STATUS REPORT

Pseudopentaceros richardsoni

2012

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1. Description of the fishery

1.1 Description of fishing vessels and fishing gear

The Korean trawl fishery in the SEAFO CA started in 2010 using trawl nets by two fishing vessels, F/V Adventure and F/V Dongsan Ho. Table 1 and Fig. 1-3 show the gear specifications for F/V Adventure. HAMPIDJAN NET, bottom fishing, is a two-piece net, 66 m in length. The head rope is 48 m long; ground rope is 50 m; the height, width and girth of the net are 5.5 m, 30 m and 100 m, respectively. The cod-end mesh size is 120 mm. The ground gear is 50 m in length and 903 kg in weight, and the float is 1,018 kg. MANUFACTURED NET is a four-piece net with the overall length of 66.9 m. The lengths of the head rope and ground rope are 59.0 m and 77.9 m, respectively. The height, width and girth of the net are 5.5 m, 200 m and 83 m, respectively. The cod-end mesh size is 120 mm. The ground is 77.9 m in length and the weight of the ground is 2,068 kg. The float is 913.200 kg with the floating rate of 44%. MIDWATER NET is 210 m long. The lengths of head rope and ground ropes are 93.6 m. The height and width of the net are 70.0 m and 240~260 m respectively. The girth of the net is 816 m. The cod-end mesh size is 120 mm.

Table 1: Gear specifications for F/V Adventure

Gear Specifications		bottom fishing HAMPIDJAN	bottom fishing (custom manufactured)	mid-water
Otter board	type	VRS-TYPE	VRS-TYPE	VRS-TYPE
	material	Steel	Steel	Steel
	size (mm)	2,300 x 4,030	2,750 x 4,900	1,854 x 3,818
	weight (kg)	3,930	4,320	2,000
	under water weight (kg)	2,619	2,473	1,145
Trawl Net	purpose	bottom fishing (figure1)	bottom fishing (figure2)	mid-water fishing (figure3)
	net length overall(m)	66	66.9	210.0
	head rope (m)	48	59.0	93.6
	ground rope (m)	50	77.9	93.6
	net height (m)	5.5	5.5	70
	net width (m)	30	200	240~260
	net girth (m)	100	83	816
	mesh size (mm)	120	120	120

F/V Dongsan Ho is a stern trawler which has two types of fishing gears; mid-water trawl net and bottom trawl net – this vessel will not be operating in the future. The gear used for the operation in the SEAFO Convention Area is the mid-water KITE gear (Fig. 4), which consists of ropes, whose upper part has kites and lower part has chains. The height of the net's gate is approximately 50 m, and the total length is around 280 m. When set the mid-water net, the gear sinks underwater, whose sinking depth is controlled by wire ropes. Bottom trawl net is that PE Net is used in the SEAFO Area, to whose upper and lower parts plastic buoys and rubber balls are attached respectively. When set the bottom net, the gear sinks underwater, and the depth is controlled by wire ropes.

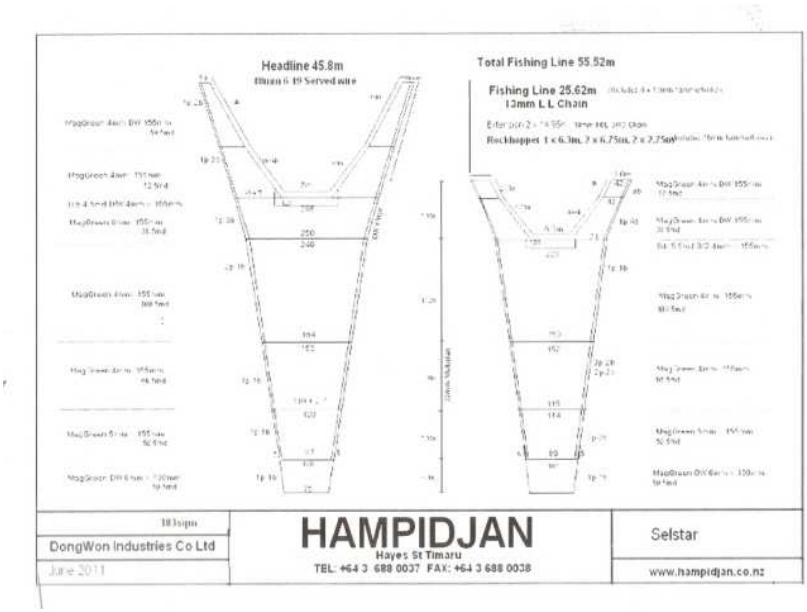

Figure 1: Diagram of HAMPIDJAN NET of F/V Adventure.

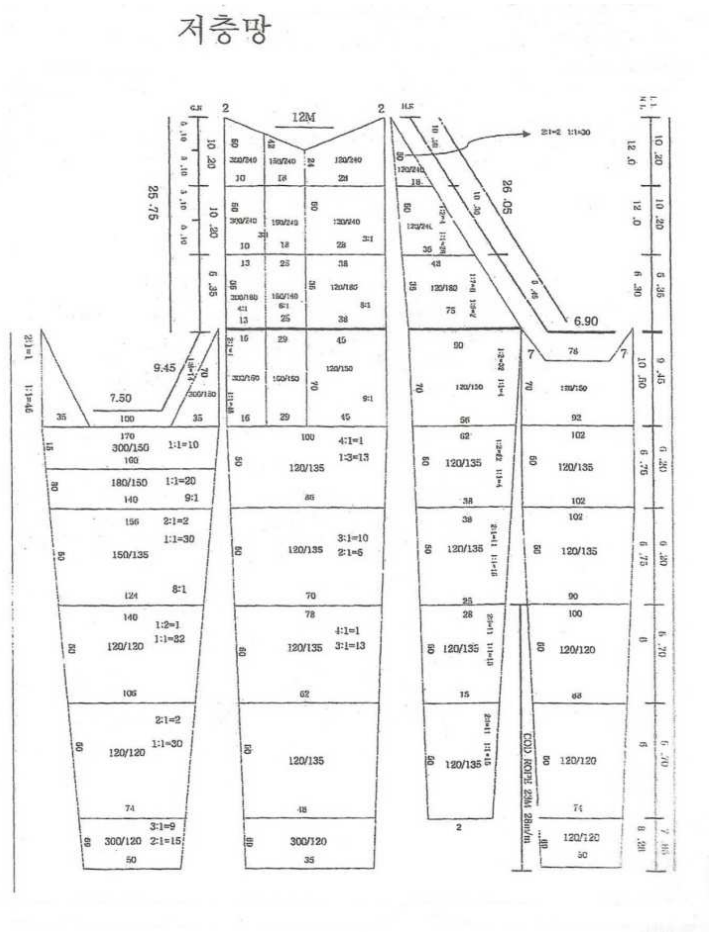

Figure 2: Drawing of the Custom Manufactured Bottom Trawl Net of F/V Adventure.

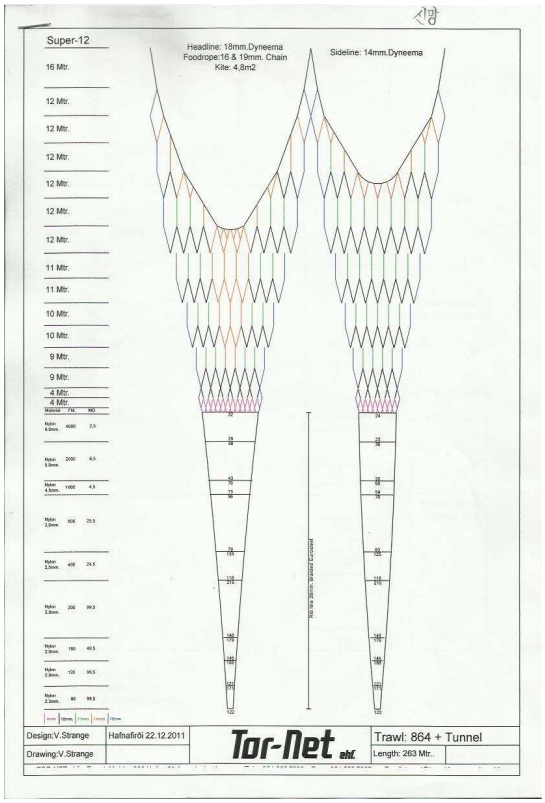

Figure 3: Drawing of mid-water trawl net of F/V Adventure.

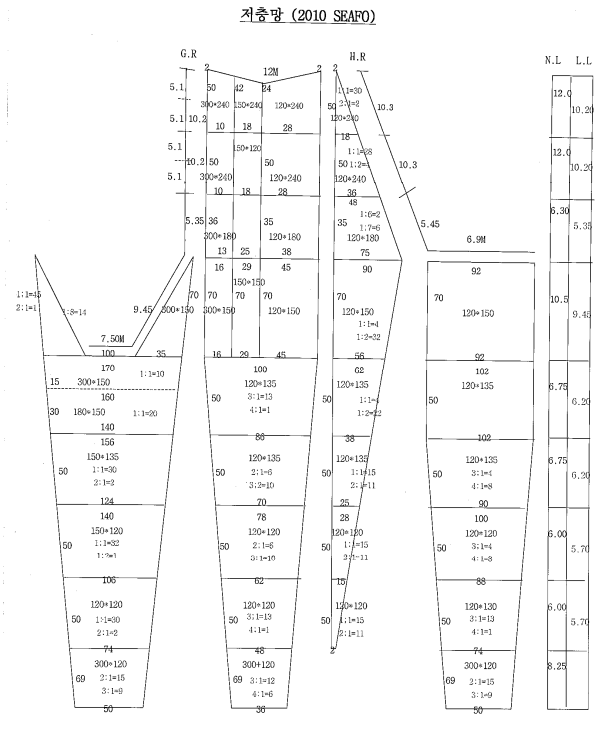

Figure 4: Drawing of mid-water trawl net of F/V Dongsan Ho.

1.2 Spatial and temporal distribution of fishing

During the period from 2010 to 2012 Korean trawl vessels (Dongsan Ho and/or Adventure) caught Pelagic Armourhead in the southern and northern parts of Valdivia Bank mainly in the southern part of the bank in Division B1 in the SEAFO CA (Fig. 5-7).

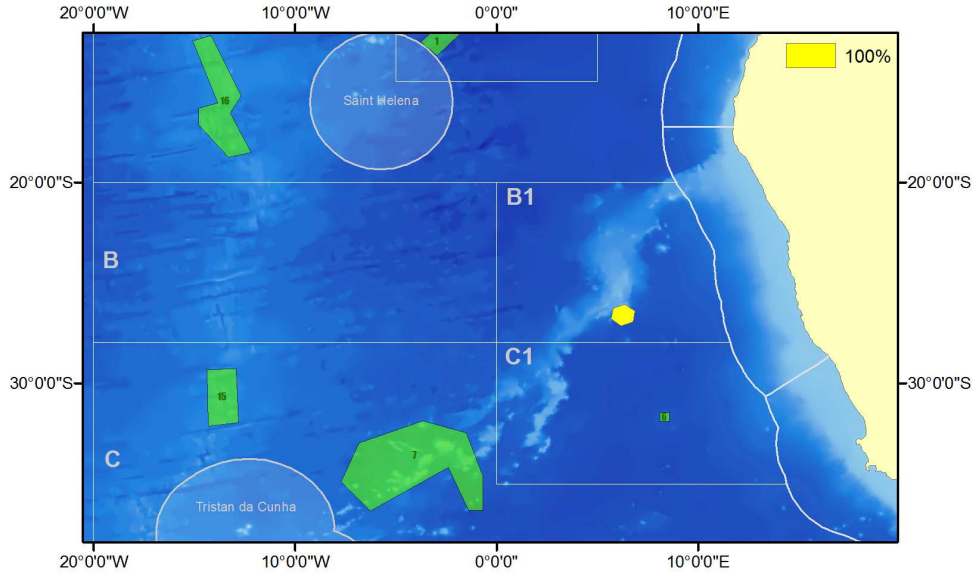

Figure 5: Annual estimated catch from the observer of Pelagic Armourhead/Southern boarfish (*P. richardsoni*) aggregated to 100km diameter hexagonal cells (Jan-Oct 2012).

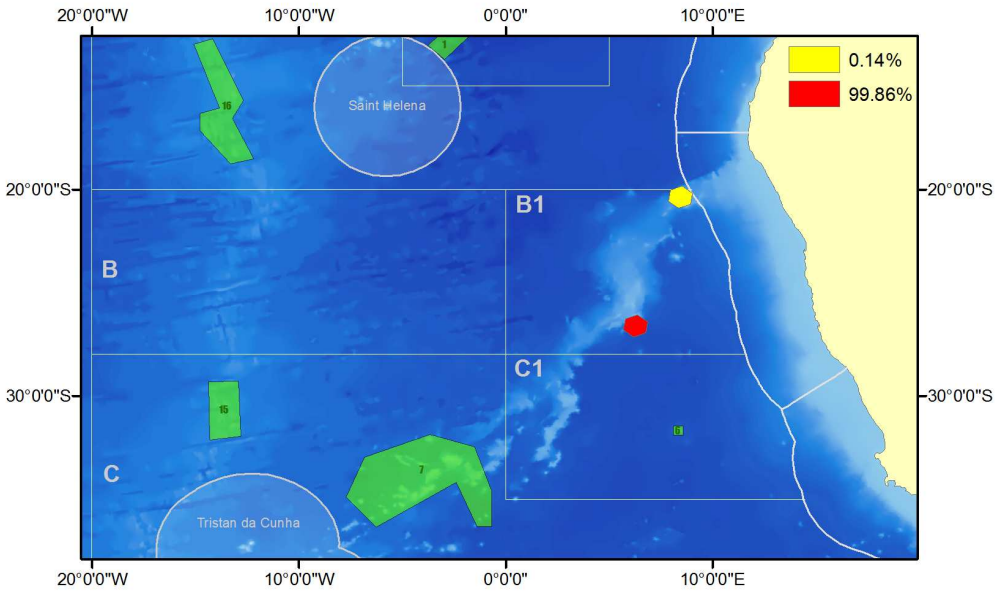

Figure 6: Annual estimated catch from the observer of Pelagic Armourhead/Southern boarfish (*P. richardsoni*) aggregated to 100km diameter hexagonal cells (2011).

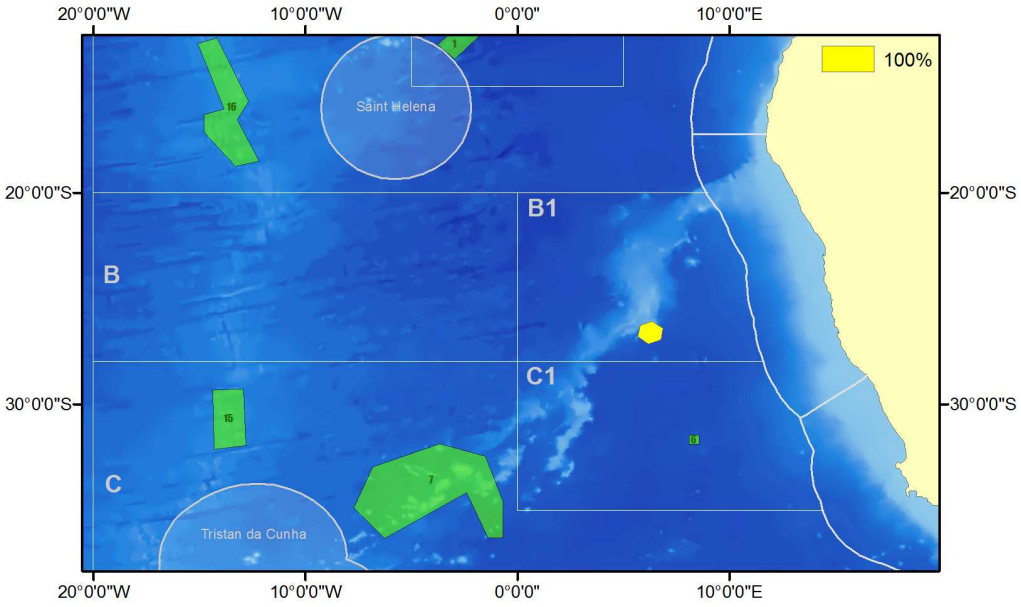

Figure 7: Annual estimated catch from the observer of Pelagic Armourhead/Southern boarfish (*P. richardsoni*) aggregated to 100km diameter hexagonal cells (2010).

1.3 Reported landings and discards

Table 2 presents Pelagic Armourhead catches by country, as well as fishing gear and the sub-division in which the catch was taken. The main fishing countries working in the area include Russia (bottom trawl) in the late 1970s, Ukraine (bottom trawl) and Namibia (bottom trawl) in the mid-1990s, and South Korea (mid-water trawl) in the early 2010s. Historically the highest catches of the fish were recorded by Russia with 1,273 and 1,000 tons in 1977 and 1993, respectively, and by Korea with 914 tons in 2010 in the SEAFO CA.

Table 2: Catches (tons) of Pelagic Armourhead made by various countries. Values in **bold** are from FAO.

Management Area Nations Fishing method	B1 Namibia Bottom trawl	B1 Russia Bottom trawl	Unknown Ukraine Bottom trawl	B1 RSA Bottom trawl	B1 Spain Bottom trawl & longline	Unknown Cyprus Bottom trawl	B1 South Korea Mid-water trawl
1976		108					
1977		1,273					
1978		53					
1993		1,000	**435**				
1994							
1995	8		49	530			
1996	284		281	201			
1997	559		18	12			
1998	N/F						
1999	N/F						
2000	20						
2001	N/F				<1		

2002	N/F						
2003	4				3		
2004					3	22	
2005							
2006							
2007							
2008							
2009	N/F	N/F	N/F	N/F	N/F	N/F	N/F
2010	N/F	N/F	N/F	N/F	N/F	N/F	918
2011	N/F	N/F	N/F	N/F	N/F	N/F	132
2012*	N/F	N/F	N/F	N/F	N/F	N/F	117

* Provisional (September 2012)

1.4 IUU catch

Apparent IUU fishing activity in the SEAFO CA has been report by vessel to the Secretariat, but the extent of this is at present unknown.

2. Stock distribution and identity

The Pentacerotidae *Pseudopentaceros richardsoni* (Smith 1844), commonly known as Pelagic Armourhead or southern boarfish, is a southern circumglobal, benthopelagic species inhabiting the waters over the outer shelf and slope (100-1000 m) between 0 and 1 000 meters depth.

The species inhabits seamounts and underwater ridges, e.g., Tristan de Cunha, Walvis Ridge and South Africa (Southeast Atlantic); south of Madagascar (Western Indian Ocean) and; southern Australia, New Zealand and Cape Horn (South Pacific) (Fig. 8).

Adults inhabit the steep and flat hard bottoms up to 800 m deep on the seamounts and underwater ridges in the open ocean. Eggs, larvae and juveniles are pelagic. This species recruit at the summit of the seamounts after approximately 4 years of pelagic life and aggregates.

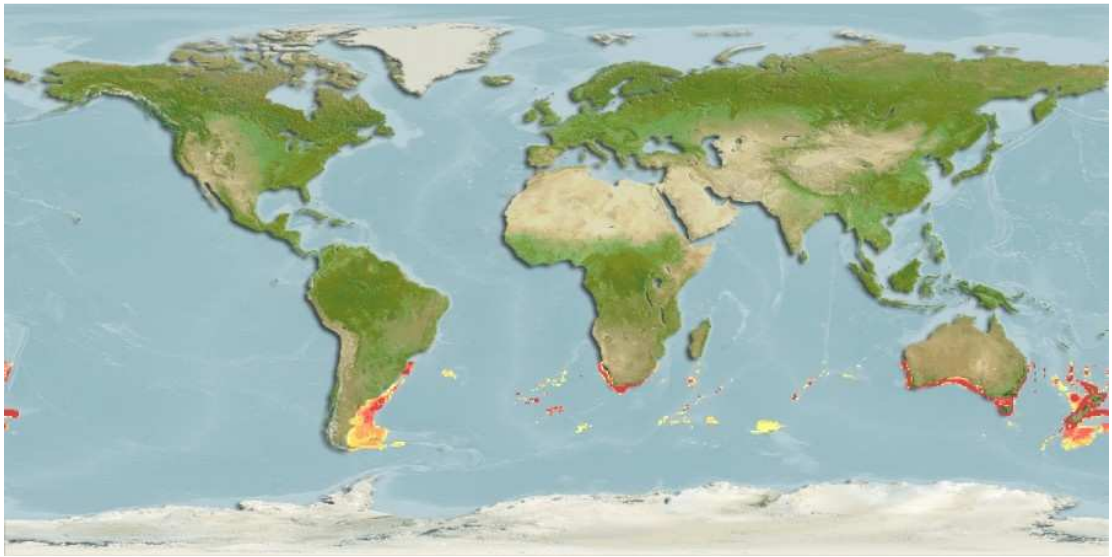

Figure 8: Distribution of Pelagic Armourhead (*Pseudopentaceros richardsoni*) (source: FishBase).

3. Life history parameters and information

3.1 Length frequencies

Using data collected by Korean fishing vessels between 2010 and 2012 September, the length frequency distributions were analysed (Fig. 9). During those years the total length of Pelagic Armourhead ranged from 35 cm to 60 cm. The annual average length was 44.3 cm, 44.1 cm and 46.6 cm in 2010, 2011 and 2012, and the annual median length was 44.0 cm, 44.0 cm and 47.0 cm in 2010, 2011 and 2012, respectively. Based on the results it is concluded that the length of the Pelagic Armourhead became lager from 44.3 cm to 46.6 cm at average length, and from 44.0 cm to 47.0 cm at median length for 2010 to 2012.

Table 3: Results of length composition of Pelagic Armourhead (*Pseudopentaceros richardsoni*) collected by the Korean vessels in the SEAFO CA for 2010-2012.

Year	2010	2011	2012
No. of samples	1,317	559	555
Minimum length (FL,cm)	36.0	35.0	37.0
Maximum length (FL,cm)	59.0	57.0	60.0
Average length (FL,cm)	44.3	44.1	46.6
Median length (FL,cm)	44.0	44.0	47.0
1st quartile length (FL,cm)	41.0	42.0	44.0
3rd quartile length (FL,cm)	47.0	46.0	49.5

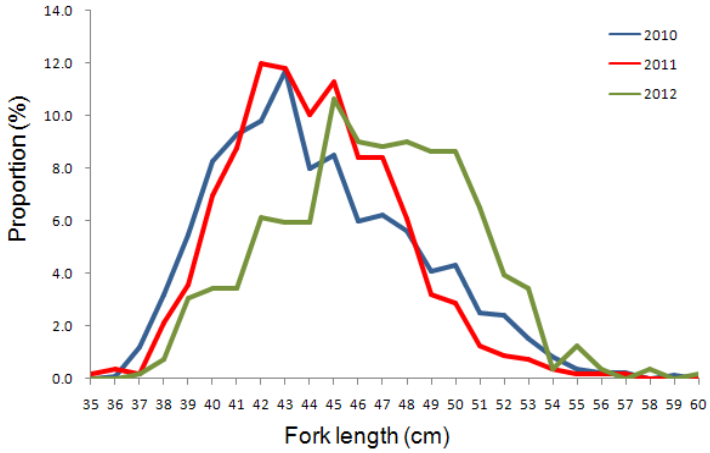

Figure 9: Annual length frequency distribution of Pelagic Armourhead (*Pseudopentaceros richardsoni*) in the SEAFO CA for 2010-2012.

Figure 10 shows the length distribution of Pelagic Armourhead by fishing depth in 2010-2012. The range of average depth became deeper from 236 to 316 m, and the average length also become lager from 44.1 to 46.6 cm (Table 4). The deepest depth and the largest length showed in 2012. Therefore, the length of Pelagic Armourhead became lager as the fishing depth deeper.

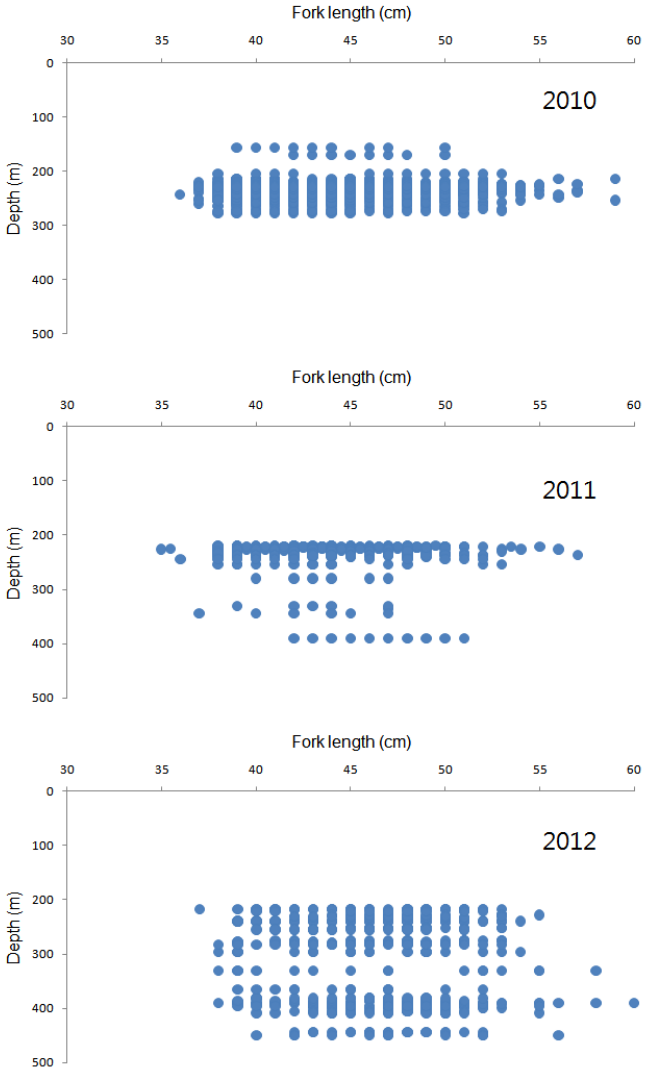

Figure 10: Fork length distribution of Pelagic Armourhead (*Pseudopentaceros richardsoni*) by depth for 2010-2012.

Table 4: Summary of fork length distribution of Pelagic Armourhead (*Pseudopentaceros richardsoni*) by depth for 2010-2012

Year	2010	2011	2012
No. of samples	1317	559	555
Average depth (m)	236.0	236.6	316.3
Average fork length (cm)	44.3	44.1	46.6

3.2 Length-weight relationships

Figure 11 represents the length and weight relationship of Pelagic Armourhead for 2010 – 2012. Two parameters of the length-weight relationship were estimated as $\alpha = 0.016$, and $\beta = 3.048$ for combined sex of Pelagic Armourhead.

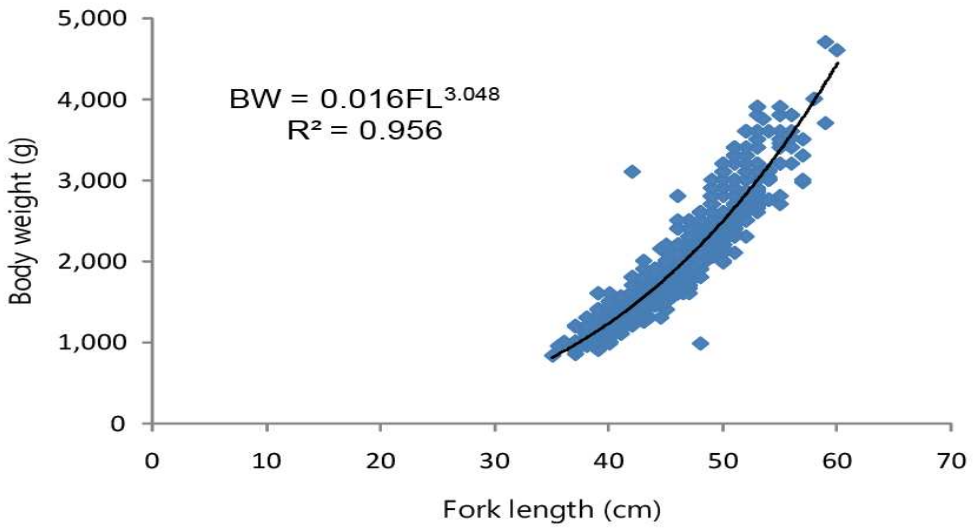

Figure 11: Relationship between length and weight of Pelagic Armourhead (*Pseudopentaceros richardsoni*) in the SEAFO CA for 2010-2012.

3.3 Age data and growth parameters

The maximum observed age of Pelagic Armourhead in the Southwest Indian Ocean was 14 years. The fish is known to aggregate and thus is vulnerable to over fishing.

The growth parameters of the fish were estimated as K=0.27 year^-1, Linf=65.1 cm, and t0=-0.34 year^-1 using the specimens from Southwest Indian Ocean (López-Abellán et al. 2007).

3.4 Reproductive parameters

The annual numbers and proportion of Pelagic Armourhead by maturity stage of gonad during 2010 – 2012 are shown in Table 5. The proportion of immature fishes was 77.8%, 80.3% and 0.0% in 2010, 2011 and 2012, respectively.

In May and June the fishes showed high proportion of pre-spawning and spawning stages (Figures 12). Based on the analysis results of maturity proportion trend by month of Pelagic Armourhead, the spawning seemed to happen sometime after May to before September in the SEAFO area, which is different from the period between October to December estimated using the specimens from Southwest Indian Ocean (López-Abellán et al. 2007).

The pre-spawning stage appeared firstly at 37 cm, and spawning stage at 38 cm (Fig. 13). All of the fish bigger than 50 cm were in the spawning stage. The first maturity length of Pelagic Armourhead was estimated as 44.1 cm (Fig. 14).

Based on the reproductive parameters it is concluded that the fishes caught by Korean vessels around Valdivia Bank were mostly adult fish, just showing different percentage rates by maturity stage as the season changes. However, the data used was very limited especially month data, so it is necessary to collect enough data for a few more years to drive more exact results related reproductive parameters.

Table 5: Annual number of fish by maturity stage of Pelagic Armourhead (*Pseudopentaceros richardsoni*) in the SEAFO CA for 2010-2012

Year	Maturity stage / Month	Immature	Developing	Pre-spawning	Spawning	Spent
2010	Sep	0	504	159	0	0
	Oct	0	437	107	0	0
	Nov	0	84	26	0	0
2011	Jan	14	78	27	0	0
	Sep	59	75	4	0	0
	Oct	30	26	13	0	0
	Nov	0	16	27	2	0
2012	May	0	0	38	96	0
	Jun	0	0	69	352	0

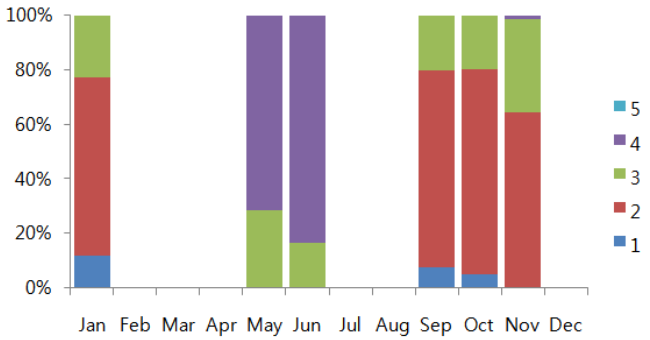

Figure 12: The proportion of maturity stage by month of Pelagic Armourhead (*Pseudopentaceros richardsoni*) in the SEAFO CA for 2010-2012 (1: immature, 2: developing, 3: pre-spawning, 4: spawning and 5: spent).

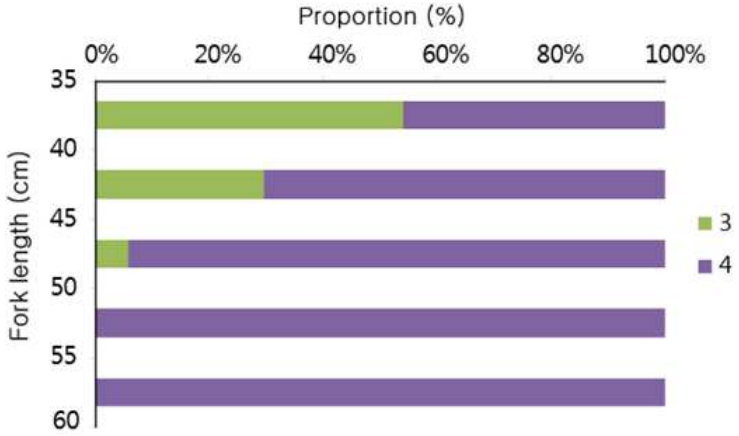

Figure 13: The proportion of maturity stage by length category of Pelagic Armourhead (*Pseudopentaceros richardsoni*) in the SEAFO CA for 2010-2012.

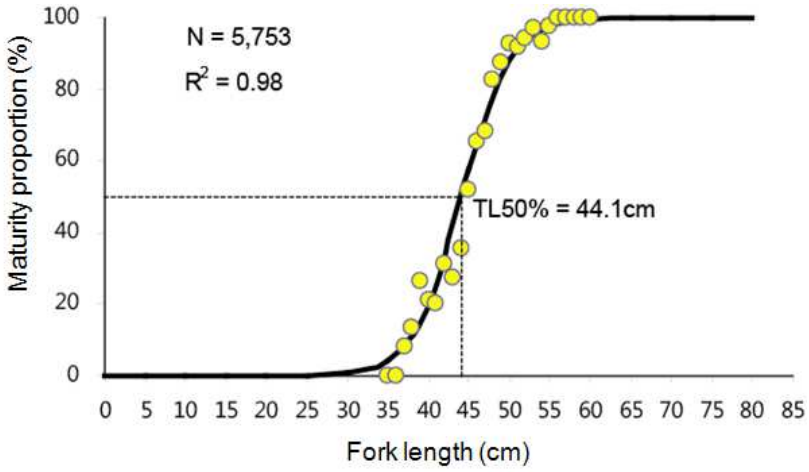

Figure 14: The maturity proportion by length of Pelagic Armourhead (*Pseudopentaceros richardsoni*) caught by Korean trawl fisheries in the SEAFO CA.

3.5 Natural mortality

The estimated natural mortality of Pelagic Armourhead was M=0.279.

3.6 Feeding and trophic relationships (including species interaction)

There is no available information and data in the SEAFO CA.

3.7 Tagging and migration

Tagging and migration study on the Pelagic Armourhead has not done in the SEAFO Area.

4. Stock assessment

4.1 Available abundance indices and estimates of biomass

P. richardsoni, particularly the adult exploited fraction of the population, has a patchy distribution: The species occurs in a restricted depth stratum on the summit of seamounts. This pattern makes the use of local depletion analysis, an adequate tool to evaluate the status of the population in those specific areas.

4.2 Data used

The data used are derived from fishing hauls in which total catch of *P. richardsoni* represented more than 80% of the total catch of *P. richardsoni* and *Beryx splendens*. This criterion is used since the catches of these two species are highly negatively correlated, i.e., when one of these two species occurs in the haul the other does not occur, as it can be seen for 2010 data (Fig. 15).

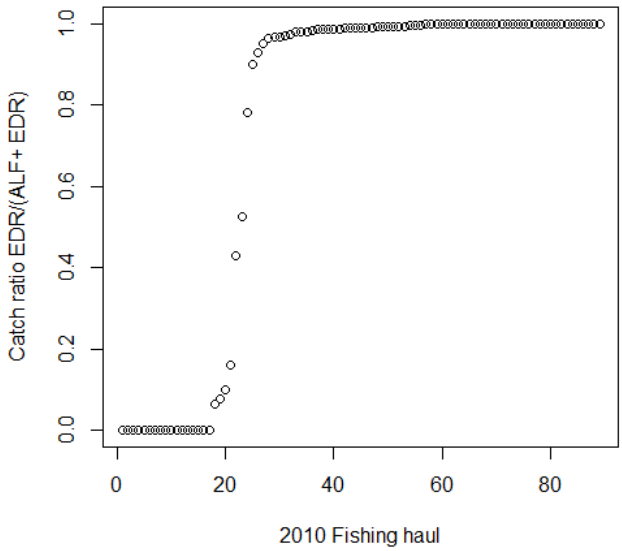

Figure 15: 2010 estimates of ratio of total catch *Pseudopentaceros richardsoni* by the total catch of *Pseudopentaceros richardsoni* and *Beryx splendens* by haul by Korean trawl vessels.

In each haul the estimate of CPUE of *P. richardsoni* is represented as the ratio of total catch of the species by the haul duration time.

4.3 Methods used

Local depletion model (DeLury 1947; Leslie and Davis 1939) was applied to 2010 and 2011 Catch and CPUE data. Depletion estimators are widely used in fish and wildlife studies to estimate population abundance (Seber 2002; Hilborn and Walters 1992).

Under Local depletion model it is assumed that no recruitment and no entries/exits to the fishing area during a particular season of fishing. Under these assumptions, catch rates will decline with continued fishing until all fishes have been removed. A linear regression model is adjusted to CPUE and the corresponding temporal cumulative catches. Through this model the total biomass available at the beginning of the season will thus corresponds to the total catch that equates to local extinction, i.e. point that cuts the x-axis.

The uncertainties of the estimates were determined by bootstrapping method. A total of 2000 bootstrap samples were derived from the input data and based on bootstrap estimates of the parameter and through this confidence interval for each parameter was derived accordingly.

4.4 Results

Figure 16 presents the CPUE against cumulative catch and the adjusted regression lines for 2010 and 2011.

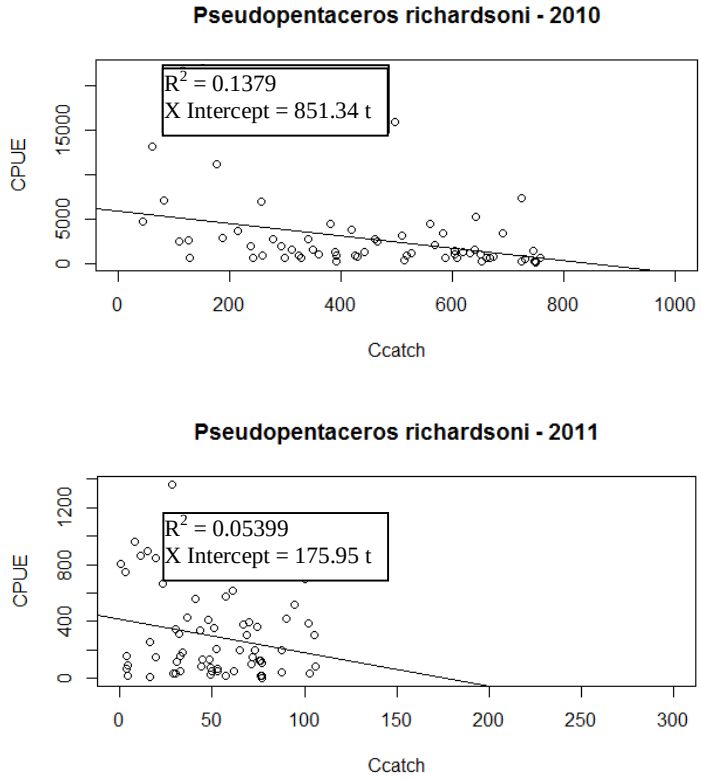

Figure 16: The CPUE against cumulative catch (Ccatch, tonne) of *Pseudopentaceros richardsoni* and the adjusted regression lines for 2010 and 2011.

Table 6 shows estimates of the biomass at the beginning of the fishing season as well as the 25% and 75% percentiles n for 2010 and 2011.

Table 6: Summary statistics of the biomass (in tons) at the beginning of the fishing season derived from 2000 bootstrap re-sampling estimates.

Year	25% Percentile	Estimate	75% Percentile l
2010	751	851	1096
2011	137	176	229

4.5 Discussion

The results obtained show a decreasing trend on the biomass available at the beginning of the fishing season from 2010 until 2011. In 2011the estimates of the biomass available at the beginning of the fishing season correspond to ¼ of that obtained for 2010.

4.5 Conclusion

The data on catches of *P. richardsoni* were from trawls held at Valdivia Bank, in a very small area, where the species concentrate at adulthood. These two aspects make the species highly vulnerable to overfishing.

Furthermore the actual level of exploitation over the stock is considered to be high and that the actual status of stock is likely to drive the population to low levels.

5. Ecosystem implications/effects

5.1 Incidental and bycatch statistics (fish, invertebrates, seabirds, cetaceans, turtles)

By-catch species from pelagic armourhead fishery were alfonsino, blackbelly rosefish, Imperial blackfish, oilfish, Cape bonnetmouth and gemfish. Among the by-catches alfonsino, blackbelly rosefish, imperial blackfish and oilfish were the most dominant species with 20-107 tons, 35-42 tons, 19-32 tons and 11 tons of catch in 2011-2012, respectively (Table 7).

Table 7: By-catch from Pelagic Armourhead/Southern boarfish (*Pseudopentaceros richardsoni*) fishery.

	2009	**2010**	**2011**	**2012**
Species	**-**	**-**	**B1**	**B1**
ALF			20,312	106,860
BRF			42,260	35,220
HDV			31,689	18,779
OIL			11,236	
EMM			724	760
GEM				20

BRF: Blackbelly rosefish (*Helicolenus actylopterus*); HDV: Imperial blackfish (*Schedophilus ovalis*); OIL: Oilfish (*Ruvettus pretiosus*) ; EMM: Cape bonnetmooth (*Emmelichtys nitidos*) and GEM: Silver gemfish (*Rexea solandri*)

5.2 VME incidental catch

5.3 Incidental and bycatch mitigation methods

5.4 Lost and abandoned gear

There was no reported lost and abandoned gear in the trawl fishery for Pelagic Armourhead in the SEAFO CA.

6. Biological reference points and harvest control rules

7. Current conservation measures

- ⇨ Conservation Measure 04/06: On the Conservation of Sharks Caught in Association with Fisheries Managed by SEAFO
- ⇨ Conservation Measure 07/06: Relating to Interim Measures to Amend the Interim Arrangement of the SEAFO Convention

- ⇨ Conservation Measure 08/06: Establishing a List Of Vessels Presumed To Have Carried Out Illegal, Unreported And Unregulated Fishing Activities in the South-East Atlantic Fisheries Organization (SEAFO) Convention Area
- ⇨ Conservation Measure 13-09: Interim Prohibition of Transshipments - at – Sea in the SEAFO Convention Area and to Regulate Transshipments in Port
- ⇨ Conservation Measure 14-09: To Reduce Sea Turtle Mortality in SEAFO Fishing Operations.
- ⇨ Conservation Measure 15-09: On Reducing Incidental By-catch of Seabirds in the SEAFO Convention Area.
- ⇨ Conservation Measures 18/10 on the Management of Vulnerable Deep Water Habitats and Ecosystems in the SEAFO Convention Area
- ⇨ Conservation Measures 19/10 on Retrieval of Lost Fixed Gear
- ⇨ Conservation Measure 20/10: on Total Allowable Catches and related conditions for Patagonian Toothfish, Orange Roughy, Alfonsino and Deep-Sea Red Crab in the SEAFO Convention Area in 2011 and 2012
- ⇨ Conservation Measure 22/11: on Bottom Fishing Activities in the SEAFO Convention Area

8. State of stock and management advice

See Agenda Point 16 of the 2012 SC report.

9. References

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