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Information on Fishing On and Around the Four Closed Seamount Areas in the NRA

by

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Abstract

Fishing activity from Jan 2003–Mar 2007 on the Orphan Knoll, and the Newfoundland, New England and Corner Rise seamounts was assessed using information from VMS, observer records and catch and effort databases. There was no evidence of commercial fishing on Orphan knoll, and only a few probable exploratory tows on Newfoundland seamount. Limited commercial fishing was observed on the New England and Corner Rise seamounts with evidence that one seamount within the Corner Rise seamounts area closure was repeatedly fished over successive seasons.

Introduction

The NAFO Fisheries Commission (FC), at their annual meeting in September 2006, closed the area on and around four seamounts in the NAFO Regulatory Area (NRA) to bottom fishing effective 1 January 2007 to 31 December 2010 (Fig. 1; Table 1; NAFO 2006a, b, 2007a). FC requested the following advice from NAFO Scientific Council (SC) "Regarding the precautionary closure to four seamount areas based on the ecosystem approach to fisheries (NAFO, 2006a), using existing survey and commercial data from these seamount areas the Scientific Council is requested to provide the Fisheries Commission, at the 2007 Annual Meeting, recommendations on: 1) areas that could be fished on each seamount and, 2) a protocol for the collection of the data required to assess these seamounts, with a view to future recommendations on management measures for these areas." (Annex 11 paragraph 9, NAFO, 2006b).

The SC Chair requested the Secretariat to provide VMS data to answer this request as per Article 22 paragraph 8 of the CEM (NAFO, 2007a) "The Executive Secretary shall make VMS data available in a summary form to the Scientific Council following specific requests from the Fisheries Commission to the Scientific Council to determine fishing effort on and around vulnerable habitats and for any other purpose." Additionally, use is made of information in the observer reports submitted to the Secretariat in accordance with Article 24 "Observer Program", and from the STATLANT 21A/B (NAFO, 2007b) and FAO FISHSTAT (FAO, 2007) databases. These databases are public access and unrestricted.

Areas of Closure

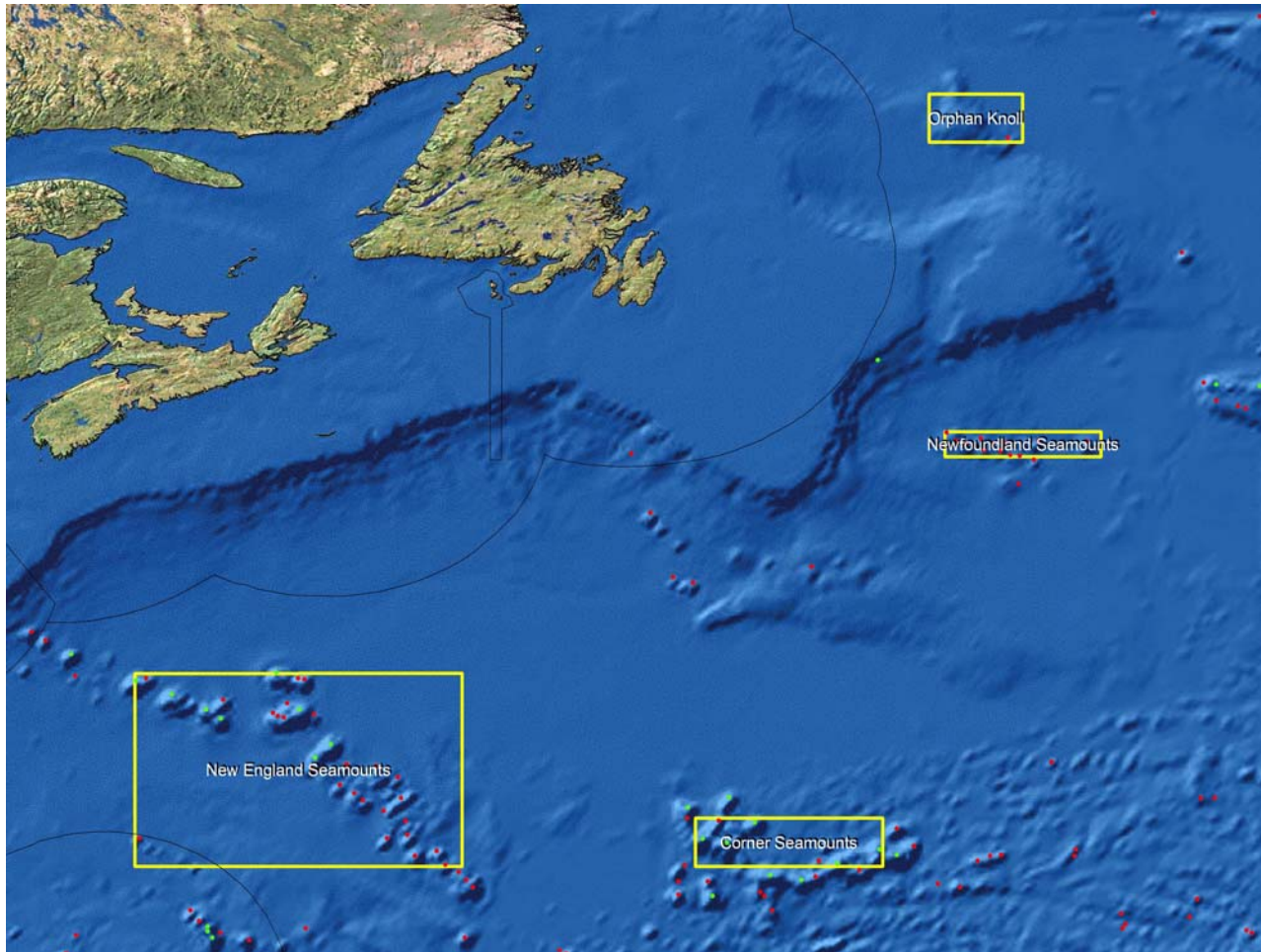


Fig.1. Area of closure on and around four seamounts in the NAFO Regulatory Area effective 1 January 2007 to 31 December 2010. Seamount peaks marked with green dots rise above 2000 m depth, those marked with red dots have peaks below 2000 m depth. (Map produced by Michael McKee and Peter Auster, National Undersea Research Center at The University of Connecticut, CI USA)

Table 1. Area of closure on and around four seamounts in the NAFO Regulatory Area effective 1 January 2007 to 31 December 2010. The NAFO Divisions are shown in parentheses.

Area (and Division)	Coordinate 1	Coordinate 2	Coordinate 3	Coordinate 4
Orphan Knoll (in 3K)	50°00'30"N 45°00'30"W	51°00'30"N 45°00'30"W	51°00'30"N 47°00'30"W	50°00'30"N 47°00'30"W
Newfoundland Seamounts (in 3NM)	43°29'00"N 43°20'00"W	44°00'00"N 43°20'00"W	44°00'00"N 46°40'00"W	43°29'00"N 46°40'00"W
New England Seamounts (in 6EF)	35°00'00"N 57°00'00"W	39°00'00"N 57°00'00"W	39°00'00"N 64°00'00"W	35°00'00"N 64°00'00"W
Corner Seamounts (in 6GH)	35°00'00"N 48°00'00"W	36°00'00"N 48°00'00"W	36°00'00"N 52°00'00"W	35°00'00"N 52°00'00"W

The NAFO Regulatory Area is mainly situated in very deepwater, especially in the central and southern portions. The established fishable areas occur around the Flemish Cap and on its shelving slopes. Recent concerns for the well-being of benthic habitats, and the protection of deepwater corals particularly, has led to the cautious closure of four seamount areas in the NRA in line with NAFO's ecosystem approach (Fig. 1). The closed areas extend beyond the seamounts themselves and include substantial areas of the seabed. It is worth noting that the closed areas are rectangular in shape, and therefore include substantial areas of seabed. The closures do not cover all the seamounts. Probably the most significant, from a fisheries perspective, are two shallow Corner Rise seamounts south of the closed area. However, the southern closure limit of the New England and Corner Rise seamounts is at the boundary division between the NAFO and the Western Central Atlantic Fishery Commission areas (WECAFC). These two seamounts are not therefore in the NRA.

The geology and marine biology has been described for the New England and Corner Rise seamounts using an ROV where it was noted that there is a distinct change in the bottom biological population from the eastern to western seamounts (Heirtzler *et al.*, 1977). The fish and larger invertebrate fauna has been studied by Vinnichenko (1997) using pelagic and bottom trawls.

The depth distribution within the seamounts shows in all cases they rise out of the deepwater seabed ranging from approximately 3 000 – 5 000 m (Fig. 1, Tables 2 and 3).

- The Corner Rise seamounts are the shallowest of the four with peaks rising to 828 m depth and some 1 274 km² above 2 000 m depth. The shallowest of these is at the western edge of the closed area, with the next shallowest at 1 500 m depth on the eastern edge of the closure. There also exists two shallow seamounts just to the south of the closed area at 900 m and 1 000 m depth.
- The New England seamounts are the next shallowest with 699 km² above 2 000 m. The four seamounts on the northwestern edge rise to 1 750–2 000 below the surface, with the two central seamounts being at 1 500 m and 1 750 m. The peaks of those in the southeastern quadrant of the closure are all deep at 2 500–4 000 m depth.
- Orphan Knoll is a much flatter seamount (strictly speaking, Orphan Knoll is not a seamount as it is of continental shelf origin (Enachescu, 2004)) and with the surrounding seabed being shallower, especially on the western side. Nevertheless, it is still deep and has 3 587 km² in the 1 500–2 000 m depth range.
- The Newfoundland seamounts are the deepest of the four closed areas, with no peaks being shallower than 2 500 m.

Table 2. Area according to depth within each seamount closure (from unpublished data courtesy John Guinotte, Marine Conservation Biology Institute, WA USA).

Depth range (m)	Area (km ²)			Corner Rise seamounts
	Orphan Knoll	Newfoundland seamounts	New England seamounts	
828 - 900	0	0	0	41
900 - 1000	0	0	0	41
1000 - 1500	0	0	151	507
1500 - 2000	3587	0	548	685
2000 - 2500	3899	0	1177	1205
2500 - 3000	6051	301	2108	1013
3000 - 3500	2355	1177	3450	1561
3500 - 4000	3395	2533	6147	3094
4000 - 5000	5462	16510	112354	17674
>5000	0	27	212291	23465
TOTAL	24749	20548	338226	49286

Table 3. Number of seamount peaks above and below 2 000 m within each seamount closure (from unpublished data courtesy of Michael McKee and Peter Auster, National Undersea Research Center at The University of Connecticut, CI USA).

	Number of peaks			
	Orphan Knoll	Newfoundland seamounts	New England seamounts	Corner Rise seamounts
Peaks <2 000 m deep	0	0	7	5
Peaks > 2000 m deep	1	13	23	2

Methods

VMS data

It has been a requirement since January 2003 for commercial vessels to carry and operate a VMS. This data is sent from the vessel to a Fisheries Monitoring Center (FMC) in the North Atlantic Format, and a sub-set is then automatically transmitted to the NAFO Secretariat. In most cases, data is transmitted and received at two-hourly intervals. In the event of a system failure, data is forwarded by fax, radio, etc, at no more than six-hourly intervals. Such automatic transmission failures are uncommon and are not included in the data sets analyzed here.

VMS data is held on a database derived from reports forwarded to the Secretariat by the Fishery Monitoring Centers. This is a sub-set of the original data string transmitted in the North Atlantic Format from the fishing vessels. The variables used in this analysis were vessel position (lat1 lon1, lat2 lon2) and data and time of transmission (t1, t2) with angles being transformed to radians.. The distance between successive transmission (d in nautical miles) was calculated from the following formulae given by Williams (2007):

$$d = \frac{180 \times 60 \times 2}{\pi} \sin^{-1} \sqrt{\left(\frac{\sin(\text{lat1} - \text{lat2})}{2}\right)^2 + \cos(\text{lat1}) \cos(\text{lat2}) \left(\frac{\sin(\text{lon1} - \text{lon2})}{2}\right)^2},$$

and the mid-latitude between transmission from:

$$\text{lat} = \tan^{-1} \left(\frac{\sin(\text{lat1}) \cos(\text{lat2}) \sin(\text{lon} - \text{lon2}) - \sin(\text{lat2}) \cos(\text{lat1}) \sin(\text{lon} - \text{lon1})}{\cos(\text{lat1}) \cos(\text{lat2}) \sin(\text{lon1} - \text{lon2})} \right)$$

for $\sin(\text{lon1} - \text{lon2}) \neq 0$ and $\text{lon} = (\text{lon1} + \text{lon2}) / 2$. Average vessel speed was then calculated from:

$$s = d / (t2 - t1).$$

A vessel was taken to be fishing when the speed was less than 4.9 knots (9 km/h, 2.5 m/s) as this is believed to be the maximum trawl speed and could include long-lining.

Distribution of vessel speeds

The frequency distribution of vessel speed for all VMS data in the NRA shows a bimodal distribution with a clear peak at 2.7 knots (5 km/h, 1.4 m/s) and a smaller peak at 9.7 knots (18 km/h, 5 m/s). It is seen that 87% of the transmission are from vessels traveling at less than 4.9 knots.

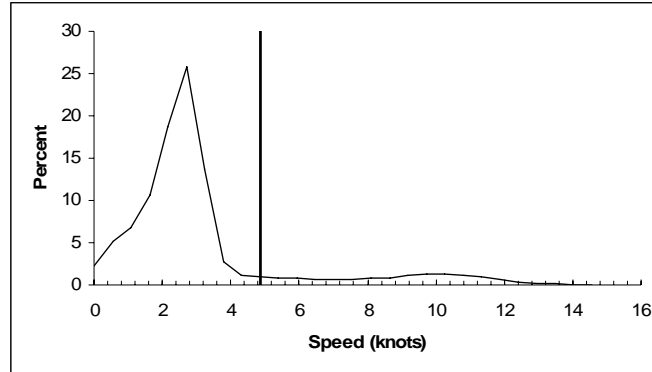


Fig. 2. Frequency distribution of vessel speed in the NRA. The vertical bar at 4.9 knots (9 km/h, 2.5 m/s) represents the maximum trawling speed of a fishing vessel.

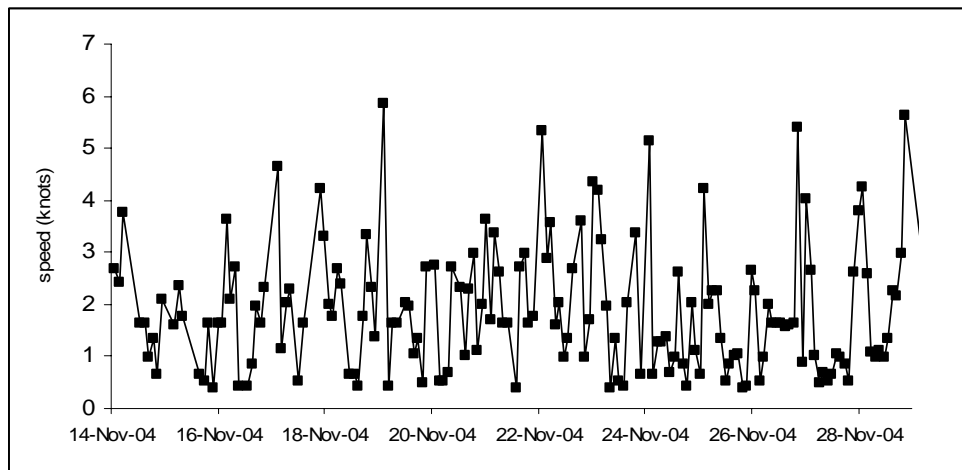


Fig. 3. Example of the speed of a vessel over a 15 day period fishing Corner Rise seamount.

Fishing Effort

The VMS data does not communicate when a vessel is actually fishing. It is therefore necessary to make inferences from the use of the speed variable. The speed of the vessel can also be used to provide approximate ideas of the duration of the tows, though this is somewhat subjective (Fig. 3). It is assumed that the vessel is trawling when the speed is approximately 2–4 knots, is hauling at slower speeds and is steaming at higher speeds. This provides an estimate of the number of tows undertaken over a known number of days.

Results

Analysis of VMS

Generally, the peaks of the seamounts are in deepwater and tend to be below 2 000 m (Fig. 1; Table 2). Fishing activity appears to be influenced by this as fishing is concentrated on the shallower seamounts. The Corner Rise seamount is the shallowest and has the highest fishing activity. The New England seamounts are the next shallowest, but are already at the limit of the fishable depth at around 2 000 m. There has been little fishing on the Newfoundland seamounts and probably none on the Orphan Knoll. Only 3–4 vessels have fished on the seamounts over the past three years, with 97% of the effort on the New England and Corner Rise seamounts being by one vessel. Fishing occurred from September to February (Table 4).

Table 4. Fishing effort within the closed seamount area.

	Orphan Knoll	Newfoundland seamounts	New England seamounts	Corner Rise seamounts
No. of vessels	1	4	1	2
No. of observations	2	24	64	453
No. of days	2	5	11	40
Number of trawls	0	3	9	66
Duration of trawls (h)	-	8 - 18	10 - 22	2 - 3
Month and year	Oct 05	Sep 06, Nov-Dec 03, Sep 03	Nov-Dec 04	Oct-Nov 04, Dec 05, Jan 06, Feb 07
Comments	Vessel probably not fishing	1 vessel probably not fishing		1 vessel was probably not fishing

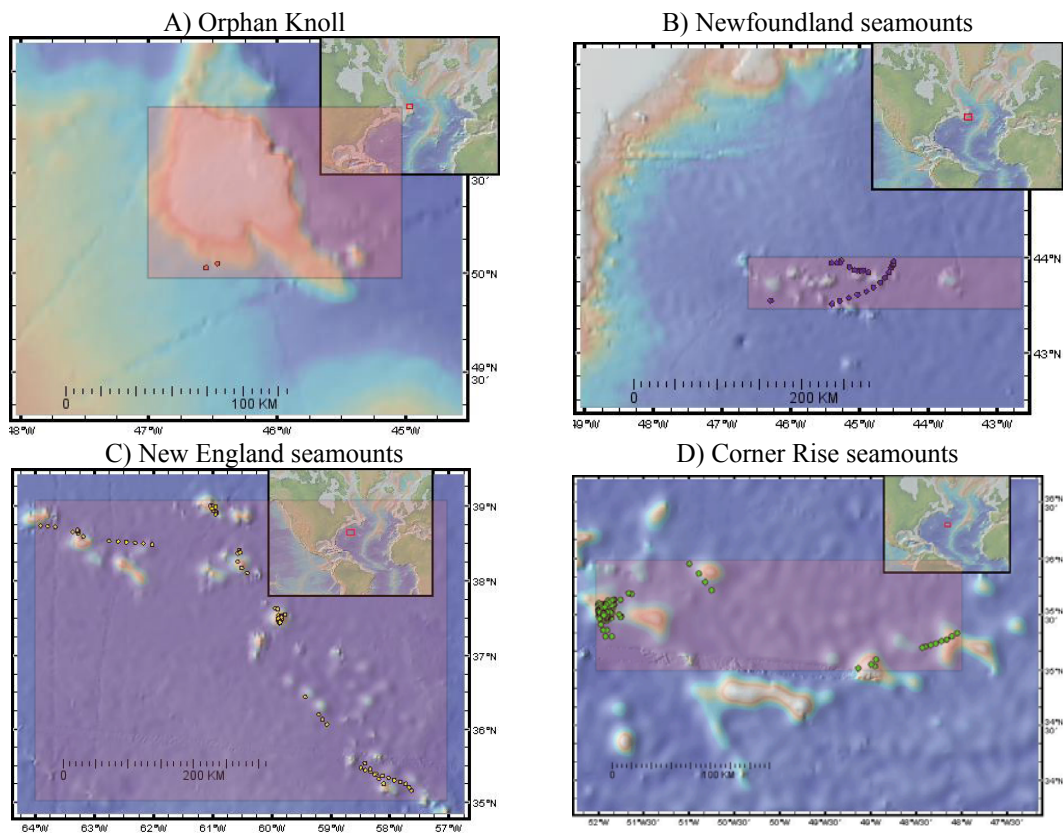


Fig. 4. Distribution of vessels traveling at less than 9 km/h in the four seamount closure areas during 2003-2007.

Fishing effort

No firm evidence of fishing was seen on Orphan Knoll. Three trawls over five days were identified on the Newfoundland seamounts and this almost certainly relates to exploratory fishing which seemed to have been too unproductive to continue. The New England and Corner Rise seamounts were fished by a single fishing vessel probably on an almost full time basis, with a total of three trawls over five days and 66 trawls over 40 days, respectively (Fig. 4, Table 4). It is quite clear that a small area measuring some 16 km × 14 km on the western edge

of the Corner Rise seamount was a targeted fishing area of only some 50 km² (Fig. 5). Some recent reports in this particular area give catches of 83 t over 3½ days of fishing giving a catch rate of 23.7 t/d or around 0.5 t/km²/d.

An estimate of tow duration was obtained from the VMS calculated vessel speed data, but this is very approximate. It would appear that tows on the Corner Rise seamount are 2–3 h duration and may well be limited by the small size of the fishing ground. Tows on the Newfoundland and New England seamounts were estimated at 10–20 h.

Fishing pressure was clearly greatest on the shallowest seamount which was in the Corner Rise closed area at approximately 800–1000 m depth. However, there are indications that some limited fishing has occurred down to 2 500+ m on the Newfoundland and New England seamounts. It is likely that these depths can not be commercially exploited with the current technology.

Observer reports

The observer reports give catch and discard information by NAFO Division. The New England seamounts in Div. 6EF and the Corner Rise seamount occur in Div. 6G. Neither of these Divisions has fishable ground off the seamounts, and so it can be assumed that any reports from 6EF and 6G came from the New England and Corner seamounts respectively. This is supported by the VMS data as no trawling was observed on the seabed away from the seamounts. The same assumption can not be made for the Orphan Knoll and Newfoundland seamounts as there are fishing ground outside of the seamounts but in the same Division.

The catch values given in Table 5 represent the end-of-trip quantity in the hold together with observer estimates of discards. Owing to the fact that almost all of the catch from the Corner Rise seamount was taken by one vessel, we can assume that the values in the table approximately represent the annual catch from these seamounts. Alfonsino, black scabbardfish and wreckfish dominated and comprised forming 98% of the catch the Corner Rise seamounts (Table 4). The average total annual catch from the Corner Rise seamount over the last few years, estimated from observer reports, is around 700 t. Reported discards amounts to around 1% of the total catch. It is likely that there has been some misreporting to NAFO on alfonsino catches in 2004 as none are recorded in the STATLANT 21 database for 2004, or that they were reported as finfish or some other higher grouping.

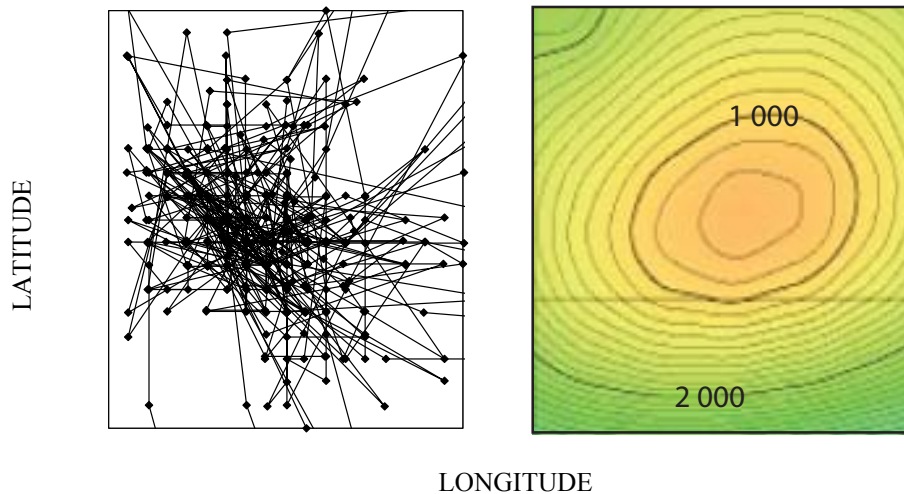


Fig. 5. Cruise track of an individual fishing vessel over multiple trips and years (left) and a contour plot at the same location (right) on the western edge of the Corner Rise seamount closure. The plots cover an area of approximately 16 km × 14 km.

Table 5. Catch estimates by the Captain and the observer for 6G on the Corner Rise seamount. Discard estimates are shown when recorded by the observer.

Division and Species code	Species	Captain's estimate	Observers estimate	
		Retained (t)	Retained (t)	Discarded (t)
6G	Oct-Nov 2004			
ALF	<i>Beryx</i> spp Alfonsinos nei	1 029.0	1 100.0	15.0
ALH	<i>Alepocephalus</i> spp Slickheads nei	1.6	1.7	0
BSF	<i>Aphanopus carbo</i> Black scabbardfish	3.5	3.5	0
WRF	<i>Polyprion americanus</i> Wreckfish	24.9	25	0
SBL	<i>Hexanchus griseus</i> Bluntnose sixgill shark	6.9	5.9	2.2
TRC	Trachichthyidae Slimeheads nei	2.4	2.4	0
6G	Dec 2005			
BSF	<i>Aphanopus carbo</i> Black scabbardfish		83	
BYS	<i>Beryx splendens</i> Splendid alfonsino		105	0.2
CYO	<i>Centroscymnus coelolepis</i> Portuguese dogfish		0.1	
EPI	<i>Epigonus telescopus</i> Black cardinal fish		4.8	
SKX	Elasmobranchii Sharks, rays, skates, etc. nei		1.0	1.0
6G	Sep 05			
BSF	<i>Aphanopus carbo</i> Black scabbardfish		0.4	-

There is some limited but still relevant additional information in the observer reports. Fishing on the seamounts is with a bottom otter trawl using a 140 mm cod-end mesh. Tow durations over the seamounts were not mentioned in the observer reports, but in other areas on the slopes around the Flemish Cap were 3–8 h at depths of 1 100–1 400 m and at approx 3 knots. 6G target fish was *Beryx* spp (Alfonsino). Stated target fish, required for compliance purposes, changed almost daily and included alfonsino, black scabbardfish, Slickheads, orange roughy, groundfish and small sharks.

Databases

The two large fisheries capture databases covering the Northwest Atlantic are the NAFO STATLANT 21 that reports catch and effort to the Division level (*e.g.* Area 21, Subarea 6, Division F) and the FAO FISHSTAT data sets that reports catches according to area (*e.g.* Area 21, Northwest Atlantic). The species listed in Table 5 are all included in the FAO FISHSTAT database with the exception of *Beryx splendens* (ALF, Splended alfonsino) which would be reported under *Beryx* spp. (ALF, Alfonsinos nei). The NAFO STATLANT 21 database lists *Beryx* spp. (ALF, Alfonsinos nei) and *Alepocephalus bairdii* (ALC, Baird's Slickhead), but not the others.

Catches of alfonsino were taken by USSR and Russia from 1978 to 1996, and more recently by Spain in 2005, gave reported catch rates averaged 4.0 t/h or 11.9 t/d (Table 6). Catches have been taken in all months of the year, with the earlier USSR and Russian catches favouring the summer period and more recent Spanish catches favouring the winter period. Catches given in the two databases are in full agreement. However, there are marked disagreements with catches of alfonsino given by Vinnichenko (1997) that were reported from the Corner Rise seamount area. Catches of alfonsino from the Corner Rise seamounts in 1976 and 1977 were not mentioned by Konstantinov and Noskov (1977, 1978). No catches were recorded for statistical areas 6G and 6H by ICNAF (1977, 1978), and in fact, these two area were not included in the catch tables, even though they were part of the ICNAF area or at least are included on the ICNAF map at that time. They may not have been considered part of the routine ICNAF area at that time. It is unclear why the discrepancy exists for 1995 catches of alfonsino.

However, Vinnichenko (1997) extended the southern boundary of his Subarea 6 by 1° to 34° N and included an extra area that conventionally is not considered to be in Subarea 6, *i.e.* the part between 35° N and 34° N. The significance of this additional area is that there are two seamounts, the Caloosahatchee Seamount and an un-named seamount to the west, that are comparatively shallow at 1000 and 900 m depth, and are likely to similar to the fished seamount

on the western edge of the closure. It is most likely that the Russian catches came from these two seamounts, otherwise they would have been reported to the STATLANT 21A database.

Table 6. Catches of alfoncino from the Corner Rise seamount area since 1960 given in the STATLANT 21, the FAO capture database, and by Vinnichenko (1997). No records were found of the other species included in Table 5 were found in either database.

Year	Country	FAO Capture	STATLANT 21		Vinnichenko, 1997
		database (Area 21) Catch (t)	Area	Catch (t)	(Corner Rise seamount area) Catch (t)
1976	USSR	-	-	-	10 200
1977	USSR	-	-	-	800
1978	USSR	147	6F	147	130
1979	USSR	437	6F	437	530
1980	USSR	-	-	-	200
1981	USSR	584	6F	584	390
1982	USSR	43	6F	43	10
1983	USSR	138	6F	138	360
1984	USSR	221	6F	221	240
1985	USSR	-	-	-	10
1986	USSR	-	-	-	110
1987	USSR	2 012	6E	2 012	2 300
1994	Russia	-	-	-	400
1995	Russia	541	6	541	3 500
1996	Russia	141	6	141	600
2005	Spain	576	6G	577	-
TOTALS		4 840		4 841	19 780

Discussion

The VMS data shows that there has probably been no commercial fishing on Orphan Knoll and only a few exploratory trawls on the Newfoundland seamounts since 2003. Pressure has been slightly greater on the New England Seamounts with commercial effort probably around 2–3 days fishing per year. The Corner Rise seamount has been the heaviest exploited, especially on the western side where there could be around 20 days fishing per year providing an annual catch of some 700 t. This effort is comparatively very low compared to other Divisions in the NRA. However, it can be intense and concentrated in particular areas where seamounts rise to less than 2 000 m depth.

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