Appendix E

Information describing the North Pacific armorhead (*Pseudopentaceros wheeleri*) fisheries relating to the North Western Pacific Regional Fishery Management Organisation

Adult (demersal)

Juvenile (epipelagic)

DRAFT
November 19, 2008

1 Overview

The North Pacific aromorhead (*Pseudopentaceros wheeleri*, Hardy, 1983, hereafter referred as armorhead) is distributed in the temperate and subarctic North Pacific between Japan and North America ranging from California to Alaska, with concentrations on seamounts of the Southern Emperor and Northern Hawaiian Ridge (SE-NHR) (Boehlert and Sasaki, 1988; Anonyumous, 2003). Juveniles inhabit the epipelagic layer of the central northern North Pacific and the Gulf of Alaska for 1-3 years. They settle to SE-NHR and become mature in the subsequent year of settlement. Adults form dense aggregation over the summits of seamounts at night. After settlement, armorhead loose their body weight, known as changes from "fat-type" to "lean-type" via "intermediate type". Armorhead in SE-NHR is considered to form a single metapopulation. The biological productivity of *P. wheeleri* is likely to be relatively high as juveniles and extremely low as adults.

Target fisheries for *P. wheeleri* occurred in the North Pacific in 1967 and lasting to the present day (Belaev and Darnitskiy, 2005). The main fishing methods of this species are bottom trawl, long-line and bottom gillnet. Trawling for this species on seamounts impacts mainly flat summits of the seamounts, but the precise impact of this on other species on the seamounts is unknown.

Limited entry system has been implemented to the Japanese fisheries for *P. wheeleri* 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. After the establishment of EEZ of USA in 1977, Japanese trawl fleets underwent commercial fishing at the Hancock seamounts until 1984, thereafter the fishing moratorium is continuing within the US EEZ (Anonymous 2003). 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.

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

Perciformes

2.4 Family

Pentacerotidae

2.5 Genus and species

Pseudopentaceros wheeleri, Hardy, 1983

2.6 Scientific synonyms

Pseudopentaceros pectoralis, Hardy, 1983 (Humphreys et al., 1989)

2.7 Common names

Pelagic armorhead, North Pacific armorhead, slender armorhead, Kusakari-tsubodai (Japan, common name used by scientists, also used by fishers for lean-type), Hon-tsubodai (used by Japanese fishers for fat-type), Tsubodai (name used by Japanese fishers for intermediate-type; N.B. also Japanese common name used by scientists for *Pentaceros japonicus*), Minsajagu (Korea), Kaban-ryba (Russia)

2.8 Molecular (DNA or biochemical) bar coding

Since there is no indication of differentiation in protein, parasite, and mitochondrial DNA among individuals collected at different seamounts and from the open ocean, the SE-NHR, armorhead is considered to form a meta-population (Borets, 1979, Martin et al., 1992, Yanagimoto et al., 2008).

3 Species Characteristics

3.1 Global distribution and depth range

Distribution is confined to the North Pacific Ocean. Juveniles inhabits epipelagic layer and adults are distributed along slope (<800m depth) and summits (<300m depth) of seamounts of SE-NHR with diel vertical migration, i.e., they aggregate near the summit of seamounts in night and disperse in daytime (Humphreys and Tagami, 1986).

3.2 Distribution within the North Pacific area

Distribution and possible migration routes in the North Pacific Ocean is shown in Figure 1. Juveniles (18-26 cm SL) inhabit epipelagic layer of the central northern North Pacific and the Gulf of Alaska and Subarctic North Pacific for about 2-3 years (Uchiyama and Sampaga, 1989, Somerton and Kikkawa, 1992). They settle to seamounts of SE-NHR and become mature in the subsequent year of settlement. Adults form dense aggregations over the summits of seamounts at night (Boehlert and Sasaki, 1988, Somerton and Kikkawa, 1992). In the SE-NHR, depths of the Japanese trawl fishing grounds were mainly 300-400m (Yanagimoto, 2004). Depth of the Korean trawl and long-line fishing grounds extends between 250-500 m and 300-1,050 m, respectively. In the last years, most Russian armorhead trawl catches were obtained from depths 360-520 m, long line catches were obtained from depths 600-750 m mainly.

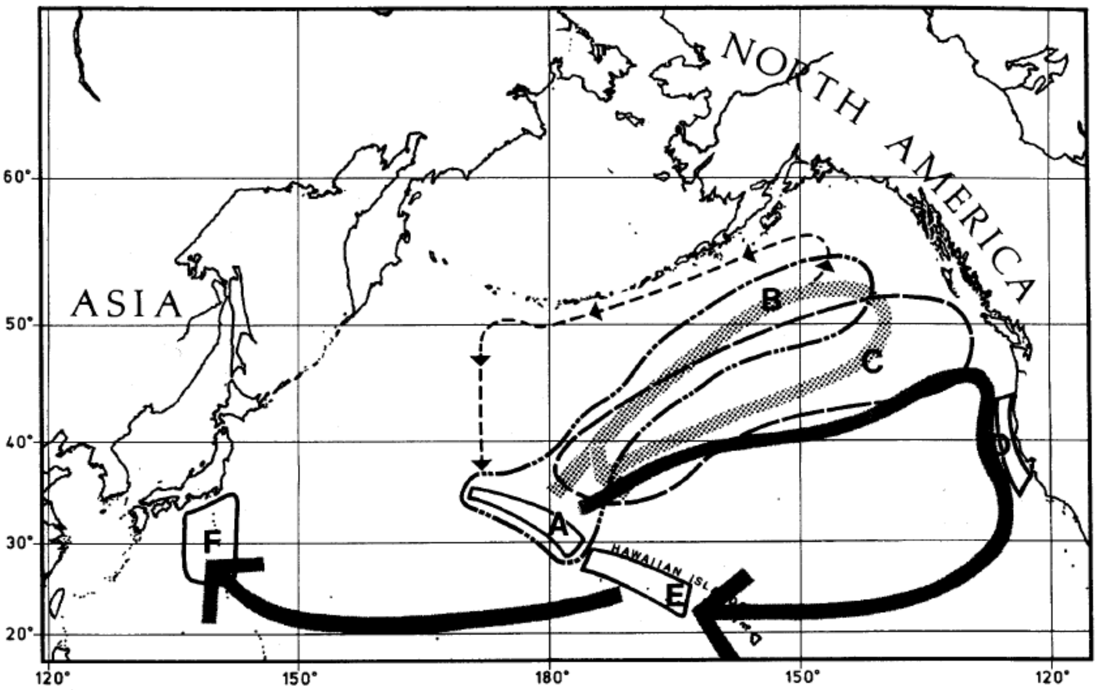


FIGURE 4.—Distributions of benthic and pelagic specimens of armorhead, *Pseudopentaceros wheeleri*, by age group with possible patterns of movement. Area A represents the major spawning area, and area E the region inhabited by the large, older specimens. Area B is the region in which specimens younger than 1 year have been captured, and area C where fish from 1 to 2 years old have been captured. The arrow through this region represents the main population movement pattern. Other arrows represent possible movements for stray fish. Areas marked D and F represent locations of benthic collections from California and Japan, respectively.

Figure 1. Known distribution and possible migration routes of North Pacific armorhead (after Boehlert and Sasaki (1988))

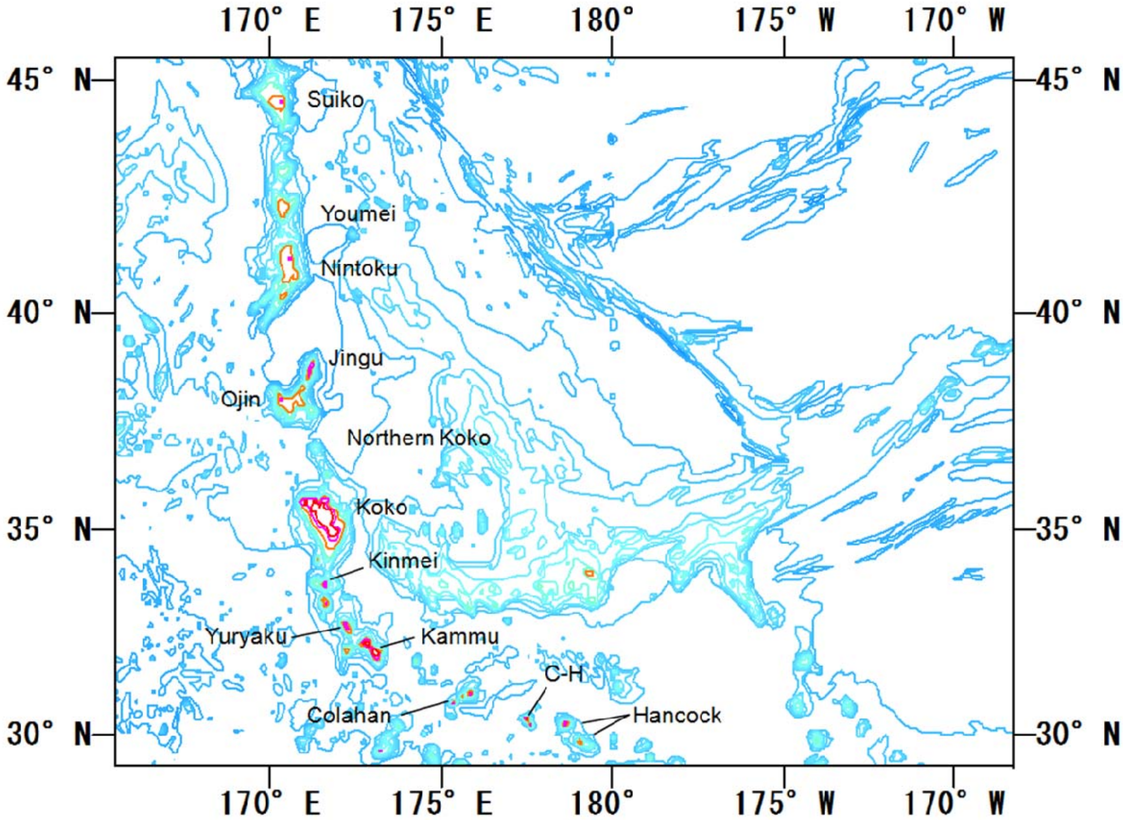


Figure 2. Locations of major seamouts in SE-NHR.
Yuryaku and Kammu are belonging to Milwaukee group. Legends of isobaths: red (500m), pink (1000m), orange (1500m), blues (500m interval below 500m).

3.2.1 Inter-annual and/or seasonal variations in distribution

Juveniles (20-32 cm FL) undergo northeast-ward migration in the central North Pacific from May to September (Yatsu et al., 1993)

3.2.2 Other potential areas where the species may be found

Armorhead are infrequently captured along the slopes of banks and islands within the Northwestern Hawaiian Islands at depths comparable (250-550 m) to their seamount distribution within the Southern Emperor-North Hawaiian Ridge. Some of these armorhead attain a much larger size (45-50 cm FL) than those found at the seamounts; this phenomenon remains unexplained.

3.3 General habitat

Juveniles inhabit epipelagic layer of the central northern North Pacific and the Gulf of Alaska and Subarctic North Pacific (SST ranged from 8.6º to 18.0ºC) (Boehlert and Sasaki, 1988, Mundy and Moser, 1997, Yatsu et al. 1993). After settlement to SE-NHR, adults (mainly 25-33 cm FL) form dense aggregations over the summits of seamounts at night (Boehlert and Sasaki, 1988, Somerton and Kikkawa, 1992).

3.4 Biological characteristics

Reproductive fish is typically 23.0-28.5 cm SL, and are distributed between 200 and 500m depth (Boehlert and Sasaki, 1988). From temporal changes of gonadal somatic index (GSI) of female armorhead (Sasaki, 1974) and observation of gonad (Iguchi, 1973), it was considered that armorhead spawn during winter. Bilim et al. (1978) and Yanagimoto and Humphreys (2005) conducted the histological observation of female gonad, which suggested, together with the GSI changes, that armorhead spawn from November to February. Larvae and young juveniles occur in February and March (Borets, 1980).

The initial pelagic phase includes the neustonic life of larvae and early juveniles in the vicinity of the seamounts with the subsequent dispersal life into the surface waters of the central and eastern portions of the subarctic North Pacific (Mundy and Moser, 1997, Yatsu et al., 1993).

Recruitment to the seamounts occurs mainly during late spring to midsummer, i.e, June-August (Humphreys et al., 1993), after 2-3 years of the pelagic life (Somerton and Kikkawa, 1992, Uchiyama and Sampaga, 1989). Size of recruited fish is characterized by narrow size range (25-33 cm FL), that differs a little between seamounts, though 15-40 cm FL specimens occur (Humphreys and Tagami, 1986, Humphreys et al., 1989). Size compositions from a bottom trawl survey in 1993 are similar in several seamounts (about 25-36 cm FL with a peak at about 27-30 cm), and females are slightly larger than males (Yanagimto and Nishimura, 2007).

Armorhead recruited to seamounts, having a high body depth with extraordinary large amount of stored fat (fat-type), will subsequently lose their fat and became lean-type over the remaining 4 years (or more) of life, on the basis of consecutive decline in fatness of strong year classes (Humphreys et al., 1989, Somerton and Kikkawa, 1992). Uchiyama and Sampaga (1989) estimated age of commercially caught fish from the Hancock seamount, mainly 26-33 cm FL, as 1.5-2.5 years, on the basis of daily and annual increments of otoliths (sagittae), and suggested possibility of only one or two spawning seasons and subsequent death, however, Somerton and Kikkawa (1992) tracked strong year classes at least four years after the settlement on the basis of transitions in fatness index. Ages of larger specimens (43-55 cm FL) taken from the Northern Hawaiian Ridge ranged from 4 to 8 and older, suggesting longer pelagic life (Uchiyama and Sampaga, 1989). The life span is considered about 11 years (http://www.fishbase.org). There remains disagreement on whether the lifespan of armorhead is 7 or 11 years; either way, it is not considered a long-lived species.

Feeding activity of adults is round-the-clock with peaks in morning and evening hours (Humphreys and Tagami, 1986). Major prey of juveniles (8.5-23.0 mm FL) collected from the Hancock seamount were copepods, chaetognaths and larval bivalve mollusks, and those of adults are organisms forming a deep-scattering-layer (DSL) such as tunicates and mesopelagic crustaceans and fishes (Humphreys and Tagami, 1986, Seki and Somerton, 1994). Armorhead feed on micronekton that are advected over the seamount and subsequently trapped on the summits as they descend, however, they are considered under starvation (Seki and Somerton, 1994).

The natural mortality coefficient (*M*) is estimated 0.25 (Borez, 1975) or 0.54 per year (Somerton and Kikkawa, 1992).

Morphological characteristics

P. wheeleri have 13-15 dorsal spines, 7-10 soft dorsal rays, 3-5 anal spines, and 6-8 soft anal rays (Humphreys et al., 1989). Lateral line extends to caudal fin, with 64-87 lateral line scales. In the pelagic stage, body depth is high and body colour is bluish dorsally with dark mottles on lateral sides, after the settlement to seamounts they turn to bluish gray in fat-type, and finally brownish in lean type (low body depth).

3.5 Population structure

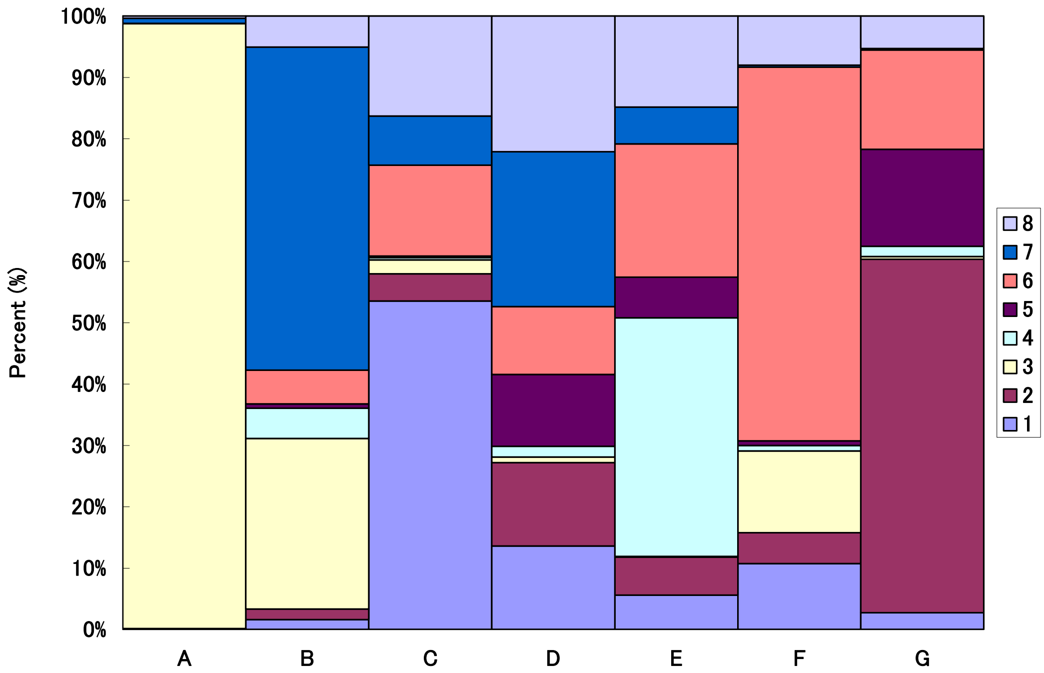
In SE-NHR, armorhead is considered to form a meta-population (Borets, 1979, Martin et al., 1992, Yanagimoto et al., 2008).

3.6 Biological productivity

Most of the somatic growth of armorhead is attained during their pelagic life stage until recruitment to seamounts (age 1.5-2.5). After settlement, they do not grow and lose their accumulated fat under a starvation condition (Seki and Somerton, 1994).

3.7 Role of the species in the SE-NHR seamount ecosystem

Since armorhead feed upon primarily the DSL-forming organisms around the summits of seamounts and they are usually starved, suggesting they do not rely on demersal organisms. Because splendid alfonsin (*Beryx splendens*) and mirror dory (*Zenopsis nebulosa*) mainly feed lantern fishes and shrimps, armorhead may avoid competition for food with other dominant fishes. Thus, ecological role of armorhead in the SE-NHR is considered producers of their eggs, consumers of micronektonic animals (mainly tunicates and mesopelagic crustaceans and fishes), and may be prey for larger animals, although there is no available documents of their predators in SE-NHR. Juvenile armorhead was found in the stomach of Bryde's whale (Boehlert and Sasaki, 1988). Armorhead is associated with alfonsin, mirror dory, and cardinalfish (*Epigonus denticulatus*) (Yanagimoto, 1996). 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).



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

Table 1. 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												

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												

Table 1. continued

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). Armorhead on the high seas in SE-NHR is predominantly caught by fishing vessels of Japan, Korea and Russia with bottom trawling, and the remainder being taken by the Japanese bottom gillnet fleets (Table 2, 3).

4.3 Catch history

The bottom trawl for this species in SE-NHR started in November 1967 by the former Soviet Union; the Japanese trawl fleets began fishing in 1969; the former Soviet Union fleets left the fishery after 1977 (Belaev and Darnitskiy, 2005). In recent years, Russia catch small amount of this species (Table 3). The main fishing grounds were initially located at the northern large tablemout seamounts (Koko, Yuryaku, and Kammu) of the SE, and expanded southward to encompass the much smaller NHR guyot-type seamounts including Colahan, C-H, and Hancock (Sasaki, 1986, Anonymous, 2003, Table 1). 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). 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. The fishing effort and catch of recent years is summarized in Table 2 and 3, respectively. Since 1967, armorhead has been the most important target species of the Japanese, Korean and Russian bottom fisheries in SE-NHR (Figure 3). After the drastic decline of catch in 1977, there were two pulses of catch in 1992 and 2004, which are presumably derived from occurrences of strong year classes. In the subsequent years, the armorhead catch sharply declined, compared to continuous good catches from 1969 to 1976 (Figure 4). Although annual armorhead catches have declined dramatically since 1977, these seamount fishing grounds have increased their importance for the Japanese trawlers, owing to the decline and cessation of pollock fishing within international waters of the Bering Sea.

Table 2. Numbers of fishing vessels and fishing days by country and fishery (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	Japan	Korea	Russia	Japan	Korea	Russia	Japan	Korea	Russia	Japan	Korea	Russia
Year												
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	Japan	Korea	Russia	Korea	Russia	Japan	Russia
Year							
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 3. Catch in ton of North Pacific armorhead in recent years by country and fishery (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	209	0	0	0	150	0
2003	449	0	0	0	0	0
2004	12,641	461	185	0.28	0	0
2005	5,638	659	141	0	232	0
2006	1,488	124	139	0	na	na

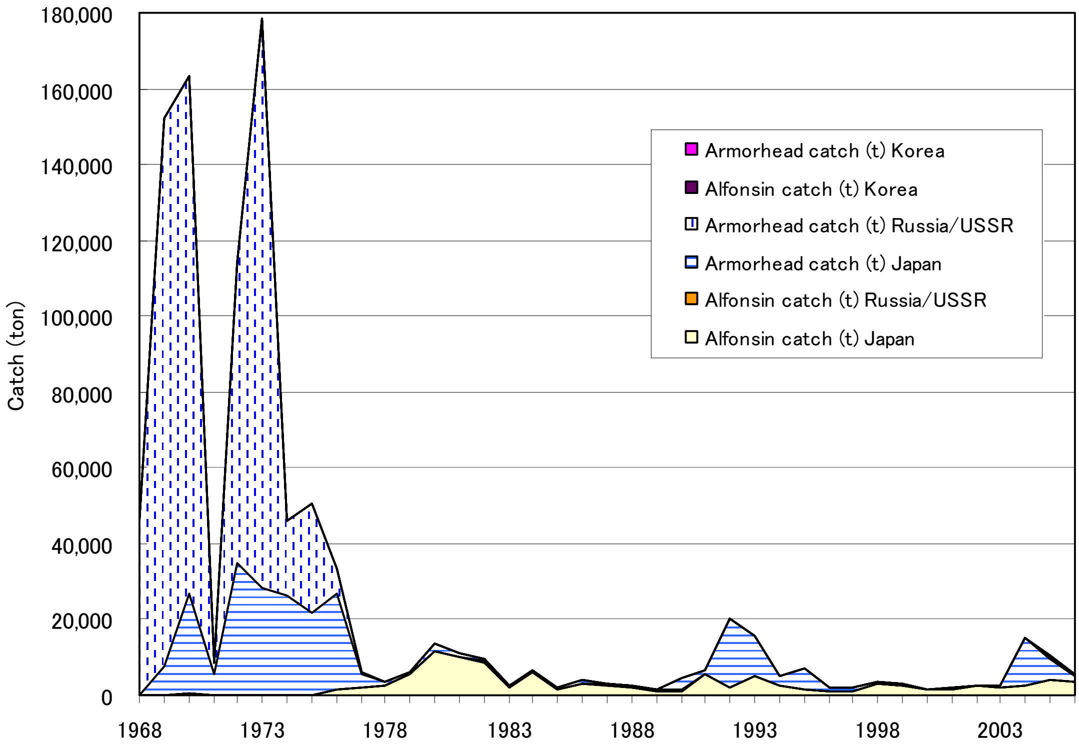


Figure 4. Catch trajectories of North Pacific armorhead and splendid alfonsin in SE-NHR.

4.4 Status of stocks

Armorhead catch-per-unit-effort (CPUE) of the Japanese trawl fishery was high in the early 1970s, with a peak of 54 ton/hour in 1972 (Figure 4, 5). But, thereafter CPUE rapidly declined and became stable at low level except for 1992 and 2004, which is derived from occurrences of strong year classes. As possible factors related to occurrences of strong year classes, Boehlert and Sasaki (1988) listed a number of factors including warm years, which are considered favourable for abundant zooplankton in the north-eastern North Pacific as their prey, changes in large scale gyres and currents, and longitudinal positions of the Aleutian Low.

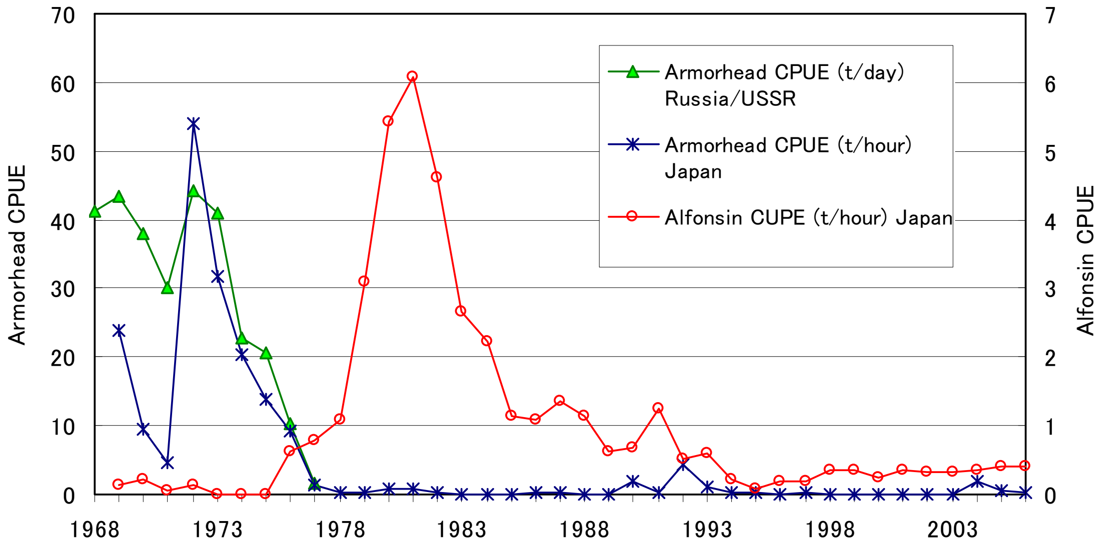


Figure 5. Catch-per-unit-effort (CPUE) of North Pacific armorhead and splendid alfonsin by Japanese and USSR/Russian trawlers.

4.5 Threats

No threat status known.

4.6 Fishery value

Section yet to be developed

5 Current Fishery Status and Trends

5.1 Stock size

Borets (1975, 1976) estimated stock abundance and fishing mortality coefficient (*F*) of armorhead distributing at nine seamounts located between the Kinmei (33° 42'N, 171° 33'E) and the Zapadnaya (28º 54' N, 179º 36' W) seamounts using an age-structured model, assuming *M* = 0.25 (Table 4).

5.2 Estimates of relevant biological reference points

5.2.1 Fishing mortality

Borets (1975, 1976) estimated stock abundance and fishing mortality coefficient (*F*) of armorhead distributing at nine seamounts located between the Kinmei (33° 42'N, 171° 33'E) and the Zapadnaya (28º 54' N, 179º 36' W) seamounts using an age-structured model, assuming *M* = 0.25 (Table 4).

Table 4. Estimation of fishing mortality coefficient (F) and stock abundance of North Pacific armorhead during 1968-75 (Borets, 1975, 1976). Unit: million fish except for *F*.

Indices	1968	1969	1970	1971	1972	1973	1974	1975
Stock	620	792	659	443	728	711	346	321
Catch	99	325	290	34	196	341	79	93
F	0,2	0,63	0,67	0,09	0,36	0,77	0,3	0,39
Natural decrease	124	135	105	94	131	114	66	58
Total decrease	223	460	395	128	327	455	145	151
Remainder	398	332	264	315	401	256	201	170
Growth	34	31	24	26	30	20	18	14
Recruitment	361	296	155	387	280	70	102	64

Using a depletion method, Somerton and Kikkawa (1992) estimated biomass and *F* of armorhead in the Southeast Hancock seamount (29°48' N, 179°04' E) during 1978-83, and reported average *F* as 1.03 per year, which is about two times of their assumed *M*. Based on a single-species dynamic model, Borets (1975) proposed the optimal level of harvesting as 20% of the stock, namely, less than their assumed *M*. The reliability of these estimations depends on accuracy of catch-at-age data, CPUE and *M*. Borets (1975, 1976) assumed that 26-30cm fish, the majority of commercial catch by Soviet/Russian trawlers, is 7-9 years old, however, recent studies suggest that the ages are much younger (Boehlert, 1986; Uchiyama and Sampaga, 1989). Also, estimation of *M* generally accompanies considerable uncertainties.

5.2.2 Biomass

Somerton and Kikkawa (1992) estimated that biomass of armorhead in the Southeast Hancock seamount declined from 5,500 metric ton in 1972 to 25 ton in 1989. Caution must be paid to these estimation values as indicated above. There is no estimation of optimum spawning stock size of SE-NHR (Somerton and Kikkawa, 1992). Abundance estimates based on bottom long line catch rate can be biased by gear saturation when the population is no longer low, particularly after a recruitment event. 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: 298 ton in 2005, 344 ton in 2006 and 156 ton in 2007, with a mean and 95% confidence interval of 266±91.

5.2.3 Other relevant biological reference points (BRPs)

After the settlement to SE-NHR, armorhead is believed to spawn for several years with a continuous loss of their body weight presumably due to poor feeding conditions and spawning. Also there are no reliable estimations of natural mortality rates. Therefore, it is impossible to apply BRPs based on yield-per-recruitment or optimum spawner stock size (Somerton and Kikkawa, 1992). Anonymous (2003) estimated %SPR from the Japanese trawl CPUE data during 1985-2002, and concluded the overall stock is in overfished condition (<20%SPR) since 1985, with mostly less than 3% SPR, however, strong year-classes were observed in 1994 and 2004. Given this situation, FAJ (2008) proposed to apply a simple adaptive feed-back control rule for management of this stock, together with splendid alfonsin.

6 Impacts of fishing

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*), splendid alfonsin (*Beryx splendens*), 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 bottom trawl, mostly on the flat summit areas of seamounts of SE-NHR. Trawling for this species on seamounts impacts habitat, but the precise impact of this on the armorhead populations or other species on the seamounts is unknown.

7 Management

7.1 Existing management measures inside EEZs

Within the US EEZ of SE-NHR, fishing is prohibited since 1986.

7.2 Existing management measures in areas beyond national jurisdiction

Currently limited entry licence system is implemented by Japan. 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 lack of information, especially a direct stock assessment, exacerbates risk.

7.4 Ecosystem considerations

Trawling for this species on seamounts impacts the ecosystem, but the precise impact is unknown.

8 Research

8.1 Current and ongoing research

Within 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 for armorhead caught in the international waters of SE-NHR, because size data is potentially an excellent indicator of both target stocks and community structures (Shin et al., 2005). Observers on board Japanese trawlers have been collecting length frequency, other biological data and intact specimens of armorhead. The collection of otoliths to determine the age and growth of armorhead 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.

9 Additional Remarks

There are no remarks at this stage.

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