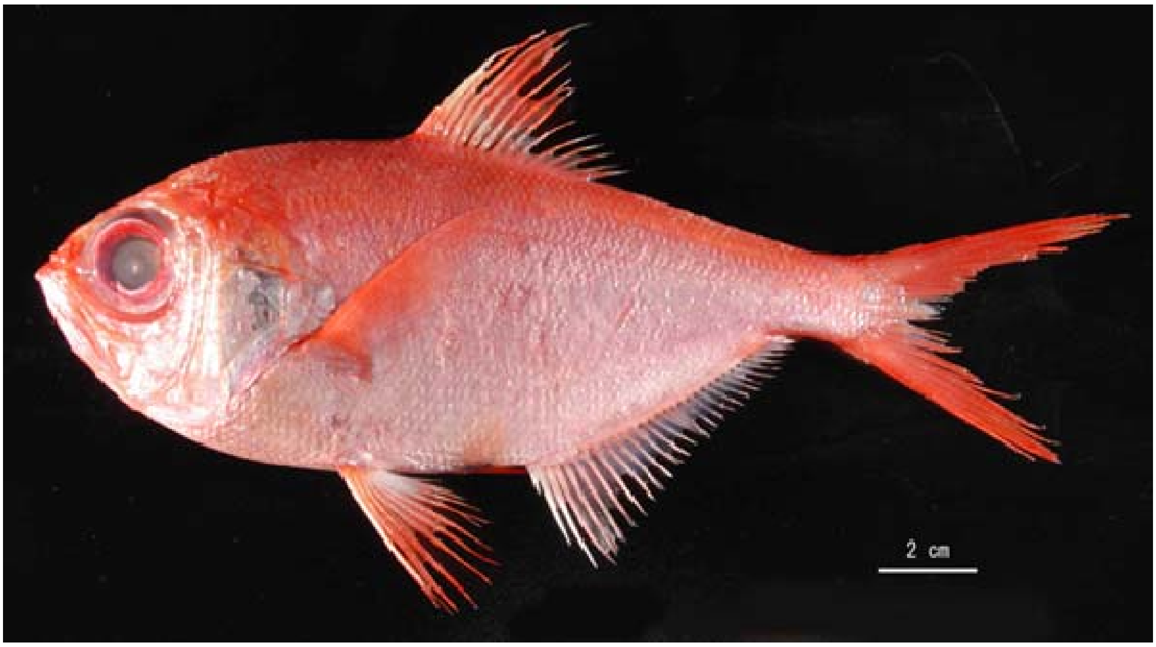
Appendix D

Information describing splendid alfonsin (*Beryx splendens*) fisheries relating to the North Western Pacific Regional Fishery Management Organisation



WORKING DRAFT
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1 Overview

Splendid alfonsin (*Beryx splendens*, Lowe, 1834, hereafter referred as alfonsin) has a circum-global distribution, from about 65° N to 43° S, excluding the northeast Pacific Ocean. It inhabits the outer continental shelves and slopes, and is often associated with seamounts. The basic biology of *B. splendens* is reasonably well known, although aspects of their reproduction and stock structure are still poorly understood. The biological productivity of *B. splendens* is likely to be moderate to low (Anonymous, 2007).

Target fisheries for *B. splendens* at the seamounts of the Southern Emperor and Northern Hawaiian Ridge (SE-NHR) started in the mid 1970s, when abundance of the North Pacific armorhead *Pseudopentaceros wheeleri* in SE-NHR was drastically declined, and lasting to the present day (Sasaki, 1986, Anonymous, 2003). After the establishment of EEZ of USA in 1977, Japanese trawl fleets underwent commercial fishing at the Hancock seamounts until 1985, thereafter fishing moratorium is continuing within the US EEZ (Anonymous 2003). The main fishing methods of this species are bottom trawl, long-line and bottom gillnet. Trawling for this species on seamounts impacts mainly flat submit and slope areas of the seamounts, but the precise impact on habitat and on other species on the seamounts is unknown. Fishing grounds of bottom gillnet is mainly located along the slope area of the seamounts.

Limited entry system has been implemented to the Japanese fisheries for *B. splendens* in the international waters of the SE-NHR. South Korea limits the number of bottom fishing vessels through the government licensing system. Russia is currently developing rules to regulate bottom fisheries in the area. No fishing is allowed within the US Exclusive Economic Zone. The Interim measures of international fisheries management were elaborated among national delegations of Japan, South Korea, Russia and USA, and took effect on 31 December 2007, which include 1) limit fishing effort in the bottom fisheries to the existing level, and 2) not allow the bottom fisheries to expand into areas of the North Western Pacific Ocean where no bottom fishing is currently occurring, in particular, by limiting the bottom fisheries to seamounts located south of 45 ºN latitude and to provisionally prohibit bottom fisheries in other areas of the North Western Pacific Ocean unless the bottom fishing was judged to have no significant adverse impacts on the marine species or vulnerable marine ecosystem.

Basic structure of this report and information on biology of alfonsin and ecosystems and were derived from Anonymous (2007). This is a living document. It is a draft report and requires additional information to complete.

2 Taxonomy

2.1 Phylum

Vertebrata

2.2 Class

Actinopterygii

2.3 Order

Beryciformes

2.4 Family

Berycidae

2.5 Genus and species

Beryx splendens Lowe, 1834

2.6 Scientific synonyms

None known

2.7 Common names

Alfonsin, Alfonsino, splendid alfonsino, slender alfonsino, imperador, “Kinmedai” (Japanese), Nizkoteliy beryx (Russian), Bitgeumnundom (Korean)

2.8 Molecular (DNA or biochemical) bar coding

No information

3 Species Characteristics

3.1 Global distribution and depth range

Beryx splendens (hereafter, alfonsin) has been reported from all tropical and temperate oceans (excluding the northeast Pacific) between latitudes of about 65° N and 43° S. It occurs from depths of about 25 m to at least 1300 m (Busakhin, 1982; Kotlyar, 1996).

3.2 Distribution within north-western North Pacific area

In the north-western North Pacific, alfonsin is distributed in Japan and SE-NHR. In Japan, alfonsin is distributed along the Pacific coast of the Japanese Archipelago, and Islands of Izu, Ogasawara (Bonin) and Nansei, south of ca 37 º N (Honda et al., 2004), and the major fishing grounds extend along the Chiba Prefecture (ca. 35-36 º N), the Izu Islands (ca. 30-35 º N), off the Shikoku Island (ca. 30-32 º N) and the northern part of the Nansei Islands (ca.26-31 º N) (Figure 1). In the SE-NHR, alfonsin is distributed at seamounts located between the Hancock seamounts (ca 30 º N) and the Koko seamounts (ca. 36 º N), at the depths of 300-1010m (Yanagimoto and Nishimura, 2007). Based on the results of observations from the man-operated underwater vehicle "Sever-2", Pakhorukov (2005) noted that, in Milwaukee seamounts region, the alfonsino shoals were distributed at the depth of 520 m. In the SE-NHR, depths of the Japanese trawl fishing grounds were mainly 300-400m, and alfonsin was most abundant at the depths of 300-500m in the catch of the Japanese gill net fishery (Yanagimoto, 2004). Depth of the Korean trawl and long-line fishing grounds extends between 100-500 and 250-1,050, respectively. In the last years, most Russian alfonsino trawl catches were obtained from depths 350-520 m.

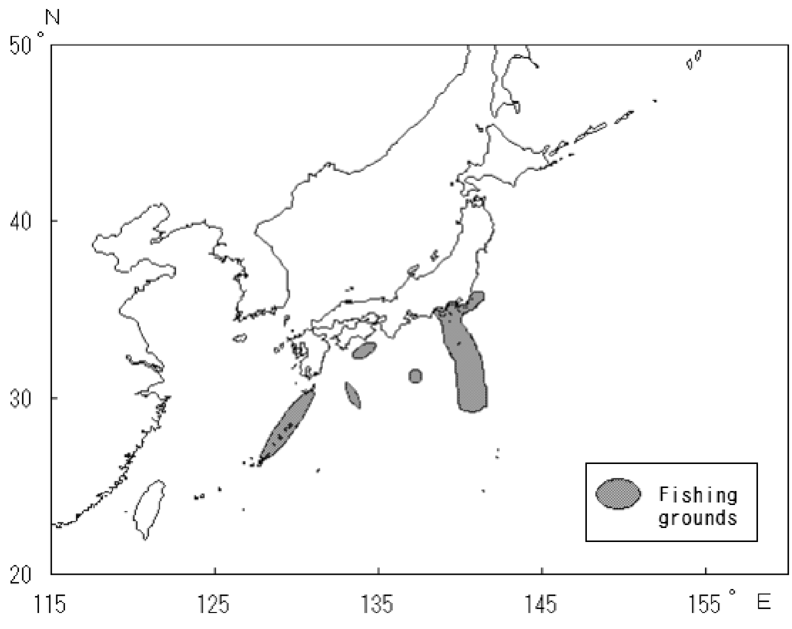


Figure 1. Locations of major fishing grounds of splendid alfonsin in Japan (Honda et al., 2004).

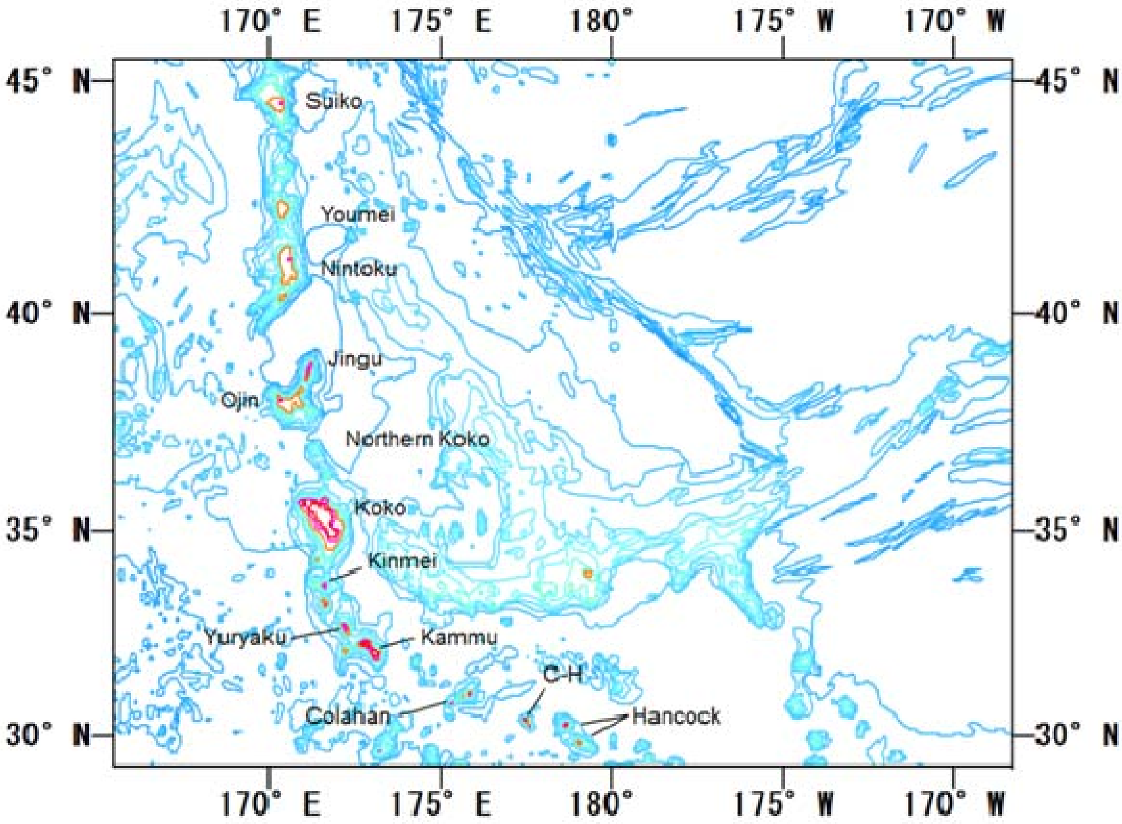


Figure 2. Locations of major seamouts in SE-NHR.
Yuryaku and Kammu are belonging to Milwaukee group. Legends of isobaths: red (500m), pink (1000m), orange (1500m), blues (500m interval below 500m).

3.2.1 Inter-annual and/or seasonal variations in distribution

No information

3.2.2 Other potential areas where the species may be found

If available, insert information on deeper seamounts from Busakhin (1982)

3.3 General habitat

In the SE-NHR, alfonsin inhabits the flat summits and slope areas of seamounts. Ontogenetic descent from flat summits to slope areas is suggested (Seki and Tagami, 1986, Yanagimoto, 2004). The species is benthopelagic (off-bottom pelagic, near-bottom pelagic); it often occurs near the bottom during the day, 2-5 m above the bottom, and ascends to feed in the midwater during the night (Uchida and Tagami, 1984; Parin and Pakhorukov, 2003).

3.4 Biological characteristics

Maximum size and age of alfonsin is over 50 cm FL and 20 years, respectively (http://www.fishbase.org). Age and growth have been investigated in a number of areas, and the ageing method of counting annual zones in otoliths has been validated (Massey and Horn 1990, Lehodey and Grandperrin 1996, Rico et al. 2001). Females tend to have a higher von Bertalanffy L_∞ value than males, but growth appears relatively similar between areas (i.e., east and west Atlantic, and North and South Pacific) (Lehodey and Grandperrin 1996, Rico et al. 2001). Growths of alfonsin estimated by otolith annual zones in SE-NHR is slightly faster than those in Japanese waters in both sexes (Table 1). Growth curve based on otoliths can be expressed as :

$$L(t)=464.816*(1-\exp(-0.1725*(t+2.0457))) \text{ for males,}$$

$$L(t)=581.672*(1-\exp(-0.1193*(t+2.2295))) \text{ for females,}$$

where, L is fork length in mm and t is age (year) (Yanagimoto and Nishimura, 2007).

Table 1. Fork length at age of splendid alfonsin in SE-NHR and Japanese waters (Yanagimoto, 2004)

Reference and area	Sex	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 10	Age 15
Yanagimoto	Male	190	234	270	301				
(2004) SE-NHR	Female	186	230	270	305				
Adachi et al.	Male	197	228	254	278	298	316	369	405
(2000) Japan	Female	166	206	240	269	294	316	377	415
Myojin and Ura	Male	178	220	256	286	312	333	393	429
(2002) Japan	Female	176	217	251	280	304	324	376	406

Sexual maturity starts from age 3 or 4 at about 28–32 cm FL in Japanese waters (Honda et al., 2004). Spawning occurs at each fishing grounds during June–October in Japan and variable by locations (Honda et al., 2004). Eggs are buoyant and hatch after 1–8 days. The pelagic larvae can be widely distributed by surface currents until they adopt a demersal existence, probably when they are about 1 year old (Chikuni, 1971).

No eggs of alfonsin have been collected from SE-NHR (Yanagimoto, 2004), but larvae and juveniles were collected from the SE Hancock seamount at the depths of 0-200m in July (Mundy, 1990) and two 2-cm juveniles were sampled from the summit of Kanmu seamount in November (Yanagimoto, 2004). In the Japanese waters, juveniles are reported from near the Izu islands at the depths of 0-300m and also from offshore of Kuroshio Current (Anonymous, 2004).

Morphological characteristics

B. splendens have four dorsal spines, 13–16 soft dorsal rays, four anal spines, and 26–30 soft anal rays. The first infraorbital bone has a spine projecting laterally on its anterior end. Lateral line extends to caudal fin. In young fishes, the second dorsal ray is elongated.

3.5 Population structure

Yanagimoto (1995, 1996) examined both meristic and morphometric characters of alfonsin collected from SE-NHR, Japan (Izu Islands), and New Zealand, and detected 1) no statistical differences within SE-NHR, and 2) statistically significant differences among the three separated regions. The results of PCR-RFLP analyses of mtDNA from the above three regions, however, indicated no statistically significant differences (Yanagimoto et al., 1995). Within the Japanese waters, mtDNA analyses and tag-recapture data suggest that alfonsin in the Japanese waters form a single population (Yanagimoto, 2004). Chikuni (1971) and Yanagimoto (2004) proposed a meta-population hypothesis of the North Pacific alfonsin, since 1) there is no genetic differentiation, 2) larvae can be drifted from the Japanese waters to SE-NHR via the Kuroshio and Kuroshio Extension Currents, and 3) morphological characters can be affected by local environmental conditions.

Recent analyses of stock structure in the central Atlantic have indicated limited gene flow between populations on relatively close archipelagos (Schönhuth et al. 2005). In contrast, Alekseev et al. (1986) suggested that populations of alfonsino were associated with large oceanic eddy systems; currents carried eggs and larvae from a reproductive to a 'vegetative' zone, and then maturing fish migrated back with the current to the reproductive zone. Results of investigations of alfonsino at southwestern Atlantic seamounts suggested that several populations or reproductive groups exist (Kokora, 2005). Alfonsin in the South Pacific are thought to migrate from shallower to deeper seamounts as the grow (Lehodey et al., 1994, 1997).

These information suggests that alfonsin of SE-NHR forms a single population, which may form a meta-population with the Japanese stock.

3.6 Biological productivity

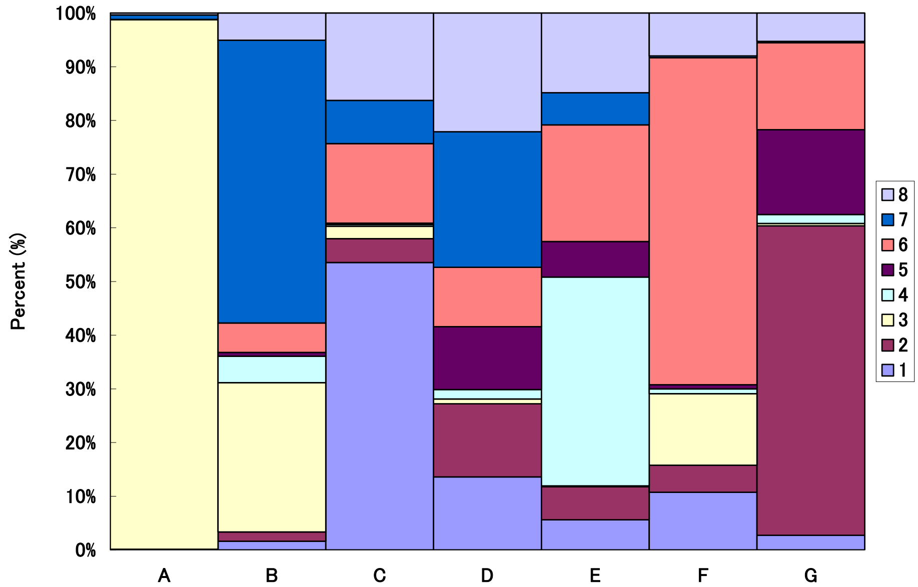
González et al. (2003) noted that alfonsin have a specialist life-history style, are only moderately fecund and moderately productive, and appear relatively sedentary. Hence, they concluded that alfonsin are relatively susceptible to growth overfishing and population depletion. Productivity of alfonsin could be much higher than those of "more-deepwater" species, such as orange roughy (*Hoplostethus atlanticus*) and the oreosomatiids, which inhabits waters deeper than 500m and having extremely slow growth and low natural mortality rates, hence more vulnerable to fishing (Koslow et al., 2001).

3.7 Role of the species in the ecosystem

Food of alfonsin in SE-NHR consisted of shrimps, fishes (mainly myctophids and *Maurolicus*), squids, and crustacean zooplankton (Yanagimoto, 2004).

Pakhorukov (2005) reported about finding of alfonsino specimens in mirror dory (*Zenopsis nebulosa*) stomach over Milwaukee seamounts. According to the Japanese, Korean and Russian experimental trawl fishing, alfonsin is associated with a number of species including: Japanese boarfish (*Polymixia japonica*), broad alfonsin (*Beryx decadactylus*), Japanese butterfish (*Hyperoglyphe japonica*), mirror dory (*Zenopsis nebulosa*), skilfish (*Erilepis zonifer*), boarfhsh (*Antigonia eos*), cardinalfish (*Epigonus* spp.), snake mackerel (*Promethichthys prometheus*), codling (Moridae), squalid sharks and scorpinfishes (Sebastidae and *Helicolenus* spp.) (Sasaki, 1986, FAJ., 2008). Based on a cluster analysis of the Japanese bottom trawl catches obtained from Koko, Yuryaku, Kammu, Colahan, and C-H seamonunts, during October-December 1993, at the depths of 271-473m, Yanagimoto (1996) detected seven groups (Figure 3).

In the South Pacific, alfonsin feeds by hunting macrofauna, mainly small squids and fish, but also crustaceans (i.e., copepods, amphipods, shrimps, prawns, and euphausiids) (Anonymous, 2007). It normally occurs within 20 m of the bottom, but is believed to make feeding forays off the bottom, generally at night. Alfonsin are often found in association with bluenose (*Hyperoglyphe antarctica*), gemfish (*Rexea solandri*), hoki (*Macruronus novaezelandiae*), javelinfish (*Lepidorhynchus denticulatus*), and orange roughy in the South Pacific (Anonymous, 2007). Alfonsin are prey at various stages of their life to other bony fishes and sharks, including *Latimeria*, squalid shark and trichiurid fishes (http://www.fishbase.org/).



1: ***Etmopterus pusillus*** **, 2:** ***Physiculus cynodon*** **, 3:** ***Beryx splendens*** **, 4:** ***Zenopsis nebulosa*** **,**
5: ***Helicolenus avius*** **, 6:** ***Epigonus denticulatus*** **, 7:** ***Pseudopentaceros wheeleri*** **, 8: Others**

Figure 3. Seven groups of species association in the Koko, Yuryaku, Kammu, Colahan, and C-H seamonunts (Yanagimoto, 1996). N.B.: *Physiculus* of Yanagimoto (1996) may include other species of the same genus.

4 Fisheries Characterisation

4.1 Distribution of fishing activity

The Japanese alfonsin catch suddenly increased in 1976 (Figure 4). The main fishing grounds were initially located at the northern large tablemout seamounts (Koko, Yuryaku, and Kammu) of the SE, and soon expanded southward to encompass the much smaller NHR guyot-type seamounts including Colahan, C-H, and Hancock (Sasaki, 1986, Anonymous, 2003). The Japanese commercial trawl fishing for alfonsin is usually carried out at the depths of 300-400m near the flat summits of SE-NHR, whose catch is dominated by small individuals of 16-20cm FL (Yanagimoto 2004, Yanagimoto and Nishimura, 2007). On the other hand, the Japanese gill net fishery have been operated at the depths of 300-1300m including slope area, where larger-size individuals (>30 cm FL) is abundant (Yanagimoto 2004). Sasaki (1985) detected a decrease of large-sized alfonsin around the flat summits since the beginning of exploitation of fishing grounds of SE-NHR. Locations of seamounts are indicated in Figure 2. Table 2 summarizes recent fishing grounds of Japan and Korea, those of the Russian fleets are not available.

Table 2. Distribution of fishing activities during 2002-2006 based on "foot print data" submitted from Japan, Korea and Russia

Trawl (Japan (∗), Russia (x) and Korea (+))

Year	Seamount A	Suiko	Showa (Seamount B)	Youmei	Nintoku (J)	Jingu (I)	Ojin (H)	Koko (F) @	Kimmei (E)	Milwaukee (D)	Colahan (C)	C-H (B)
2002				x	∗	∗	∗	∗ x	∗	∗	∗	∗
2003					∗	∗	∗	∗ x	∗	∗	∗	
2004						+	∗ +	∗ +	∗	∗ +	∗ +	∗ +
2005					∗	∗	∗	∗ x +	∗ x +	∗ x +	∗ x +	∗ x
2006					∗	∗	∗	∗ +	∗ +	∗ +	∗ +	∗

Longline (Russia (x) and Korea (+))

Year	Seamount A	Suiko	Showa (Seamount B)	Youmei	Nintoku (J)	Jingu (I)	Ojin (H)	Koko (F)	Kimmei (E)	Milwaukee (D)	Colahan (C)	C-H (B)
2002								x				
2003								x				
2004					+		x +	+		+	+	+
2005												
2006												

Table 2. continued

Crab pot (Russia (x))

Year	Seamount A	Suiko	Showa (Seamount B)	Youmei	Nintoku	Jingu	Ojin	Koko	Kimmei	Milwaukee	Colahan	C–H
2002			x	x	x			x				
2003								x				
2004												
2005												
2006												

Gill net (Japan)

Year	Seamount A	Suiko	Showa (Seamount B)	Youmei	Suiko	Koko @	Kinmei	Yuryaku+	Kammu+	Colahan	C–H
2002					*	*	*		*	*	*
2003						*				*	
2004						*			*	*	*
2005						*			*	*	*
2006						*		*	*	*	*
2007						*		*	*	*	*

+ Milwaukee group

@: includes Northern Koko seamount in the Japaense fisheries (years unspecified)

@: includes Northern Koko seamount in the Korean trawl fishery in 2004

4.2 Fishing technology

Japanese commercial trawlers use ground ropes equipped with rubber tires in order to avoid hard contacts to the bottom, and subsequent break of the gear (Yanagimoto, 2004). Gill nets used by the Japanese fleets are made of nylon monofilament (Yanagimoto, 2004). In the high seas of the South Pacific, alfonsin are caught by bottom trawling (85.5%) with the remainder being taken by mid-water trawling. Ratio of bottom and midwater trawling is unknown in SE-NHR.

4.3 Catch history

Since the discovery of large concentrations of the North Pacific armorhead over SE-NHR by the former USSR in 1967, the Soviet/Russian and Japanese trawlers started their commercial trawl fishing in 1967 and 1969, respectively (Boehlert and Sasaki, 1988, Anonymous, 2003, Yanagimoto and Nishimura, 2007). After the establishment of EEZ of USA in 1977, Japanese trawl fleets underwent commercial fishing at the Hancock seamounts until 1985, thereafter the fishing moratorium is continuing within the US Exclusive Economic Zone (Anonymous

2003). Japanese bottom gillnet catch statistics are available since 2000, when the Japanese government implemented a limited-licence system for this fishery (Yanagimoto and Nishimura, 2007). After the armorhead fisheries disaster, the Soviet/Russia bottom fishery in SE-NHR was conducted occasionally. Russian trawls and bottom gillnet statistics was available since 1999 on a regular basis. During June-September 2004, South Korea carried out experimental trawl and long-line fishing operations in SE-NHR, although the latter catch was less 1 ton in 2004. Armorhead and alfonsin are major targets of these fishing activities (Figure 4). The fishing effort and catch of recent years is summarized in Table 3 and 4, respectively.

Table 3. Numbers of fishing vessels and fishing days by country and fishery during 2002-2006 (summarized from the "footprint data" submitted by Japan, Korea and Russia). NB: these numbers include all target fishes, including splendid alfonsin, North Pacific armorhead and other species.

Number of vessels (all countries)

Fishery	Trawl			Longline			Gillnet			Crab pot		
Country / Year	Japan	Korea	Russia	Japan	Korea	Russia	Japan	Korea	Russia	Japan	Korea	Russia
2002	4	0	1	0	0	2	2	0	0	0	0	2
2003	3	0	1	0	0	1	1	0	0	0	0	1
2004	7	2	0	0	1	1	1	0	0	0	0	0
2005	8	1	6	0	0	0	1	0	0	0	0	0
2006	7	2	na	0	0	na	1	0	0	0	0	na

Number of fishing days (all countries)

Fishery	Trawl			LL		GN	
Country / Year	Japan	Korea	Russia	Korea	Russia	Japan	Russia
2002	801	0	2	0	14	199	0
2003	680	0	1	0	na	21	0
2004	939	90	na	56	na	141	0
2005	1,014	146	na	0	na	209	0
2006	973	109	na	0	na	221	0

Table 4. Catch in ton of alfonsin in recent years by country and fishery during 2002-2006 (summarized from the "footprint data" submitted by Japan, Korea and Russia).

Country Fishery	Japan Trawl	Japan Gillnet	Korea Trawl	Korea Longline	Russia Trawl	Russia Longline
2002	2,543	20	0	0	272	0
2003	2,005	0	0	0	0	0
2004	2,445	152	16	0.06	0	0
2005	3,877	242	513	0	297	0
2006	3,656	375	289	0	na	na

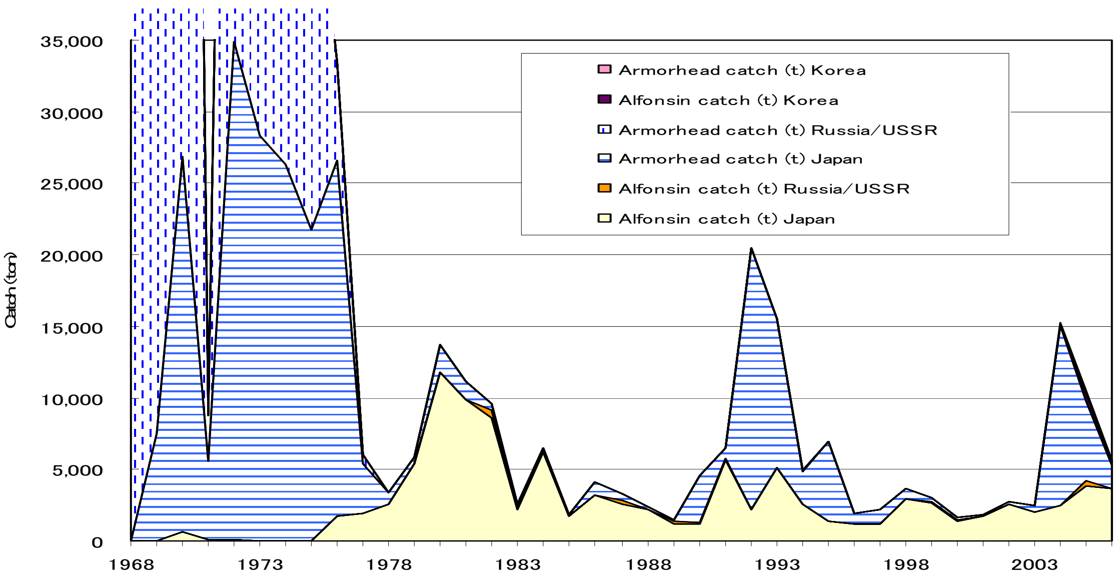


Figure 4. Catch trajectories of splendid alfonsin and the North Pacific armorhead in SE-NHR.

4.4 Status of stocks

Stock of alfonsin in SE-NHR seems stable but considered below B_{MSY} (see section 5).

4.5 Threats

No threat status known.

4.6 Fishery value

Section yet to be developed

5 Current Fishery Status and Trends

By applying two different surplus production models (ASPIC (see Prager, 1994) and MS Excel) to the available catch data and the Japanese trawler's CPUE during 1969-2005 (Figure 5), stock size, fishing mortality coefficient and MSY-related parameters were estimated (Nishimura and Yatsu, 2008). The ratio between F_{MSY} and current F (average of 1997-2006) were 72-80% (Tables 5, 6, Figure 8). It should be noted that absolute values of F nad biomass obtained from production model are subject to great uncertainties but the relative values to F_{MSY} or B_{MSY} are robust (Hilborn and Walters, 1992). Russian research data suggest that CPUE has increased rapidly during 1981-1983, and dropped in the next few years.

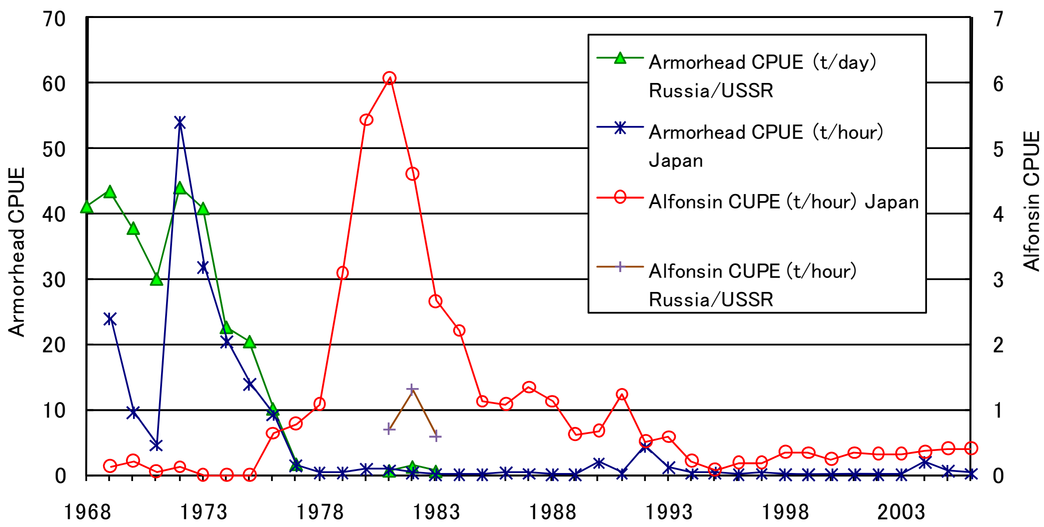


Figure 5. Catch-per-unit-effort (CPUE) of splendid alfonsin and the North Pacific armorhead by Japanese and USSR/Russian trawlers

5.1 Stock size

Stock size estimation by Korea in Colahan (C), Milwaukee (D), Kimmei (E), and Koko (F) seamounts, during 2005-07, by.a commercial vessel (Oryong 503) using a swept-area method with a catchability (q) of 0.5 are: 1,086 ton in 2005, 717 ton in 2006 and 570 ton in 2007, with a mean and 95% confidence interval of 791±246.

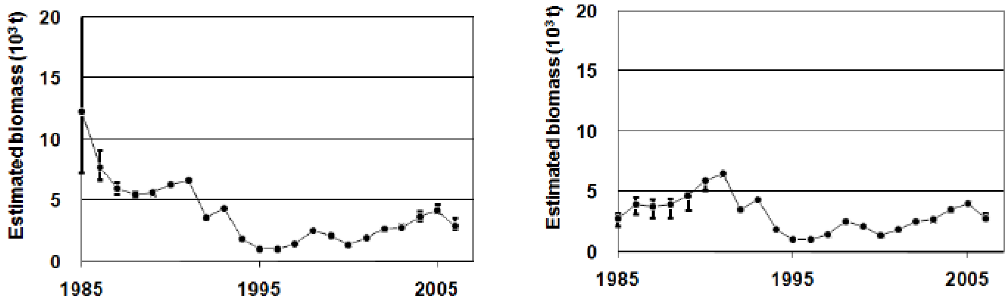


Figure 6. Trajectory of estimated biomass of splendid alfonsin, with 80% confidince limits from bootstrap resamling analyses (ASPIC run output). Left: anajdusted CPUE Right: ajusted CPUE (for details, see Nishimura and Yatsu (2008))

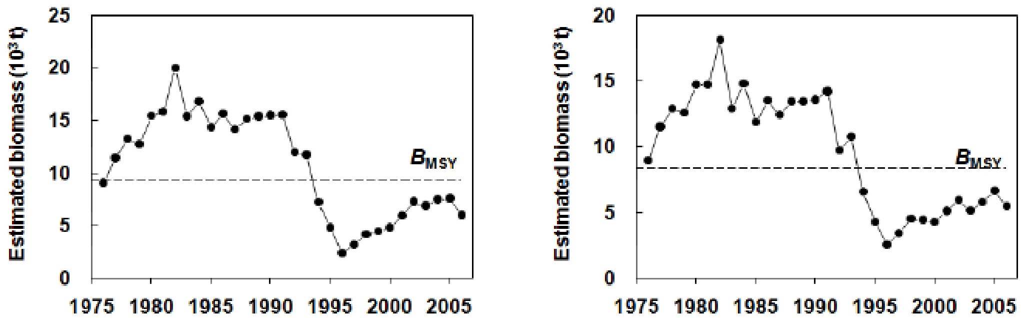


Figure 7. Trajectory of estimated biomass of splendid alfonsin (Excel spredsheet run output). Left: anajdusted CPUE Right: ajusted CPUE (for details, see Nishimura and Yatsu (2008))

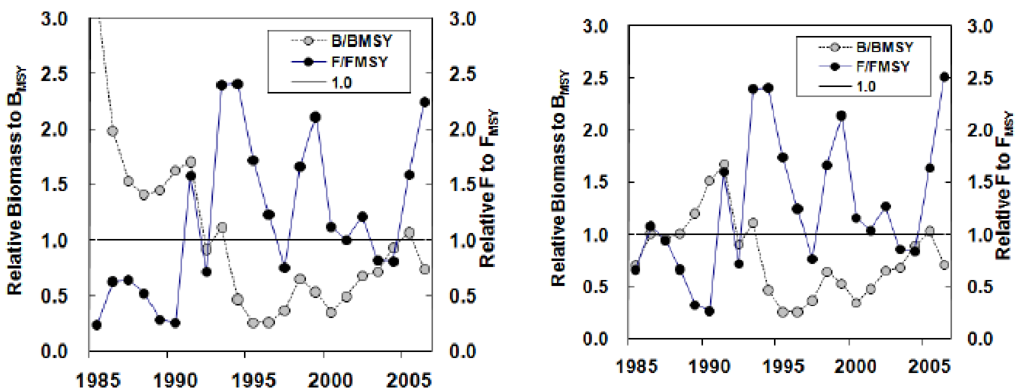


Figure. 8. Time-series of F/F_{MSY} and B/B_{MSY} (ASPIC run) of splendid alfonsin. Left: anajdusted CPUE Right: ajusted CPUE (for details, see Nishimura and Yatsu (2008))

According to four different production models, the estimated biomass trajectories of those two analyses showed similar tendency (Figures 6, 7). Estimated biomass was suggested to be higher level in the 1980s and suddenly decreased in the early 1990s. The both analyses indicated the lowest biomass was observed in 1996, and biomass increased steadily in the latest decade.

Table 5. Results of a bootstrap production model (ASPIC run).

	unadjusted effort			adjusted effort
		Confidence limits (Bootstrapped analysis)		
	Point estimate	80% lower	80% upper	Point estimate
Directly estimated parameters				
r	1.535	1.478	1.579	1.547
K	7,753	7,596	7,961	7,783
q	0.0001448	0.00013	0.0001627	0.000311
Management benchmarks				
MSY	2,975	2,940	3,002	3010
B_{MSY}	3,876	3,798	3,980	3891
F_{MSY}	0.768	0.739	0.789	0.774
observed $F_{10yrsAV.}$	1.025			1.076
ratio $F_{MSY/10yrs}$	75%			72%

Table 6-1. Results of a production model, assuming constant *r* and variable *K* and *q* (Excel spredsheet run, for unadjusted CPUE)

Year period	1976-78 and 83-2006	1979-82
Directly estimated parameters		
r	0.959	0.959
K	18,494	47,206,536
q	8.38E-05	4.28E-04
Management benchmarks		
MSY	4,432	11,312,568
B_{MSY}	9,247	23,603,268
F_{MSY}	0.48	0.48
observed $F_{10yrsAV.}$	0.60	
ratio $F_{MSY/10yrs}$	80%	

Table 6-2. Results of a production model, assuming constant *r* and variable *K* and *q* (Excel spredsheet run, for adjusted CPUE)

Year period	1976-78 and 83-2006	1979-82
Directly estimated parameters		
r	1.073	1.073
K	16,710	159,173
q	1.82E-04	8.07E-04
Management benchmarks		
MSY	4,482	42,694
B_{MSY}	8,355	79,586
F_{MSY}	0.54	0.54
observed $F_{10yrsAV.}$	0.70	
ratio $F_{MSY/10yrs}$	76%	

According to the time-series of relative biomass (B/B_{MSY}) was significantly above 1.0 in the 1980s (Figure 8). In the 1990s and after, however, the relative biomass declined below 0.5, and the alfonsin stock is suggested to be depressed below the MSY level, namely overfishd and overfising conditions.

5.2 Estimates of relevant biological reference points

5.2.1 Fishing mortality

F_{MSY} as estimated fishing mortality is considered appropriate as a limit reference point.

5.2.2 Biomass

B_{MSY} is a candidate for a reference point, but due to the nature of surplus production models, it shall be considered as a relative value.

5.2.3 Other relevant biological reference points

No information

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

No estimates available.

6.3 Bycatch of commercial species

The Japanese, Korean and Russian trawl fisheries has an associated by-catch of several species. The dominant include: Japanese boarfish (*Pentaceros japonicus*), broad alfonsin (*Beryx decadactylus*), Japanese butterfish (*Hyperoglyphe japonica*), mirror dory (*Zenopsis nebulosa*), skilfish (*Erilepis zonifer*), boarfhshies (*Antigonia* spp.), cardinalfish (*Epigonus* spp.), snake mackerel (*Promethichthys prometheus*), Morid cods (Moridae), squalid sharks and scorpinfishes (Sebastidae and *Helicolenus* spp.) (Sasaki, 1986, FAJ., 2008).

6.4 Habitat damage

The main method used to catch this species is a trawl generally fished hard down on the bottom. Trawling for this species on seamounts impacts habitat (Clark and O'Driscoll, 2003, Koslow et al., 2001), but the precise impact of this on the alfonsino populations or other species on the seamounts is unknown.

Severe damage of coral cover from bottom trawl fishing for orange roughy (*Hoplostethus atlanticus*) inside the Australian EEZ has been documented (Koslow et al., 2001). Video images reveal bare rock and pulverized coral rubble where bottom trawling has occurred.

Bottom trawling also tends to homogenise the sediment, which damages the habitat for certain fauna.

As fishing gear disturbs soft sediment they produce sediment plumes and re-mobilise previously buried organic and inorganic matter. This increase in the rates of nutrients into the water column has important consequences for the rates of biogeochemical cycling (Kaiser et al., 2002).

7 <u>Management</u>

7.1 Existing management measures inside EEZs

Within the US EEZ, fishing moratorium is continuing since 1986 (Anonymous, 2003).

7.2 Existing management measures in areas beyond national jurisdiction

Japan is implementing a limited entry system for trawl and gillnet fisheries. South Korea limits the number of bottom fishing vessels through the government licensing system. Russia is currently developing rules to regulate bottom fisheries in the area. For the interim measures, see the Section 1.

7.3 Fishery management implications

The present analysis using surplus production models suggested followings: 1) there were highly productive regime during 1979-82 and "ordinary" regime lasting to present, 2) alfonsin is overfished, 3) current fishing effort is above F_{MSY}, thus should be reduced considerably. Despite the unresolved problems such as population structure and migration between other areas, it is recommended to reduce current fishing effort by about 20%, as a first step of active adaptive learning.

7.4 Ecosystem considerations

The main method used to catch this species is a trawl generally fished close to, or on, the bottom. Trawling for this species on seamounts—which has taken place—will bring about habitat change, but the precise impact of this on the alfonsin populations and other species on the seamounts is unknown.

8 Research

8.1 Current and ongoing research

Within US EEZs
There is no scientific research within EEZ (USA) of SE-NHR since 1992.

High seas
Korea underwent scientific research cruse since 2004.
Japan conducted scientific research cruises since 2006.
Russia will conduct a scientific research cruise in 2009.

8.2 Research needs

Sampling of length frequency data to determine the size composition of commercial catches is necessary, because size data is potentially an excellent indicator of both target stocks and community structures (Shin et al., 2005). Observers should be placed on board. The collection of otoliths to determine the growth of alfonsino populations is also necessary. The resulting age composition of the catch would reveal the age at recruitment to the fishery, the number of age classes supporting the commercial catch, the maximum age of fish in the catch and the variability of recruitment strength in the SE-NHR. These data would provide a useful baseline for future monitoring of trends in the length and age composition of the SE-NHR catch, which is indispensable for the adaptive management.

9 Additional Remarks

There are no remarks at this stage..

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