Northwest Atlantic Fisheries Organization

Serial No. N6439 **NAFO SCR Doc. 15/018**

SCIENTIFIC COUNCIL MEETING – JUNE 2015

Assessment of Splendid alfonsino (*Beryx splendens*) in NAFO Subarea 6

by

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Abstract

Commercial aggregations of alfonsino (*Beryx splendens*) on the Corner Rising and in the area of North Azores were discovered for the first time on board the USSR exploratory vessels the mid-70s of last century. The NAFO SC recommended that precautionary regulations of the mid-water trawl fishery on splendid alfonsino be put in place. In 2014 NAFO Fisheries Commission request for scientific advice on provide a stock assessment for alfonsino. Taking in account the alfonsino spatial distribution associated with seamounts, their life history and their aggregation behavior and due to the limited availability of data it could be advised a scalar approaches to advice the future catch levels by using simple scalar multipliers applied to current or historical catch patterns. Based on this approach a maximum catch limit of 200 tonnes (the mean of the last 6 years) on 16-18 days or around 120 fishing hours could be advised by year in Kükenthal seamount and recommend that the exploitation of new seamounts should not be allowed to prevent the exploitation of populations that have not yet been fished.

Introduction

The Corner Rise Seamount complex is located in a small area of the NAFO Subarea 6 (34º- 37º N, 47º - 53º W). Figure 1 presents the Corner Rise Seamount complex map of the "Deep Atlantic Stepping Stones: Exploring the Western North Atlantic Seamounts" NOAA exploration with the names submitted by Les Watling to the International Hydrographic Organization and the Intergovernmental Oceanographic Commission for some of the seamounts. In this area there are at least 13 seamounts and in Figure 1 we show the names proposed by Les Watling for five of them.

Commercial aggregations of alfonsino (*Beryx splendens*) on the Corner Rising and in the area of North Azores were discovered for the first time on board the USSR exploratory vessels the mid-70s of last century. Further fisheries expeditions to the seamounts were repeatedly carried out during which a considerable body of research and commercial data has been obtained. In some years a commercial fishery was conducted on the banks based on the results of the research. The results of these exploratory surveys were presented by V. I. Vinnichenko (1997, 1998).

Alfonsino is distributed over a wide area which may be composed of several populations. Alfonsinos are oceanic demersal species occurring at the top of seamounts and along slopes. They are widespread in the northeast Atlantic from Iceland to the Azores and along the continental slope. Alfonsinos are aggregative. Population dynamics are uncertain with recent estimates suggesting high longevity (>50 years), while other estimates suggest a longevity of ~15 years. Due to their spatial distribution associated with seamounts, their life history and their aggregation behaviour, Alfonsinos are easily overexploited by trawl fishing; they can only sustain low rates of exploitation.

At the September 2013 meeting (NAFO, 2013), the SC noted that although today this fishery is generally small (catches of 302 t in 2012), this mid-water trawl commercial fishery is not covered under Chapter II of the NCEM (i.e. Bottom Fisheries in the NAFO Regulatory Area) or any other chapter. SC noted that this gap in the NCEMs could result in an ongoing fishery that is unregulated. Consequently the SC recommended that precautionary regulations of the mid-water trawl fishery on splendid alfonsino be put in place. In 2014 NAFO Fisheries Commission (NAFO FC 2014) request for scientific advice on provide a stock assessment for alfonsino and recommendation.

The objective of this document is to present the available information on the alfonsino fishery in NAFO Div. 6G as well as answer the Fisheries Commission request to provide advice of this resource.

Population Structure

There is not much information about the North Atlantic alfonsino population structure. There are two points of view concerning this structure. In the opinion of most investigators this species is believed to form an independent population on each separate seamount of the open North Atlantic, does not migrate to long distances and all stages of its life cycle are developed within the same bank. This approach is proved by the results of genetic investigations (Titova, 1981) as well as by absence of Alfonsino aggregations on the banks for a long time (several years) caused by heavy fishery on these banks (Klimenko, 1983; Melnikov et al., 1993; Vinnichenko, 1995).

The hypothesis of some scientists according to which Alfonsino migrates between the Corner Rising and the Azores banks and there is a single population in that area (Alekseev et al., 1987) appears doubtful not only in view of the above reasons. Analysis indicates that this hypothesis is largely based on non-representative data on length-age composition of Alfonsino on the Corner Rising and in the Azores area suggesting only large mature fish (reproductive part of the distribution area) to inhabit the area of the Corner Rising whereas the Azores area is inhabited mostly by small immature fish (foraging part of the distribution area). However, materials from a number of research-scouting expeditions suggest that both older and younger age groups of Alfonsino permanently inhabit the Corner Rising and the Azores area (Sherstyukov, Noskov, 1986; Vinnichenko et al., 1993; Vinnichenko, 1996). Besides, it should be taken into account that not a single report on mature Alfonsino migrations in the open ocean has been available (Kotlyar, 1996).

Biological information

The available Corner Rise Alfonsino biological information was presented in 1998 by Vinnichenko based on the USSR 1976-1996 fishery information. Among the results presented are the following:

> The growth rate during the first year of life was found to be relatively high, with the mean length at-age of 1, 2, and 3 year olds being 8, 15, and 22 cm (to the fork), respectively. Sexual maturation was found to begin in the second year of life at a mean length of 18 cm, and by age 5–6 years all specimens had become mature at 25–30 cm length (Pshenichny et al., 1986; Anon., 1993). Based on this information practically all fish caught in the commercial fishery since 2004 are mature individuals.
>
> On the Corner Rise, Alfonsino were observed to spawn from May-June to August-September (Alekseeva, 1983). The main spawning period was observed in July–August in bottom layers of the water at temperatures of 7–12°C. Spawning of Alfonsino was intermittent, and observed as a number of batches at a time of around 10–12. The duration of individual spawning period was estimated to be about two months. Young Alfonsino of 25–98 mm length were caught by the fry-sampling trawl in the 0–600 m water layers in autumn, where water temperatures were 14–26°C (Sherstyukov and Noskov, 1986). Alfonsino were reported to feed on different mesopelagic fish species (lanternfishes, hatchetfishes, viperfishes, etc.), squid and shrimp (Pshenichny et al., 1986; Anon., 1993).

Description of the Fisheries

Commercial aggregations of deep water species in the Corner Rise Complex area were discovered by the Union of Soviet Socialist Republics (USSR) research vessels in 1976. Splendid alfonsino (*Beryx splendens*) was the main species group sought by the trawl fishing on seamounts of the Corner Rising. Cardinal-fish (*Epigonus telescopus*), black scabbard fish (*Aphanopus carbo*) and oilfish (*Ruvettus pretiosus*) were also of commercial

importance. After 1976, several fishing and commercial trip were made in this area by USSR and Russian vessels till 1996 (V. I. Vinnichenko, 1997). The splendid alfonsino is an aggregating moderately productive bathypelagic deep-sea fish that can be caught using either a bottom trawl or a mid-water trawl. The tendency of increasing in fish size with an increase in towing depth was registered by different researchers (Pshenichny et al., 1986; da Silva et al., 1996; Vinnichenko, 1997).

In 2004, one polyvalent Spanish trawler carried out an experimental survey in NAFO Regulatory Area Divisions 6EFGH and 4XWVs (P. Duran Muñoz et al., 2005). A directed commercial fishery had been conducted since 2005 by Spanish trawlers. Two different fishing operations have been carried out in this area by these vessels: One was a pelagic trawl over the peaks called "cucharada" with the trawl gear "Pedreira" (OTB) used in the NAFO Regulatory Area (NRA). And the other was a normal pelagic trawl with a pelagic trawl gear (OTM). Both gears with 130 mm cod-end mesh size (Gonzalez-Costas and Lorenzo, 2007). Since 2007 virtually all the effort has been made with pelagic trawls with "Pedreira" gear.

In July 2012, the Spanish trawl vessel Esperanza Menduiña carried out an experimental fishery in NAFO Regulatory Area Divisions 6G with two different trawl gears: Pedreira (Bottom Trawl) and Gloria (Pelagic Trawl). Results of this experimental fishery were present to the NAFO Secretariat. The aim of the experimental fishery was to explore the use of the bottom trawl gears in the area.

Commercial fishery data

Figure 2 shows the commercial Alfonsino catches since 1976 in NAFO Div. 6G and Table 1 present the catches as well as the effort (days and fishing hours). Catches have generally been low, less than one thousand tons, except for 1976, 1987, 1995 and 2005 where catches were: 10 200, 2 400, 3 500 and 1 187 t respectively. In the last years (2005-2014), annual catches for this fishery ranged from 52 to 1187 t and the annual effort ranged from 16 to 167 fishing hours. The mean present days per year in the fishing grounds in this period (2005-2014) was 20 days and the mean fishing hours by day were 7.9. This effort was mainly carried out by only one Spanish vessel.

Figure 3 shows the commercial hauls positions from 2007. From 2005 to 2007 were presented by Gonzalez-Costas and Lorenzo (2007). In the period 2005-2014, practically all of the effort has been made in the western part of Corner Rise in a single seamount (Kükenthal seamount) with a pelagic trawl fishing operations over the peaks called "cucharada" with the trawl gear "Pedreira" (OTB).

Information on historical length composition was derived from sampling of USSR (1995) presented by V. I. Vinnichenko in 1997 and EU-Spanish commercial catches (2004, 2007, 2009 and 2012). The 2004, 2009 and 2012 length distribution samples were measured to the total length and made by the Spanish Scientific Observers while those of the 1995 and 2007 were measured to the fork. Table 2 present the catches length distributions since 2004 and Figure 4 shows the length distribution in percentage by year for the same period. It can be observed that these length distributions are quite similar for all years. Catches in all years are in the 30-50 cm range with a mode around 40 cm. These distributions are very similar for the commercial catches (2009, 2012) and for experimental fisheries (2004-2012). The 2007 catches length distributions for Beryx splendens measured to the fork, the length range was 27 – 41 cm and the most abundant length in the catches were between 33 and 36 cm. These length distributions are very similar to the length distributions presented by V. I. Vinnichenko in 1997.

Table 3 present the length-weight relationship parameters estimated in the 2004 and 2012 Spanish experimental fishery for the Alfonsino NAFO Div. 6G. It were used the 2004 values to estimate the length distributions SOP presented in this document due to a greater number of individuals examined and a better length range covered.

Survey data

There is not available survey information of this resource in the Corner Rise area.

Assessment

Not analytical or survey based assessment were possible due to the lack of data.

There is not estimation of Alfonsino stocks in the Corner Rise area. Vinnichenko in 1995 calculated the biomass of Alfonsino aggregations on six seamounts of the North Atlantic in the period between 1976 and 1995 and estimated 50-80 thousand tons of the Alfonsino biomass. It should be taken into account that the most of the data used to calculate stock size was obtained long time ago. At present they can serve only as a reference for estimation of the possible fishery removal. He concluded that the high fishing pressure during the nineties (1500 tons by year) had a negative impact on the status of Alfonsino. A signal of this negative impact was the gradual decline in fishing efficiency of trawlers in the period 1993-1997 as well as by the reduction in size, density and stability of the fish aggregations. He concluded that the North Atlantic Alfonsino stocks were in that time in a state of depression and that his recovery would need at least 4 or 5 years.

Taking in account the alfonsino spatial distribution associated with seamounts, their life history and their aggregation behavior and due to the limited availability of data it could be advised a scalar approaches to advice the future catch levels by using simple scalar multipliers applied to current or historical catch patterns. Similar approach was following by ICES (2014) and SEAFO (2014) to give the alfonsino advice. The primary reference for this approach is Restrepo et al. (1998) who formalized the concept in their Technical Guidance document for the 1998 National Standard 1. The Restrepo approach proposed scalar multipliers for catch targets ranging from 0.25 to 0.75, depending on the estimated stock status at the time. This approach uses an average catch and it was suggested to explore several definitions of recent catch such as the mean or median catch during different periods. In the alfonsino case we think that in addition to estimating the average catch it would also be interesting to estimate the mean of the effort required to perform those catches due to the aggregation behavior of this species. It was chosen the 0.75 multiplier which reflected the precautionary buffer between the catch target and catch limit, with the catch limit being status-quo catch levels in a presumed healthy fishery. Table 4 present the mean catches and effort for the last 3, 6 and 9 years as well as the 0.75 catch levels for these periods.

Based on this approach a maximum catch limit of 200 tonnes (the mean of the last 6 years) on 16-18 days or around 120 fishing hours could be advised by year in Kükenthal seamount and recommend that the exploitation of new seamounts should not be allowed to prevent the exploitation of populations that have not yet been fished.

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Table 1. Commercial alfonsino catches (tons) in NAFO Div. 6G by year as well as the effort, CPUE and number of vessels.

Year	Catch (t)	Effort (days)	Effort hours	CPUE (Kg/hour)	Vessels
1976	10200				3
1977	800				2
1978	130				1
1979	530				2
1980	200				1
1981	390				2
1982	210				2
1983	160				3
1984	240				1
1985	10				1
1986	110				1
1987	2300				3
1994	400				1
1995	3500				2
1996	600				2
2004	415	50	104	3990	1
2005	1187	29	162	7327	3
2006	130	6	44	2955	1
2007	52		16	3256	1
2008					
2009	479	28	167	2868	1
2010	52	4	66	788	1
2011	152	9	68	2235	1
2012	302	22	165	1830	1
2013	114	17	87	1310	1
2014	118	15	117	1009	2

Table 2. Alfonsino NAFO Div. 6G catches length distributions for the commercial fishery and for the experimental fisheries. The 2004, 2009 and 2012 length distribution was measured to the total length while those of the 2007 were measured to the fork.

Beryx splendens	2004 (Exp. Fhisery)			2007 (Fork)			2009			2012			2012 (Exp. Fhisery)		
Length (cm)	**Males**	**Females**	**Total**	**Males**	**Females**	**Total**	**Males**	**Females**	**Total**	**Males**	**Females**	**Total**	**Males**	**Females**	**Total**
25			0	0	0	0			0			0			
26			0	0	0	0	88	88	176			0			
27	0	405	405	363	301	664	0	88	88			0			
28	0	0	0	187	187	373	0	318	318			0			
29	0	0	0	301	488	789	0	90	90	202	0	202			
30	0	0	0	1140	363	1503	117	0	117	0	0	0			
31	327	0	327	1416	248	1664	119	74	193	0	0	0			
32	735	0	735	1015	674	1690	164	991	1155	825	311	1136	23	0	23
33	3017	1136	4153	1354	1191	2546	2075	207	2282	1939	642	2581	108	39	147
34	4670	732	5402	735	1965	2700	5044	2346	7390	1446	1026	2472	117	104	221
35	8484	3113	11597	549	1509	2058	10264	5413	15677	2239	1773	4012	288	120	408
36	7607	2959	10566	813	2714	3527	25939	8883	34822	10937	3574	14511	418	158	576
37	15744	6320	22064	216	612	828	30731	13000	43731	11353	5217	16570	1102	176	1278
38	22613	10481	33094	371	1717	2088	40401	19106	59507	20339	9001	29340	855	386	1241
39	30117	8473	38590	61	509	571	33793	25555	59348	22327	11403	33730	1075	432	1507
40	38241	18477	56718	0	61	61	34391	21893	56284	27636	18183	45819	987	715	1702
41	42073	22008	64081	0	202	202	39701	29763	69464	23517	18788	42305	1023	775	1798
42	42030	26942	68972	0	61	61	30295	28038	58333	21948	20195	42143	923	732	1655
43	31656	29833	61489	0	0	0	20869	29559	50428	14099	17228	31327	413	696	1109
44	24296	29871	54167	0	0	0	15819	21958	37777	8826	11685	20511	296	390	686
45	23185	25533	48718	0	0	0	12693	18534	31227	3957	7221	11178	42	281	323
46	17266	27245	44511	0	0	0	9971	13243	23214	1988	6716	8704	98	238	336
47	9283	20675	29958	0	0	0	4862	6893	11755	2014	5628	7642	41	54	95
48	8825	10244	19069	0	0	0	4059	6272	10331	515	2179	2694	0	41	41
49	674	6266	6940	0	0	0	1697	2976	4673	479	1973	2452	0	0	0
50	520	6074	6594			0	586	2727	3313	90	1277	1367	0	41	41
51	275	1036	1311			0	1631	824	2455	73	404	477			
52	1083	1486	2569			0	31	476	507	0	0	0			
53	0	656	656			0	0	816	816	0	0	0			
54	0	195	195			0	0	88	88	0	342	342			
55	113	212	325			0	0	0	0	0	168	168			
56			0			0	0	991	991	0	0	0			
57			0			0			0	0	0	0			
58			0			0			0	0	0	0			
59			0			0			0	0	95	95			
60			0			0			0			0			
Total	332834	260372	593206	8521	12803	21325	325340	261210	586550	176749	145029	321778	7809	5378	13187
Ind. Sampled			3262			147			3127			1602			491
Samples			24			4			31			17			6
Catch (tons)			414.8			18			474			297.6			10.94
SOP			0.73			1.66			0.93			1.07			1.01

Table 3. Alfonsino NAFO Div. 6G length-weight relationship parameters estimated in the 2004 and 2012 experimental fishery.

Year	Sex	Ind.	a	b	R2	Range (cm)	Range (gr)
2004	Males	636	0.0131	2.9759	0.9522	23-55	150-1820
	Females	608	0.0104	3.0399	0.957	24-61	130-3270
	Total	1277	0.017	2.9068	0.9863	10-61	15-3270
2012	Males	117	0.0124	3.0062	0.9541	23-49	150-1520
	Females	76	0.0131	2.9853	0.9382	24-45	170-1100
	Total	193	0.0127	2.9967	0.9469	23-49	150-1520

Table 3. Alfonsino NAFO Div. 6G mean catches and effort for three different periods.

Period	Mean Catches	75% Mean Catches	Mean Effort (days)	Mean Effort (Hours)
2012-2014	178	134	18	123
2009-2014	203	152	16	111
2005-2014	287	215	16	99

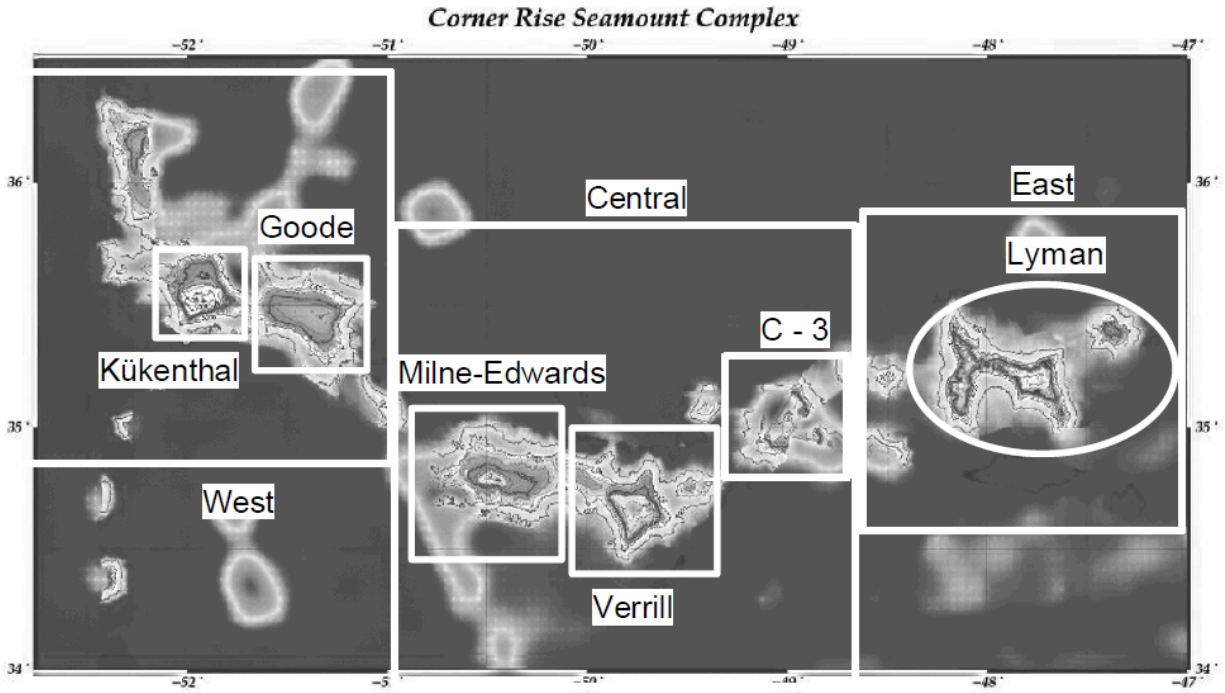

Figure 1. Corner Rise Seamount Complex map with areas and peak names.

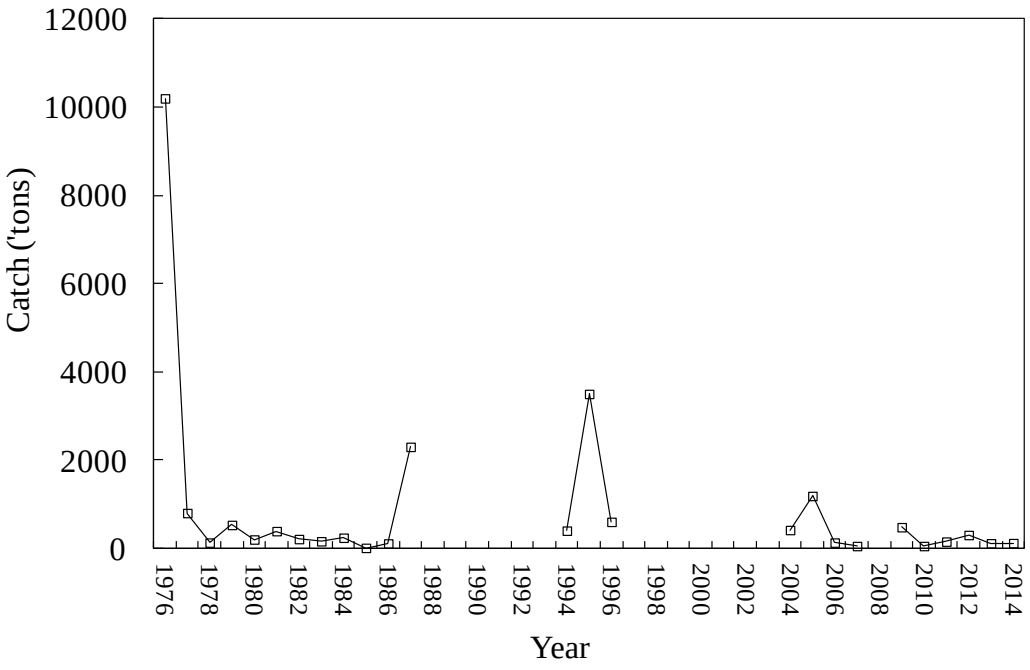

Figure 2. Alfonsino (*Beryx splendens*) catches since 1976 in NAFO Div. 6G.

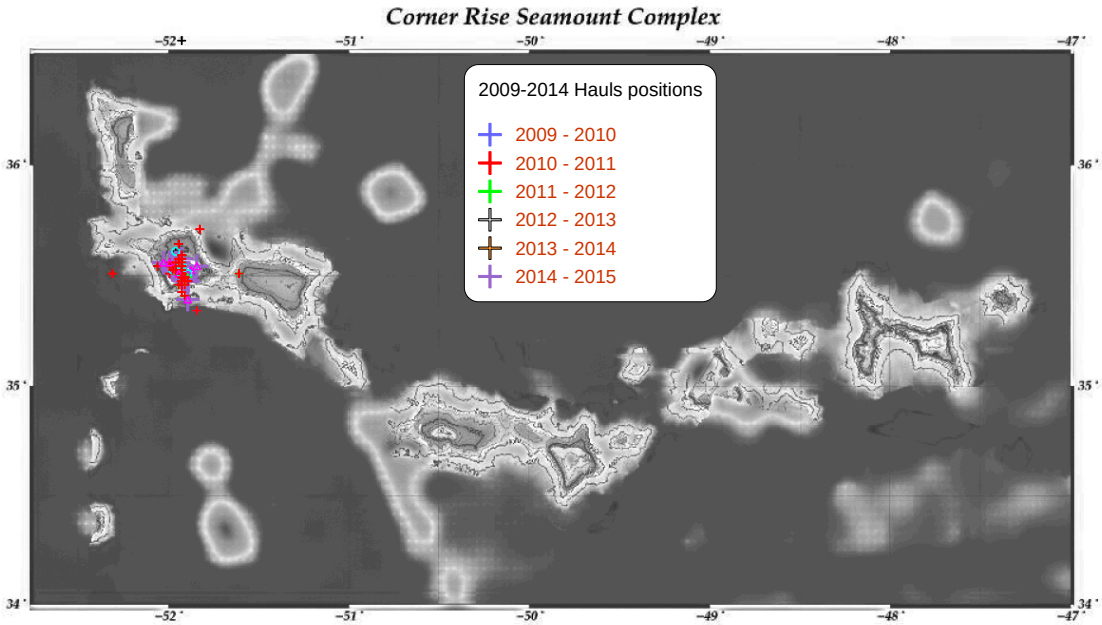

Figure 3. Corner Rise Seamount Complex map with 2009-2014 hauls positions based on the NAFO Observers information.

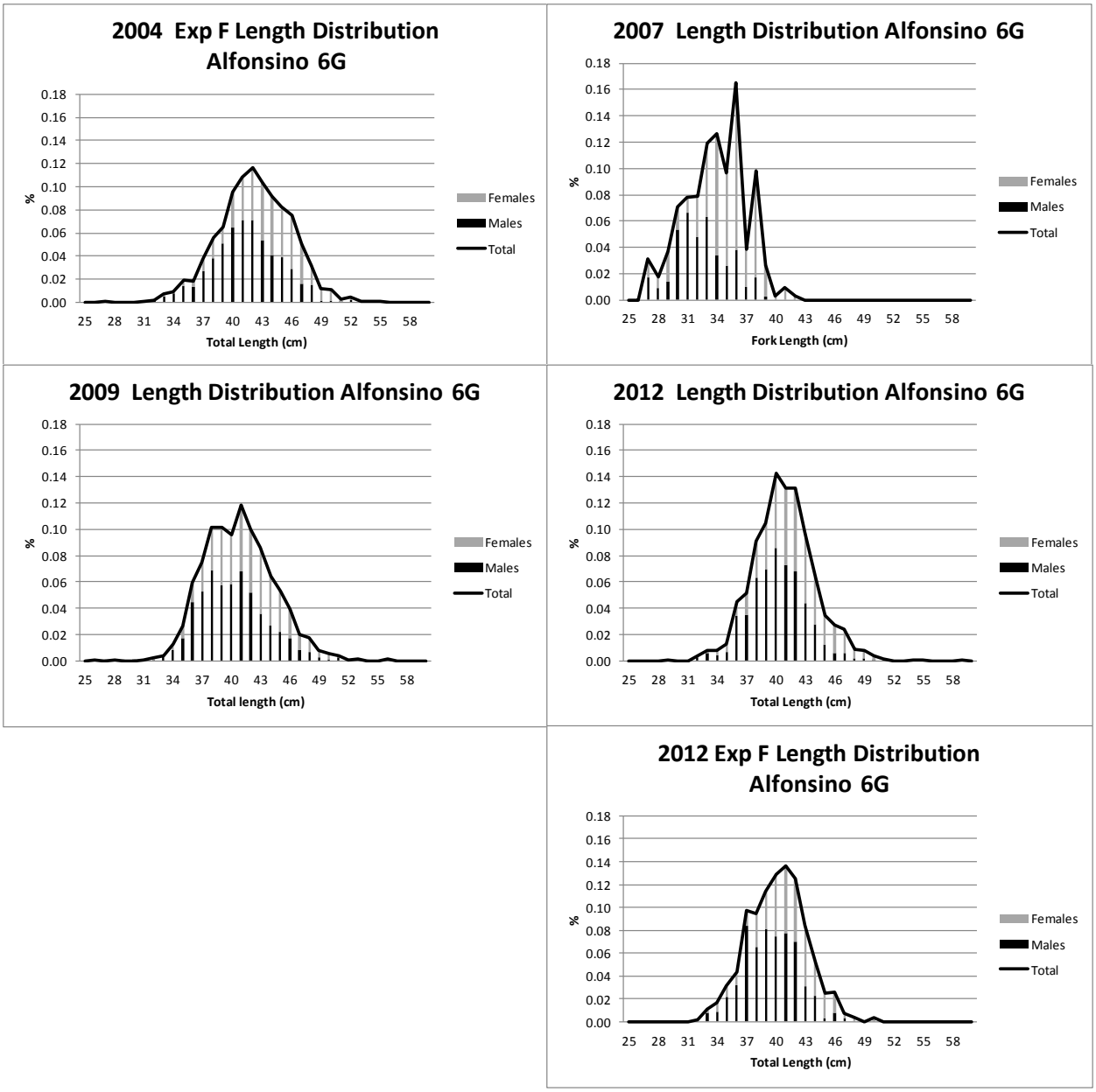

Figure 4**.** Alfonsino NAFO Div. 6G commercial and exploratory fisheries length distributions since 2004.