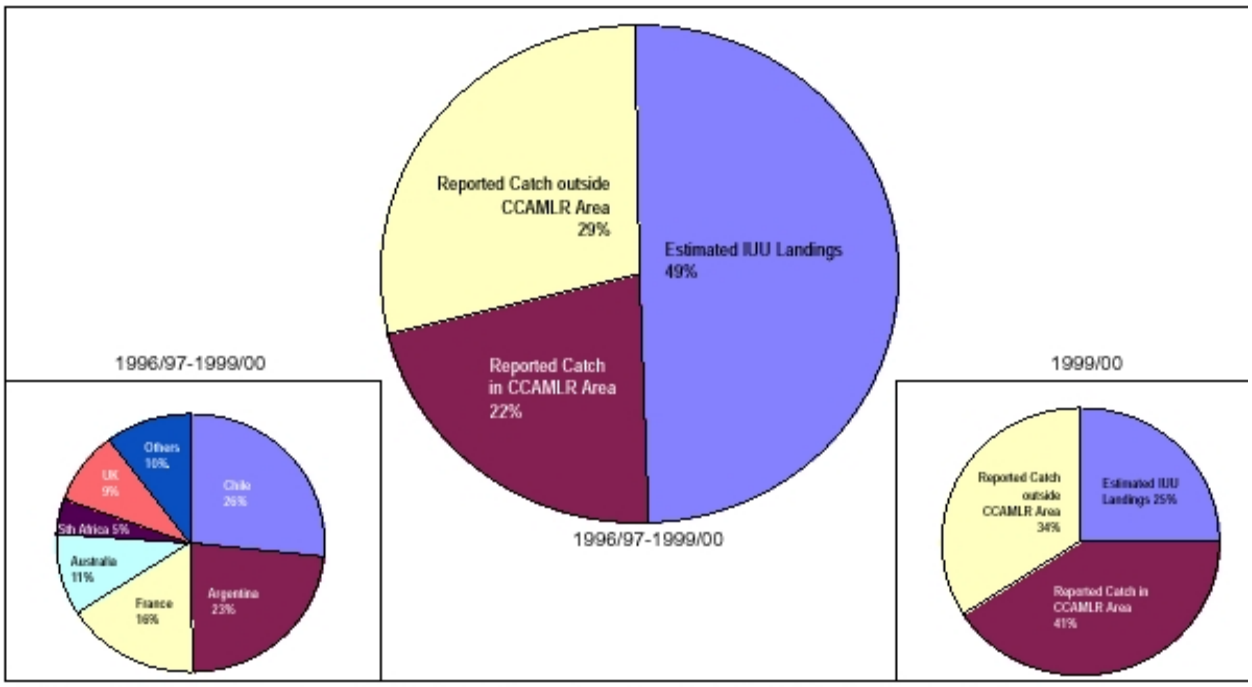


Figure 2. CCAMLR-reported and -estimated catch of Patagonian Toothfish, 1996/97 to 1999/00.
Sources: CCAMLR, 1998b, 1999d, 2000d and 2000e

Illegal and Unreported (IUU) Fishing

Illegal fishing supplies an increasing percentage of "Chilean Sea Bass" on world markets (Figure 4). Australia's legal catch quota is 2,900 mt/year, but, in 2003, Australian enforcement agencies estimated that 2,000 mt **per month** were fished illegally from Australian waters [59]. Eleven nations are identified by TRAFFIC as involved in the illegal trade [35]. TRAFFIC reports that the illegal fishery is dominated by Spanish-owned fishing interests which employ vessels registered through "flag-of-convenience" states, such as Panama,Vanuatu and Belize [35,37]. The Chilean fishing industry is alleged to be heavily involved in the illegal trade in toothfish [40]. A good deal of illegal fishing is reported from the Indian Ocean sector of the subantarctic [35, 39, 38], including areas around Heard and MacDonald Islands [38]. Ports known to support offloading of illegally-caught toothfish include Walvis Bay, Namibia [37]; Port Louis, Mauritius[37]; Montevideo Port, Uruguay [40]; and many ports in southern Chile [40].

It is often difficult to ascertain the origin of toothfish once it reaches the world market. China imports, processes, and re-exports large amounts of toothfish; toothfish labelled as Chinese imports may originate from many sources [35]. In addition, the practice of transshipment at sea is on the rise: toothfish is transferred from vessels of one nation to another far from any port [35, 40].

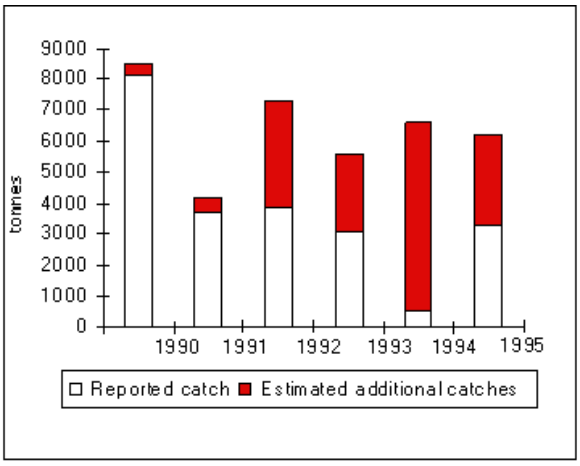


Figure 3: Legal (white) and estimated illegal (red) toothfish catches, 1989-1995. *Source: CCAMLR*

Management of the Stocks:

Antarctica is unique in that no nation holds sovereign rights to its land mass. The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) is an international body created to monitor and regulate exploitation of marine resources in the Antarctic region [22]. As most Patagonian toothfish habitat--and all Antarctic toothfish habitat--lies within CCAMLR's zone of influence[22], CCAMLR is the world's primary toothfish management body.

Created in 1982 as part of the Antarctic Treaty System [23], CCAMLR now has a total of 31 signatories: 24 member nations (Argentina, Australia, Belgium, Brazil, Chile, European Community, France, Germany, India, Italy, Japan, Republic of Korea, Namibia, New Zealand, Norway, Poland, Russian Federation, South Africa, Spain, Sweden, Ukraine, United Kingdom, United States and Uruguay) and seven states that have ratified the Convention but have not chosen to become Members of the Commission (Bulgaria, Canada, Finland, Greece, the Netherlands, Peru and Vanuatu) [23].

CCAMLR embraces a precautionary approach to fisheries management, aiming to ensure that exploitation does not harm the long-term viability of individual species or the Antarctic ecosystem [22]. Its authority extends from the shores of Antarctica to the edge of the Antarctic Polar Front, an oceanographic feature located at about 60˚south latitude where cold, low-salinity Antarctic ocean water meets warmer, saltier water descending from the tropics [22].

CCAMLR has a suite of progressive measures in place to conserve toothfish stocks within its zone of authority [52]. These include:

- a minimum trawl-net mesh size of 120 mm (in place since 1985)
- a 1991 provision that member nations must conduct an environmental-impact review before undertaking new toothfish fisheries
- a 1996 provision halting discards of plastic packing bands from fishing boats (to halt "substantial" entanglements of Antarctic fur seals)

- closures of areas south of Australia to longlining in order to protect seabirds
- closure of areas south of the Indian Ocean to demersal trawl to protect demersal crabs
- a 2001 crackdown on "flag-of-convenience" vessel registration via stricter licensing and inspection obligations [52].

Chile and Australia are responsible for toothfish fisheries in their own territorial waters north of CCAMLR's zone of authority.

Monitoring:
CCAMLR collects catch and effort data from the logbooks of fishing vessels of all nations that have ratified the CCAMLR treaty [22]. CCAMLR also places observers on member nations' fishing vessels to check compliance with conservation measures [22, 45]. CCAMLR conducts independent fisheries research and estimates the abundance of harvested species via their own acoustic and trawl surveys [22].

CCAMLR states that this system is widely adhered to by its 31 signatory nations [22]. Until recently, only CCAMLR nations fished south of the Antarctic Polar Front. However, in recent years, non-CCAMLR nations have begun exploiting toothfish in this area. CCAMLR itself admits that its effort to manage the toothfish fishery is confounded by a recent increase in illegal and unreported fishing by non-CCAMLR nations [22]. Additionally, some authorities identify CCAMLR member-nation Chile as a major participant in the illegal trade[40], on top of its leading role in the legal trade.

Since 1997, CCAMLR has adopted a number of new measures designed to stem illegal and unreported fishing. These include annual catch quotas; requirements that vessels carry satellite-linked Vessel Monitoring Systems, or VMS, that allow authorities to track the movements of ships; requirements that all fishing gear be marked so that the vessel it came from can be identified; and a requirement that each member nation license each fishing vessel that carries its flag [41, 52].

In 2000, CCAMLR created a chain-of-custody system designed to stem international trade in illegally-caught toothfish [23]. Called the Catch Documentation Scheme (CDS), this system involves documents designed to be started by fishing captains, completed by exporting customs officials and checked by importing customs officials [30]. According to CCAMLR, the aims of the CDS are fourfold [22]:
1. to monitor the international toothfish trade
2. to identify the origin of toothfish imports and exports
3. to determine which toothfish in the market have been caught in accordance with CCAMLR conservation measures
4. to gather catch data for scientific evaluation of toothfish stocks.

To align its data collection with toothfish breeding ecology [10], CCAMLR reports annual catch data from July 1 of one year to 30 June of the next [35]. Unfortunately, this puts CCAMLR annual catch reports somewhat out of line with the standard "trade year" of Jan 1-Dec.31. Since toothfish fishing takes place mainly May-July, and since considerable time can elapse before fillets frozen at sea are brought to market, some

monitoring organizations believe toothfish catch data should be compared with the following year's trade data [35].

Enforcement:
Like other international fishing agreements, CCAMLR does not enforce regulations. CCAMLR signatory nations are responsible for making sure their own fishing vessels adhere to CCAMLR policy [22, 52]. And, despite the progressive nature of CCAMLR's management regime, the rules are only enforceable upon CCAMLR signatories [52]. CCAMLR has no independent authority to enforce the law upon non-CCAMLR nations.

Chile and Australia are responsible for enforcing fishing regulations within their territorial waters. Australia is making it known that it takes this responsibility seriously. When illegal fishing can be proven, fishing captains are fined and their vessels are confiscated [54]. Australia seized illegal toothfish vessels in its waters in 1997 and 2000, including the 2000 capture of a Togo-registered vessel after a 14-day chase from Australia to South Africa [54]. In February 2002, the Australian navy captured two Russian vessels fishing toothfish illegally off Heard Island [53]. Some of the difficulties of toothfish enforcement are revealed in details of the story. To make the captures, armed Australian troops and fisheries officials were lowered from helicopters onto the Russian vessels in hazardous conditions of extreme cold and rough seas. The Australian enforcement personnel met resistance from the Russian crews [53]. One of the Russian vessels had previously been trailed for two weeks by an unarmed Australian fisheries patrol vessel, which was forced to give up the chase when it ran low on fuel [53, 54]. In August 2003, Australia sought international help to apprehend a Uruguayan vessel (the Virasa) after an 11-day chase across the southern ocean [59]. In November 2003, Australia raised its fine for illegal fishing from Au$550,000 to Au$835,000, and made convicted vessels liable for all costs of pursuit [60]. Also in November 2003, Australia led an international effort with six other nations to install and test satellite tracking devices on fishing boats, in order to help curb illegal fishing in remote areas [60].

CCAMLR's toothfish Catch Document Scheme has been in place only since May 2000 [30]. It is not yet clear how successfully it is being enforced, or what effect it has had on international trade.

Trends/Status of the Stocks:
Despite the innovations introduced by CCAMLR, illegal toothfish harvest continues unabated [35]. At the November 2003 CCAMLR meeting, data was presented suggesting that toothfish abundance has been over-estimated in CCAMLR's past stock assessments [Bruchman, 2004]. In 2003, CCAMLR cut its allowable catch by 20% to attempt to compensate [Bruchman, 2004], although some models suggested that, to produce a truly sustainable harvest, the catch limit would have to be reduced by 75% [Bruchman, 2004].

While fish importers and wholesalers hail CCAMLR's new CDS system as proof that all toothfish imported into the U.S. are now legally caught [31], questions remain about the legitimacy of imports. The U.N.'s independent trade-monitoring organization TRAFFIC

reports that, to beat the new system, toothfish are being trans-shipped at sea and landed under different species names [35].

ASOC has called for a complete ban on toothfish fishing [36]. TRAFFIC does not go that far, but suggests regulating the fishery under the relatively strict provisions of the international Convention on Trade in Endangered Species (CITES) [35].

III. Seafood Watch Recommendation

Fisheries scientists have argued that heavy exploitation of slow-growing, low-fecundity deep-sea species is inherently unsustainable [50,51]. The history of large-scale deep-sea fisheries has been a "boom-and-bust" pattern of rapid development, resource depletion, and very slow recovery [50]. As such species, the two toothfishes would appear to be poor candidates for sustainable large-scale exploitation. Both species of toothfish grow slowly, reach sexual maturity after they reach market size, and live in a fragile ecosystem. All of these factors make them inherently vulnerable to overfishing. It is questionable whether large-scale exploitation of such a species could ever be considered sustainable. Add to this the heavy levels of illegal fishing and the bycatch of seabirds (including endangered albatrosses), and you have a fishery that could possibly be called a worst case. Overall, the Seafood Watch® recommendation for Chilean seabass is **Avoid**.

Table of Sustainability Ranks

	Conservation Concern			
Sustainability Criteria	**Low**	**Moderate**	**High**	**Critical**
Inherently Vulnerability			√	
Status of Stocks		√		
Nature of Bycatch				√
Habitat Effects			√	
Management Effectiveness				√

Overall Seafood Recommendation:

Best Choice | Good Alternative | **Avoid**

IV. Acknowledgements

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Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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VI. Appendix I: MSC certification of a subset of the Chilean seabass fishery

The Marine Stewardship Council (MSC) certified the South Georgia Patagonian toothfish (Chilean seabass) bottom longline fishery in 2004. This fishery operates around a chain of islands off the tip of South America in the Antarctic region. In 2010, the MSC certified another portion of the Chilean seabass fishery, the Ross Sea toothfish longline fishery.

The National Marine Fisheries Service has initiated a strict documentation program to ensure that all shipments of Patagonian toothfish can be tracked back to legal sources. However, according to a recent report (*High Seas Task Force (2006). Closing the net: Stopping illegal fishing on the high seas*) the United States inspects only 2% of the 6 million containers of seafood that are imported into our country every year (page 30 of the report).

Currently there are two MSC-certified Chilean seabass fisheries (visit www.msc.org for more information), the Ross Sea toothfish longline fishery and the South Georgia Patagonian toothfish bottom longline fishery. Seafood Watch® recommends that, if purchasing Chilean seabass, consumers look specifically for Chilean seabass labeled with the blue and white MSC label to avoid any confusion with the non-certified product that is widely available in the marketplace. Any Chilean seabass not from an MSC-certified fishery falls under the Seafood Watch recommendation to consumers and businesses to avoid until issues of illegal, unregulated, and unreported fishing are fully addressed.

This report was amended in March 2011 to reflect the MSC certification of the Ross Sea Toothfish Longline fishery, which occurred in November 2010.