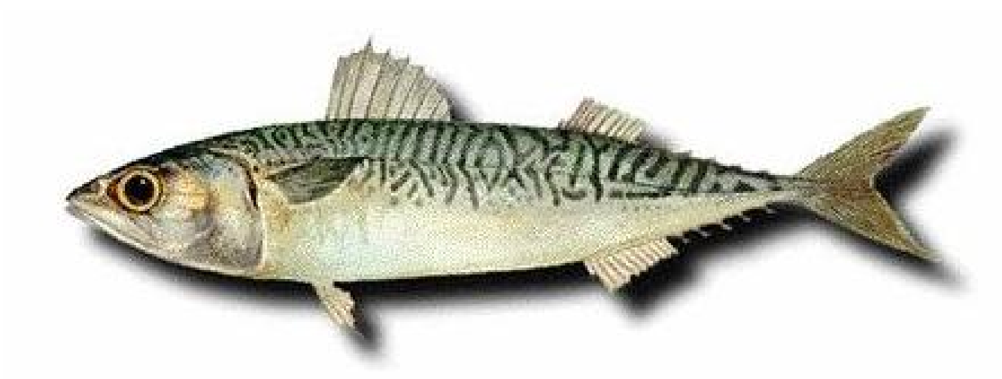
Information describing chub mackerel (*Scomber japonicus*) fisheries relating to the South Pacific Regional Fishery Management Organisation



WORKING DRAFT
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1 Overview

Scomber japonicus, Houttuyn, 1782, has a widespread pelagic distribution, primarily coastal. It also occurs to a lesser extent in the epi-pelagic and meso-pelagic over the continental slope. In the South Pacific the species is generally restricted to the eastern areas (it is replaced by the morphologically and ecologically similar *Scomber australasicus* in the west). It only appears to occur on the high seas of the South Pacific at the southern end of its range in the Southeast Pacific. The species occurs from the surface to about 250 or 300 m depth.

In the South Pacific *S. japonicus* catches are usually associated with the jack mackerel (*T. murphyi*) fishery and the species is generally taken as a commercially important bycatch in that fishery rather than as a target species in its own right.

Global landings of *S. japonicus* reached their peak (3 412 602 t) in 1978; since then they decreased to a low of 963 302 t in 1991 but, in the recent years, have slightly increased up to 1 556 888 t in 1995. The total global landings reported for this species by FAO for 1999 was 1 955 053 t.

Reported South Pacific (FAO Area 87) landings also peaked in 1978 (835,958 t), falling as low as 44,115 t in 1994 and increasing back up to 527,729 t in 1999 (27% of the global total in that year). Landings remained high from 2001 to 2004 (393,000 t to 699,000 t), but recent information from Chile, Peru and Ecuador suggests landings are at the lower end or below that range in 2005 and 2006.

Growth and physical characteristics of *S. japonicus* are reasonably well known, but the general biology of the species especially as it relates to stock structure and spawning are less well known.

The biological productivity of *S. japonicus* is likely to be moderate. The species is preyed upon by a large range of species and *S. japonicus* forms an important trophic link between production levels and top predators.

There has only been one recent assessment conducted for chub mackerel (by Chile in 2005). This covered the area from the northern Chilean border to 40° S within the EEZ, and out 84°W between 33° S and 40°S. In terms of this assessment (Feltrim & Canales 2006), the spawning biomass in this area was estimated to be 985,000t, with a confidence interval of 835,000t – 1,150,000 t in 2004. There have been no other assessments conducted on chub mackerel in the high seas proposed convention area.

There are currently no known management measures in place for *S. japonicus*.

This is a living document. It is a draft report and requires additional information to complete.

2 Taxonomy

2.1 Phylum

Chordata

2.2 Class

Actinopterygii

2.3 Order

Perciformes

2.4 Family

Scombridae

2.5 Genus and species

Scomber japonicus, Houttuyn, 1782

2.6 Scientific synonyms

Scomber colias, Scomber australasicus (Note that *Scomber australasicus* Cuvier 1832 is a valid species in its own right, but appears to have an Australasian only distribution. *S. australasicus* has been used erroneously in the past as a synonym for *S. japonicus* in the eastern Pacific).

2.7 Common names

Chub mackerel, caballa, cavalinha, estornino, mackerel, blue mackerel

2.8 Molecular (DNA or biochemical) bar coding

On the GenBank website various nucleotide and protein sequences are available, but no genome information is available. The www.FishBol site has records of 15 bar-coded specimens from FAO Area 27 and 3 bar-coded specimens from FAO area 51.

3 Species Characteristics

3.1 Global distribution and depth range

The distribution of S. japonicus is reported as circum-global and cosmopolitan. In the Atlantic Ocean it occurs off the east coast of North America from New Scotia, Canada to Venezuela. On the South American east coast, it occurs from southeast Brazil to south Argentina. On the European coast S. japonicus is reported from the United Kingdom to France. S. japonicus is reported from almost the whole coast of Africa. It occurs in the Mediterranean and Red Seas. It is apparently absent in the Indian Ocean, from Indonesia and Australia. In the Pacific Ocean S. japonicus is fished off Japan and the west coast of South America from Ecuador to Chile (Collette, 2001). S. japonicus appears to be replaced by Scomber australasicus in the South West Pacific (found off New Zealand and eastern Australia).

3.2 Distribution within South Pacific area

Matsui (1967) describes the distribution of *S. japonicus* in South Pacific to be from Panama to Chile, around including around the Galapagos Islands, with austral limits at Guamblin Island, at 45°41'S. The longitudinal distribution includes areas outside EEZ limits in the south (off Chile), but it occurs mainly within 100 nm of the coast in the north.

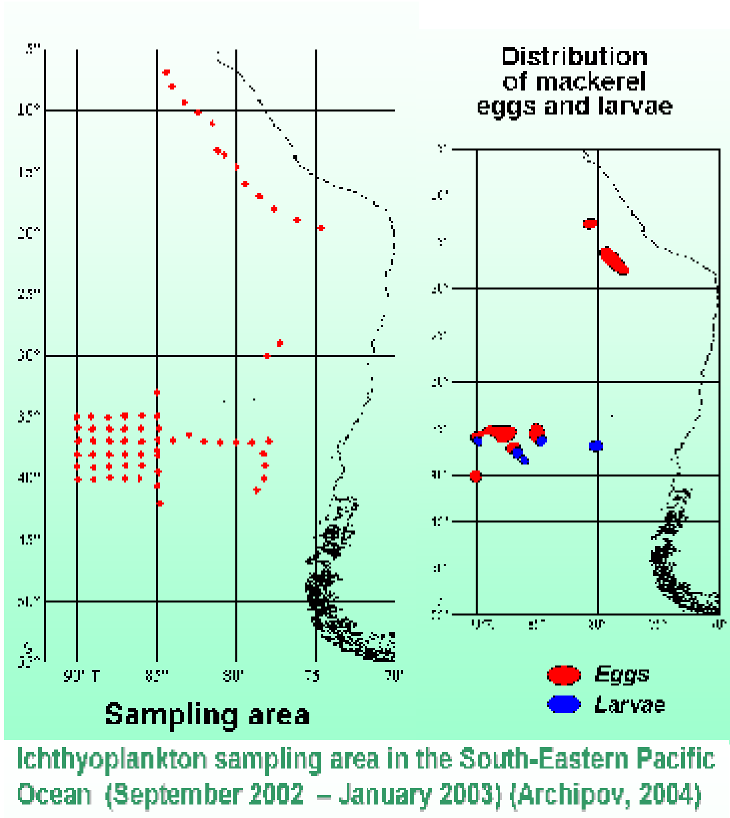
3.2.1 Inter-annual and/or seasonal variations in distribution

In Chile there is no confirmed information about trophic or spawning migrations. Nevertheless, Hernández (1991) observes that it is considered the species migrates from feeding in deeper areas to spawning areas nearest the coast. This behavior may cause substantial changes in fishery availability, and consequently high variability in fisheries catches.

Recent Russian sampling on the high seas in the Southeastern Pacific shows eggs distributed in a narrow band from ~13°S – 18°S and eggs and larvae in the area from 35°S – 40°S and 80°E – 90°E (Archipov 2004).

Historic Russian sampling found *S. japonicus* eggs and larvae in 1980-1981 off coastal states EEZ northward to 20°S in November-December. Maximum egg catch rate was 16 eggs per square metre (Galaktionov et al. 1983).

Figure 1: Distribution of chub mackerel eggs and larvae in the Southeastern Pacific ocean (from Archipov 2004).



3.2.2 Other potential areas where the species may be found

Give the species generally near shore distribution it is unlikely that it occurs in other high seas areas.

3.3 General habitat

S. japonicus is a pelagic fish with gregarious behavior. In Chilean waters it form schools usually with jack mackerel (*Trachurus murphyi*) and sardine (*Sardinops sagas*) at the adult stages, but also with anchovy (*Engraulis ringens*) when smaller than 15 cm. It is uncommon for *S. japonicus* to inhabit waters deeper than 50 m and according to Maridueña & Menz (1986) the species undertakes vertical migration to surface for feeding. However, Hernández (1991) relates the occurrence of *S. japonicus* about the Big Canaries Islands to be over the continental slope, from the surface to 300 meters depth.

3.4 Biological characteristics

S. japonicus is a heterosexual fish, with no sexual differentiation to determine sex externally. Histological studies demonstrate *S. japonicus* as a partial spawner, with an extended period of reproductive activity. Off Peru the spawning season is described to be from August to March, mainly in high summer (January). Near Ecuador there seems to be a secondary period in September (Serra *et al*, 1982; Maridueña & Menz, 1986). In Chilean waters the spawning season is identified in November through March in northern and southern areas. This has been confirmed with results from projects monitoring pelagic fisheries in these regions, which report an increase of mature fishes at the end of the year, and high values of gonadosomatic index (GIS) within January and March (Martínez *et al*., 2006). The length of 50% maturity was estimated by Pardo & Oliva (1992) in the north region as 26cm, a mean between macro and microscopic criteria.

Growth of the species is characterised as very fast in the first two years, manifested in a high growth rate (*k*). Fishes can reach 50% of the asymptotic length in this period, considering that L_∞ are reported in the literature to be approximately 45 cm and longevity between 9 to 10 years. Table 1 shows the growth parameters reported in the literature for this species from the eastern Pacific in both hemispheres. Considerable additional data are available from the northwestern Pacific, but not reported here (e.g. Choi et al. 2000).

Table 1: Growth parameters estimated for *S. japonicus* in the eastern Pacific Ocean.

	Country	L_{oo} (cm)	k	t0 (years)	Aging method	Age validation
Parrish y MacCall, 1978	USA (California)	43.60	0.244	-3.022		
Aguayo,1982	Chile	44.60	0.160	-1.550		
Mendo,1984	Perú	40.57	0.408	-0.050		
Pizarro,1984	Ecuador	39.20	0.230	-1.790		
Aguayo y Steffens, 1986	Chile	44.37	0.164	-1.543		
Canales *et al*., 2004	Chile	37.56	0.264	-0.500		
Martinez *et al*., 2006	Chile	41.43	0.184	-1.541		

Morphological characteristics

S. japonicus present a fusiform and elongate body, with a sharp muzzle. Inter-pelvic process is small and single. No well developed corselet. Swim bladder is present. First haemal spine is posterior to first inter-neural process and 12 to 15 inter-neural bones under first dorsal fin. Anal fin spine conspicuous clearly separated from anal rays but joined to them by a membrane. Back with narrow stripes which zigzag and undulate. Caudal peduncle with 5 finlets on the upper and lower edge. Distance between dorsal fins shorter than or equal to the first dorsal fin base. Lateral line not interrupted and caudal fin forked. Belly is unmarked (Pacific population) or with wavy lines. Dorsal color green and yellow, with thin blue lines.

Maximum length is about 50 cm, while the most common lengths are around 30 cm.

Key morphological features are:

- Dorsal spines (total): 9 - 11;
- Dorsal soft rays (total): 11 - 12;
- Anal spines: 0;
- Anal soft rays: 12 – 14; and
- Vertebrae: 31.

3.5 Population structure

Serra (1983) suggests the existence of two *S. japonicus* stocks in Southeast Pacific waters, one of them localised at central-north Peru, and other at North Chile. However, spawning areas have been observed at central Chile, as well high catches near Ecuador, which suggests that other stocks could exist in the area, or, at least, that the stock dynamics and relationships between these areas are not well known (**needs reference**).

Various historic studies and recent egg and larval distribution studies provide conflicting evidence for alternate stock structure hypotheses. Additional work is required to resolve questions related to relationships between egg and larval distributions and possible stock components in the northern/southern and inshore/offshore areas.

For the purposes of this document, chub mackerel occurring in the area from the northern Chilean border to 40°S within the EEZ, and out to 84°W between 33°S and 40°S are referred to as the Chilean stock. This is an assumed stock and reflects a working hypothesis.

3.6 Biological productivity

Medium – onset of maturity is moderate, fecundity is moderate, annual growth rate is moderate and the species is moderately long lived.

NOTE: Needs to be updated here

3.7 Role of the species in the ecosystem

According Hernández (1991), it is difficult to determine the trophic level of *S. japonicus* on the food web, mainly due the diversity of food items found inside their stomachs. In some areas the species seems to eat from phytoplankton to copepods, larvae and small juveniles of other fish species. In this way, *S. japonicus* can vary their trophic level between the second and fortieth levels, depending on the moment and the type of food available. *S. japonicus* are predated upon by a large range of species, such as tunas, sharks and even dolphins and whales. These features make the species a very important component of the trophic web, as a link between production levels and top predators.

4 Fisheries characterisation

4.1 Distribution of fishing activity

Fishing effort within Chilean waters is distributed about the north and central-south, within Arica and Antofagasta, and Talcahuano and Valdivia respectively, and out beyond the EEZ to 600 nm offshore (Canales, 2005). *S. japonicus* catches are usually associated with the jack mackerel (*T. murphyi*) fishery, especially as the fleet follows the migration patterns of that resource (Martinez *et al.*, 2006).

In the north, catches have some temporal pattern between 2002 and 2005, when highest values are observed in the beginning and end of the year, in February-March and November. In the south, catches follow an opposite annual trend, with high catches between April and June for these years.

4.2 Fishing technology

The fleet fishing ***S. japonicus*** is basically the same as that for ***T. murphyi***, consisting mainly of purse seine and midwater trawl methods. In Chile, it is targeted extensively by industrial purse-seine vessels. In the northern Chilean fishery a Marco type of purse seiner is used, while in the fishery off central Chile purse seiners with their fishing gear at the deck level are used, similar to the Scandinavian design. The international fleet is composed mainly of large midwater trawlers.

In 2005, the size of the industrial purse seine fishing fleet in northern Chile was about 84 vessels, with an average size of 380 cubic metre of hold capacity, while the size of the fishing fleet in the central Chilean fishery was 47 vessels with an average hold capacity of 1151 cubic metre and an average length of 57 metres (Martinez ***et al.***, 2006).

4.3 Catch history

FAO

Reported *S. japonicus* landings from FAO data (www.fao.org/figis) in the Southeast Pacific (FAO Area 87) are provided in Table 2 for 1970 through 2004. These data contain catches from within EEZs and on the high seas. No landings of *S. japonicus* are reported in the FAO data for the Southwest Pacific (FAO Area 81).

During the 1970-2004 period the highest landings reported was in 1978 (835,958 t) and the lowest was in 1970 (51,800 t). The landings peaked for a period in the late 1970s with landings over 500,000 t in 1977-1980. From 1980-1997 the landings were mostly in the range of 100,000 – 300,000 t. From 1997-2004 landings have been above 500,000 t in all but two years (2000, 2002) and have averaged just over 550,000 t (see Figure 1).

Chile, Ecuador and Peru

Chile, Ecuador and Peru account for over 97% of the reported *S. japonicus* landings in the Southeast Pacific in the period 1970-2004. Recent data from Chile, Ecuador and Peru shows lower landings since 2004 (Figure 2).

S. japonicus landings in Chile are reported since 1970, with a very high variability among years. Substantive landings have been reported since 1975 (see Table 2).

Ecuador reported the largest landings from the Southeast Pacific for the 25 years 1965-1989. After 1990, the largest landings reported alternates between Chile and Peru (Figure 2).

In Chile, landings of *S. japonicus* have shown high variation in the last few years. Within Chile, highest landings were observed in the north between 1998 and 2000, after that, landings have increased in the south, reaching more than 50% of the total in the most recent years (Canales, 2005; Martinez et al., 2006).

Russia

In R.V. *Atlantida* survey in 2002-2003 the average chub mackerel catch per hour was 131 kg (range 1 – 2222 kg) and 8.2% of the total catch by weight (A. Glubukov, VNIRO, pers. comm.).

Netherlands

Data from a Dutch vessel in 2006 shows *S. japonicus* forming 5% by weight of the total *T. murphyi* catch, *S. japonicus* being caught in nearly 50% of all *T. murphyi* tows, and for tows in which chub mackerel were taken catches were 5-50% of the total catch in that tow by weight (A. Corten, pers. comm.).

Table 2: Reported landings (t) of chub mackerel (*S. japonicus*) by country, FAO area and year from 1970 to 2004.

Flag State	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Bulgaria	0	0	0	0	0	0	0	0	0	35	89	997
Chile	8000	8500	1000	3800	215	15235	50738	141263	182680	89117	102279	97457
Cuba	0	0	0	0	0	0	0	0	0	100	2852	3239
Ecuador	35000	41900	55200	95000	110000	132000	236000	370000	550000	528623	570617	131862
Peru	8800	10100	8700	65000	63270	23588	40172	46071	101505	118067	59062	32803
Un. Sov. Soc. Rep.	0	0	0	0	0	0	0	0	1773	5795	41893	41500
Total	**51800**	**60500**	**64900**	**163800**	**173485**	**170823**	**326910**	**557334**	**835958**	**741737**	**776792**	**307858**

Flag State	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Bulgaria	73	338	13	0	0	0	0	0	5	0	0	0
Chile	20987	9280	111877	11314	1584	32799	26423	39328	192948	191723	72364	96023
Cuba	2091	0	0	0	0	0	0	0	0	0	0	0
Ecuador	257469	96527	291686	114139	107711	116625	180347	145577	74473	61939	26322	45322
Estonia	0	0	0	0	0	0	342	0	208	468	0	0
Georgia	0	0	0	0	0	0	209	345	1972	0	0	0
Latvia	0	0	0	0	0	0	50	0	3428	1010	4	0
Lithuania	0	0	0	0	0	0	316	1610	1938	1644	36	0
Peru	22072	22579	87134	57069	38709	24072	25554	32042	60776	17304	17939	29504
Poland	54	37	20	0	0	0	0	0	0	0	0	0
Russian Federation	0	0	0	0	0	0	2277	24758	43728	18257	970	0
Ukraine	0	0	0	0	0	0	941	1447	22894	1337	0	0
Un. Sov. Soc. Rep.	41878	2123	6818	18270	1128	274	0	0	0	0	0	0
Total	**344624**	**130884**	**497548**	**200792**	**149132**	**173770**	**236459**	**245107**	**402370**	**293682**	**117635**	**170849**

Flag State	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Bulgaria	0	0	0	0	0	0	0	0	0	0	0
Chile	27171	110210	146649	211649	71769	120123	95789	365031	343371	572052	577336
Cuba	0	0	0	0	0	0	0	0	0	0	0
Ecuador	38991	57950	79484	192182	44716	28307	84324	85378	17073	33273	51806

Ghana	0	0	0	0	0	0	1148	855	0	0	0	
Japan	0	0	0	0	0	1	0	0	0	0	0	
Korea, Republic of	0	0	0	0	0	0	0	0	0	0	581	
Peru	44115	44259	49221	206183	401903	527729	73263	176202	32698	94384	62255	
Russian Federation	0	0	0	0	0	0	0	0	0	5	0	**All Years**
Total	**110277**	**212419**	**275354**	**610014**	**518388**	**676160**	**254524**	**627466**	**393142**	**699714**	**691978**	**12264185**

Figure 1: Reported landings (t) of chub mackerel (*S. japonicus*) in the Southeast Pacific, 1970-2004.

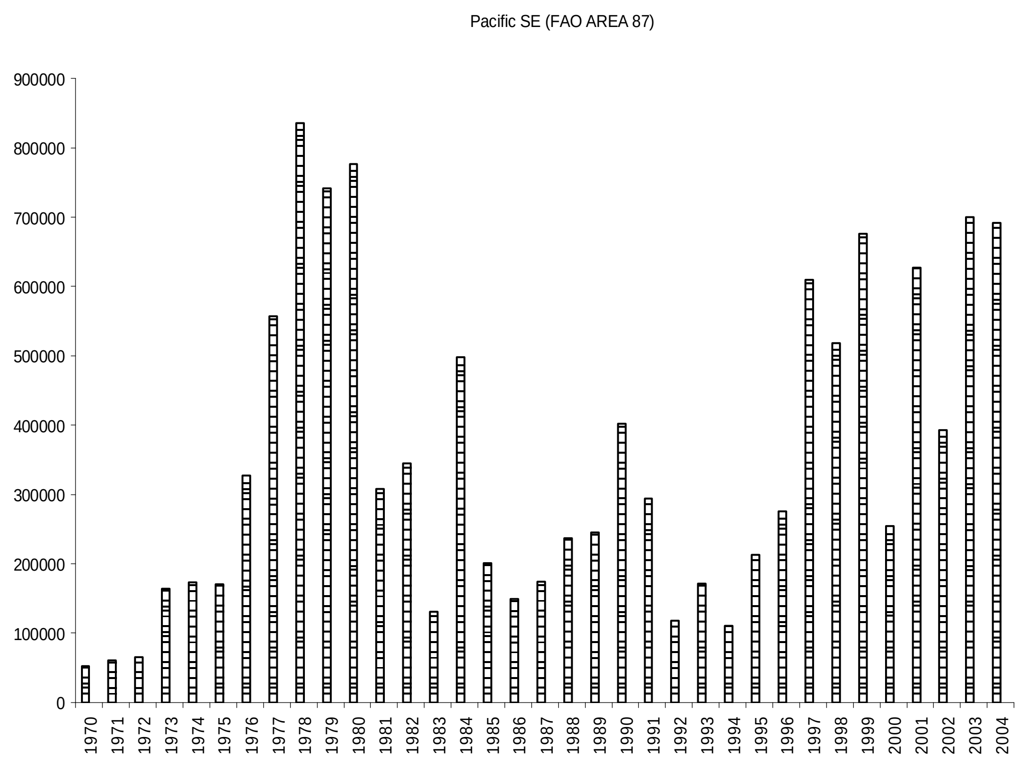
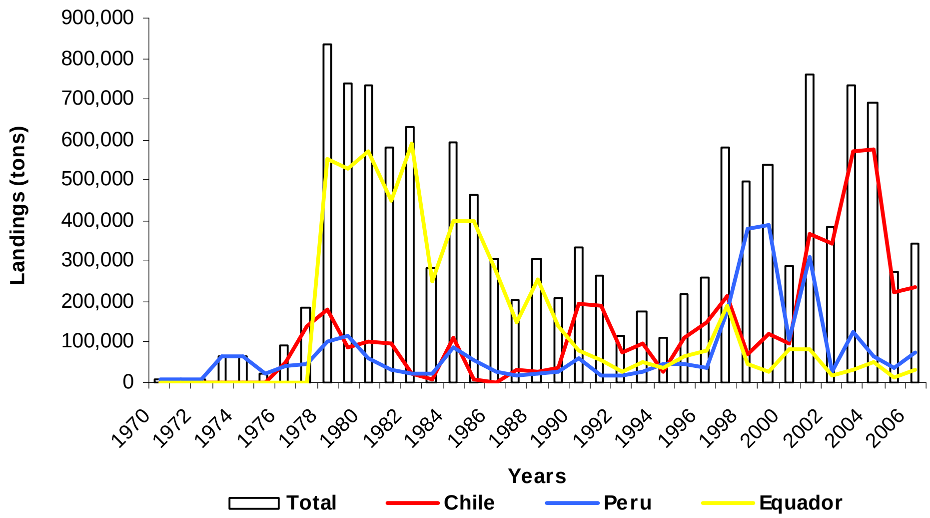


Figure 2: Reported landings (t) of chub mackerel (*S. japonicus*) in the Southeast Pacific for Chile, Ecuador and Peru, 1970-2006.



4.4 Status of stocks

The stock(s) are thought to range between moderately and overexploited (see additional detail in Section 5).

Chilean stock

The potential reproductive rate (PRR) of the resource in 2004 was estimated near 55%, and the authors alert to a possible intensification of this trend, due to the failure in recruitment observed in 2003 and 2004.

4.5 Threats

No threat status known.

4.6 Fishery value

Section still in progress

5 Current Fishery Status and Trends

5.1 Stock size

Chilean Stock

In Chile, there is a lack of acoustic assessments to *S. japonicus*; consequently the estimation of stock size depends exclusively on indirect stock assessment. In the last stock assessment Feltrim & Canales (2006) found spawning biomass levels near to 985,000 t, with confidence intervals 835,000 – 1,150,000 t in 2004.

5.2 Estimates of relevant biological reference points

5.2.1 Fishing mortality

Chilean Stock
Feltrim & Canales (2006) observed a removal rate of 56% in 2004, the highest value estimated for the whole period evaluated (1990-2004).

5.2.2 Biomass

Chilean stock
Feltrim & Canales (2006) identified a strong impact of the fishery on the species after 2001, especially in 2003 and 2004, when catches surpassed 500,000 t in Chile. These exploitation rates decreased the stock to 1/3 of the size observed in 1991.

5.2.3 Other relevant biological reference points

Chilean stock
The potential reproductive rate (PRR) of the resource in 2004 was estimated near 55% by Feltrim & Canales (2006).

6 <u>Impacts of fishing</u>

6.1 Incidental catch of associated and dependent species

No estimates available.

6.2 Unobserved mortality of associated and dependent species

This is unlikely given the methods used (mid-water trawl and purse seine) and the small mesh sizes of that gear allowing limited escapement.

6.3 Bycatch of commercial species

Essentially, *S. japonicus* is a commercial bycatch species itself, as the most important resource caught by the fleet is *T. murphyi* (Martinez, 2004). However, the importance of *S. japonicus* in the total catches from that fishery increased substantially after 2001, with occurrence in 85% of the *T. murphyi* landings, and for almost one third of the landing events in that fishery *S. japonicus* made up more than 50% of the landing (Canales, 2005).

6.4 Habitat damage

There are no known habitat damage issues for this essentially purse seine and mid-water trawl fishery.

7 Management

7.1 Existing management measures

There are no known management measures applied specifically to the *S. japonicus* fishery in Chile currently, although the measures applying to vessels participating in the *T. murphyi* fishery apply by default to a large proportion of the *S. japonicus* landings.

7.2 Fishery management implications

Chilean stock

The last stock assessment realised for *S. japonicus* in Chile, (Feltrim & Canales, 2006) observed that the stock seems to remain healthy when catches are below 300,000 t in Chile. After 2001, catches exceed this level (reaching almost 600,000 t), and the stock started to decline. The authors propose that a sustainable catch limit for *S. japonicus* in the assessed area should be near to 150,000 t.

General

The absence of recruits in catches needs to be considered when assessing stock health, especially in the face of the catch levels observed in the last years. The lack of information, especially a direct stock assessment, exacerbates current risk. Catches are thought unsustainable at the recently observed high levels.

7.3 Ecosystem considerations

Section still in progress

8 Research

8.1 Current and ongoing research

Chile undertakes catch sampling and indirect stock assessment.

NOTE: Korea to provide additional information.

8.2 Research needs

Research is required to:

- Improve the understanding of the stock structure of *S. japonicus* to aid the development of appropriate management units.

  This should be done using multiple techniques such as genetics, otolith microchemistry, morphometrics, parasites and ecology to discriminate between separate stocks and test the current stock structure hypothesis. A collaborative approach in undertaking and funding this project will be required for a comprehensive and enduring outcome.

- Obtain biomass estimates for all stocks that are actively fished as inputs to stock assessment modelling.

  This will need careful planning to ensure that biomass estimates are obtained using standard methods that can be utilised for stock assessment purposes.

- Undertake a stock assessment for the actively fished stocks to support the provision of robust fisheries management advice.

  A preliminary task is the compilation of relevant data for undertaking stock assessment. A review of the available data will determine the types of assessment that might be able to be used. Any assessment should be done using a modern method capable of integrating all relevant available data and that can provide the types of management advice sought by the SPRFMO negotiation participants.

9 Additional remarks

Although *S. japonicus* is replaced by the ecologically and morphologically similar *S. australasicus* in the Southwestern Pacific, their is no reported fishing for *S. australasicus* on the high seas. In the Southwest Pacific although *S. australasicus* is important within EEZs it appears to have a continental shelf only distribution unlike its eastern relative.

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