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Ecosystem approach considerations: Deepwater chondrichthyans
(sharks, rays and chimaeras) in the Western SPRFMO Area
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1. Purpose of paper

This paper provides a characterisation of the catch of chondrichthyans in New Zealand bottom fisheries in the SPRFMO Area and information on potential risks to deepwater chondrichthyan species from SPRFMO bottom fishing. Chondrichthyans, particularly those which predominantly occur or complete most of their lifecycle below 200 m depth, are known to have life history characteristics which make them especially vulnerable to fishing pressure.

2. Background

About half of chondrichthyans are considered deepwater species, of which around half are sharks (predominantly squaloid dogfishes, Order Squaliformes, and catsharks, Order Carcharhiniformes, Families Pentanchidae and Scyliorhinidae)), with the remainder being skates (predominantly Arhynchobatidae, Rajidae, and Anacanthobatidae), and holocephalans (Kyne & Simpfendorfer 2007). There are currently 177 species reported from the SPRFMO Area that are known to regularly occur below 200 m depth (Appendix 1).

Chondrichthyans generally exhibit relatively slow growth rates, late age at maturity, low fecundity and low natural mortality. Knowledge of the growth and reproductive parameters of most deepwater species is generally poor or completely lacking. For the limited number of deepwater species for which sufficient life history data is available, their estimated intrinsic rebound potential values (i.e., ability of a species to recover from fishing pressure) fall at the lower end of the chondrichthyan productivity scale, and include the lowest levels observed (Kyne & Simpfendorfer 2007). Kyne & Simpfendorfer (2007) found a significant decline in species intrinsic rebound potential with increasing maximum depth and concluded that deepwater chondrichthyans are likely to take decades to recover from overfishing.

3. Composition of New Zealand deepwater chondrichthyan catch

New Zealand bottom fisheries in the SPRFMO Area are predominantly bottom and midwater trawl targeting orange roughy or alfonsinos, and line methods including bottom longline, Dahn line, and handline targeting bluenose, hapuka, and bass. New Zealand observers on vessels fishing in the SPRFMO Area identify all catch to species level wherever possible to allow for understanding of the level of non-target fish catch. Additionally, New Zealand fishers report the top five species in the catch on estimated catch forms, and as a result, species that do not make up a significant proportion of catches are often under-reported in estimated catch data.

Based on observer and fisher-reported catch data, 58 nominal chondrichthyan taxa have been caught by New Zealand vessels in SPRFMO bottom fisheries from 2012-2016, at least 53 of which were taken in trawl fisheries.

Trawl fisheries

In trawl fisheries, the main chondrichthyan species reported by observers include shovelnose spiny dogfish (*Deania calcea*), widenosed chimaera/Pacific spookfish (*Rhinochimaera pacifica*), seal shark (*Dalatias licha*), and longnose spookfish (*Harriotta raleighana*) (Table 1). The proportion of deepwater chondrichthyan species in the trawl catch not identified to species level varied widely between years, ranging from 6-17% of the total chondrichthyan catch.

Table 1: Volume of top 10 chondrichthyan species observed caught (t) in New Zealand bottom trawl fisheries in the SPRFMO Area by calendar year from 2012 to 2016, and % of total chondrichthyan catch over the time period

Species	2012	2013	2014	2015	2016	% total chond. catch
Shovelnose spiny dogfish <i>Deania calcea</i>	5.5	2.8	2.0	37.7	100.7	35%
Pacific spookfish <i>Rhinochimaera pacifica</i>	0.3	0.2	0.04	16.1	40.0	13%
Seal shark <i>Dalatias licha</i>	2.3	6.6	0.4	6.6	33.8	12%
Unspecified deepwater sharks	4.1	1.4	0.6	12.2	18.4	9%
Longnose spookfish <i>Harriotta raleighana</i>	0.7	0.1	0.2	8.2	14.0	5%
Baxters lantern dogfish <i>Etmopterus baxteri</i>	3.9	5.8	2.8	4.5	3.5	5%
Portuguese dogfish <i>Centroscymnus coelolepis</i>	1.1	0.8	0.3	10.6	1.1	3%
Plunket's shark <i>Proscynnodon plunketi</i>	2.2	0.4	1.2	2.4	6.2	3%
Smooth skin dogfish <i>Centroscymnus owstoni</i>	0.5	0.3	0.1	5.4	5.1	3%
Pale ghost shark <i>Hydrolagus bemisi</i>	0.6	0.2	0.1	3.6	5.3	2%

In general, the fisher-reported data was made up of a high proportion of generic codes (e.g. unspecified deepwater dogfish) (67% over 5 years), and was significantly less in volume than that reported by observers (commercial reported catches were 49% of the observer reported catches).

Line fisheries

In New Zealand line fisheries around 10% of fishing days are observed, and therefore the observed data may not reflect the total catch of chondrichthyan species. Based on observer collected data from New Zealand line fisheries, 20 chondrichthyan species were caught from 2012-2016. The top species were northern spiny dogfish (*Squalus griffini*) which made up 44% of the total observed chondrichthyan catch, school shark (*Galeorhinus galeus*) (15%), sixgill shark (*Hexanchus griseus*) (10%), and seal shark (*Dalatias licha*) (8%). The observed sixgill shark catch appears to come from a single fishing event, as all four records come from sets

made on the same ridge in the South Fiji Basin during 2013. Very little of the observed chondrichthyan line catch was not reported to the species level (<1%).

Commercial reported data was dominated by spiny dogfishes (61% of total chondrichthyan catch reported), seal shark (12%), shovelnose spiny dogfish (7%), school shark (6%) and shortfin mako (*Isurus oxyrinchus*) (5%). Around 2.5% of fisher-reported catches over the five years were not identified to the species level (Table 5).

The bulk (87%) of the spiny dogfish catch was reported as SPD (*Squalus acanthias*) and was taken from the West Norfolk Ridge, Three Kings Ridges and seamounts north of New Zealand. However, as *S. acanthias* is either rare or absent from this area most of the catch is likely to be a mixture of *S. griffini* and other *Squalus* species (Clark 1988; Anderson et al. 1998; Duffy & Last 2007a, b, 2015; Clark & Roberts 2008). Species only recorded in line fisheries were blue shark (*Prionace glauca*), sharpsnout sevengill (*Heptranchias perlo*), sixgill shark and southern Mandarin dogfish (*Cirrhigaleus australis*).

4. Notes on species

As previously noted, the life history traits of deepwater chondrichthyans make them particularly vulnerable to overfishing, with several species exhibiting large, rapid and widespread declines in abundance after only low to moderate levels of fishing (Wilson & Seki 1994; Graham et al. 2001; Foster et al. 2015).

As the western SPRFMO Area has been fished since before 1990 it is unlikely that the catch data available presented here reflects the unfished or natural composition and abundance of the deepwater chondrichthyans. Species occurring in the SPFRMO Area exhibiting the strongest documented negative responses to fishing in other jurisdictions have been gulper sharks (*Centrophorus* spp.), spiny dogfishes belonging to the *Squalus mitsukurii* species complex, the smalltooth sandtiger (*Odontaspis ferox*) and school shark (Andrew et al. 1997; Graham et al. 2001; Fergusson et al. 2008; Huveneers et al. 2013; Williams et al. 2013; Foster et al. 2015).

Squalus spp.

Squalus species belonging to the *mitsukurii*-group potentially occurring in the SPFRMO Area include *S. albifrons*, *S. chloroculus*, *S. griffini*, *S. melanurus*, *S. montalbani* and *S. rancureli* (Appendix 1). *Squalus* species reported by observers on New Zealand vessels in the SPRFMO Area include *S. griffini*, and *S. acanthias*. As noted above misidentification of even relatively easily distinguished species (i.e. *S. acanthias* cf. *S. griffini*) is evident in the fisher-reported catch data indicating that this is an area requiring improvement. Ongoing taxonomic research also indicates the possibility that several undescribed *Squalus* species occur in the SPRFMO Area. While species from the *Squalus megalops* species complex appear to be more resilient, populations of these species occurring on seamounts and ridges are also likely to be vulnerable to overfishing due to limited population connectivity and the small area of suitable habitat

(Foster et al. 2015). Many of the *Squalus* species listed in Appendix 1 have only recently been described and further research is required to determine their distributions and life history parameters. Some species appear widespread in the region, while others are only known from one or a small number of seamounts. Ongoing taxonomic research also indicates the possibility that several undescribed *Squalus* species occur in the SPRFMO Area.

Deania calcea

Combining all methods of bottom fishing, the species most abundant in the observed catch data is shovelnose spiny dogfish (*Deania calcea*). Clark & Roberts (2008) observed that *D. calcea* was the most abundant species by weight on the West Norfolk Ridge and Lord Howe Plateau during the NORFANZ expedition, and noted that as it is not recorded from New Caledonian waters it is probably at, or close to its northern limit in these areas. They also acknowledged some taxonomic uncertainty regarding the identity of *D. calcea* from the survey area, and recorded two other *Deania*, *D. quadrispinosum* and an unidentified species, in the area (Clark & Roberts 2008). The genus *Deania* needs global taxonomic revision and it is not certain that Southern Hemisphere *D. calcea* are conspecific with *D. calcea* from the Mediterranean (the type locality). Beyond that there are a number of nominal species requiring re-description. Preliminary genetic barcoding of *Deania* indicates the presence of at least three species in New Zealand waters, including one that may or may not be *D. hystricosa* (Duffy et al. 2015). At present, there are no field characters that can be reliably used to distinguish *D. hystricosa* from *D. calcea*. It is therefore likely that the observed and fisher-reported catch includes at least two species, the proportions of which are likely to vary with location, depth and season. The overlap of shovelnose dogfishes with fisheries in the SPRFMO area and vulnerability to a wide range of fishing methods warrants attention (Ford et al. 2015). Further research is required to determine species and stock boundaries, gestation period, reproductive periodicity (which may be as much as four years, Parker & Francis 2012; Irvine et al. 2012), and age and growth of the different species.

In the New Zealand qualitative risk assessment of chondrichthyans, which employed a modified Scale Intensity Consequence Analysis (SICA) approach, shovelnose spiny dogfish was judged to be subject to relatively high fishing intensity (5 on a scale of 1 to 6), of medium consequence (3.5/6), with a total risk score of 17.5 out of a possible 36. Data were considered to exist and be sound, and consensus was reached by the expert panel.

Gollum attenuatus

The low fecundity (usually only two embryos per litter), restricted distribution (endemic to the New Zealand EEZ and ridges north of New Zealand) and demersal habit of the slender smoothhound (*Gollum attenuatus*) suggest that it is vulnerable to depletion and that its status warrants further assessment (Yano 1993a, b). This species received a moderate risk rating by Ford et al. (2015), although this was qualified by acknowledgement that data availability was

poor and there was low confidence in the assessment. Overlap with fisheries within the New Zealand EEZ was estimated to be across more than 60% of the species range, with capture expected on 100-200 days per year. It received a consequence score of 4 indicating it was considered there is “actual, or potential for, unsustainable impact (e.g. long-term decline in CPUE)” (Ford et al. 2015).

5. Recommendations

It is recommended that the Scientific Committee:

- **Notes** the potential for deepwater chondrichthyans to interact with bottom fisheries in the SPRFMO Area
- **Notes** that chondrichthyans generally exhibit relatively slow growth rates, late age at maturity, low fecundity and low natural mortality, making them particularly vulnerable
- **Notes** that misidentification of bycaught chondrichthyans is evident in the reported catch data,
- **Agrees** that better species identification processes should be developed in conjunction with the FAO sharks identification tools
- **Encourages** all Members and CNCPs operating bottom fisheries in the SPRFMO Area to implement observer programmes that specifically task observers to document deepwater chondrichthyans interactions, record chondrichthyans species bycatch to the lowest possible taxonomic level, and report all such data using the prescribed methods
- **Assesses** data provided on chondrichthyans interactions with bottom fisheries to determine the nature and extent of these interactions at the scale of combined SPRFMO fishing activity.

Table 2. Composition of the observed chondrichthyan catch by New Zealand trawlers operating in the SPRFMO Area from 2012-2016 calendar years. Tows = number of tows the species was recorded in; kg = green/unprocessed weight.

Code	Scientific name	2012		2013		2014		2015		2016		Total		
		tows	kg	tows	kg	tows	kg	tows	kg	tows	kg	tows	kg	% kg
SND	<i>Deania calcea</i>	166	5494	187	2802	116	1966	550	37748	508	100716	1527	148726	35.01
RCH	<i>Rhinochimaera pacifica</i>	16	297	28	230	9	39	286	16062	286	39971	625	56599	13.32
BSH	<i>Dalatias licha</i>	71	2307	129	6536	27	436	163	6647	373	33834	763	49760	11.71
CSH, DWD, OSD, SHA	unidentified sharks	98	4093	47	1434	25	575	178	12223	192	18436	540	36761	8.65
LCH	<i>Harriotta raleighana</i>	36	702	25	145	23	233	272	8163	252	14016	608	23259	5.47
ETB	<i>Etomopterus granulosus</i>	240	3932	287	5804	161	2853	266	4470	158	3488	1112	20547	4.84
CYL	<i>Centroscymnus coelolepis</i>	25	1140	19	777	12	338	153	10570	60	1089	269	13914	3.27
PLS, SCM	<i>Centroscymnus macracanthus</i>	40	2167	18	442	45	1157	72	2423	122	6194	297	12383	2.91
CYO	<i>Centroscymnus owstoni</i>	27	472	38	296	13	84	171	5360	114	5086	363	11298	2.66
GSP	<i>Hydrolagus bemisi</i>	46	626	40	192	25	132	241	3648	218	5258	570	9856	2.32
CSQ	<i>Centrophorus squamosus</i>	11	136	32	671	41	911	136	2317	90	3527	310	7562	1.78
CYP	<i>Centroscymnus crepidater</i>	45	331	80	390	40	274	179	2356	175	3472	519	6823	1.61
SPD	<i>Squalus acanthias</i>			6	4667			1	2	2	37	9	4706	1.11
ETL	<i>Etomopterus lucifer</i>	1	1	2	63	1	3	57	491	94	2844	155	3402	0.80
CHI	<i>Chimaera</i> spp.	1	18	4	30			4	14	35	2646	44	2708	0.64
CHG	<i>Chimaera lignaria</i>	7	36	11	75	16	165	58	697	41	1024	133	1997	0.47
DSK	<i>Amblyraja hyperborea</i>	1	2			2	3	38	180	37	1733	78	1918	0.45
SSK	<i>Dipturus innominatus</i>	9	102	1	32	2	14	26	627	43	1058	81	1833	0.43
CHP	<i>Chimaera</i> sp.	10	62	12	63	7	50	9	45	32	1064	70	1284	0.30

Code	Scientific name	2012		2013		2014		2015		2016		Total		
		tows	kg	tows	kg	tows	kg	tows	kg	tows	kg	tows	kg	% kg
NSD	<i>Squalus griffini</i>							2	3	12	1231	14	1234	0.29
OSK	Rajidae			2	3			52	492	73	705	127	1200	0.28
SCH	<i>Galeorhinus galeus</i>	15	1190									15	1190	0.28
APR	<i>Apristurus</i> spp.	29	66	47	114	25	64	100	466	40	146	241	856	0.20
BTS	<i>Brochiraja spinifera</i>	3	3					100	349	84	405	187	757	0.18
GSH	<i>Hydrolagus novaezealandiae</i>	13	311	8	66			21	313	6	31	48	721	0.17
PDG	<i>Oxynotus bruniensis</i>	13	66	11	48	5	14	46	192	83	386	158	706	0.17
PSK	<i>Bathyraja shuntovi</i>	3	8	6	28			45	219	50	304	104	559	0.13
BTA	<i>Brochiraja asperula</i>	1	1	1	1			8	21	52	309	62	332	0.08
ERA	<i>Torpedo fairchildi</i>	2	14	1	20			20	150	14	169	37	353	0.08
HYD	<i>Hydrolagus</i> sp.	3	7	6	55			1	3	12	169	22	234	0.06
ZAS	<i>Zameus squamulosus</i>	7	55					8	128	1	20	16	203	0.05
ETP	<i>Etomopterus pusillus</i>	1	2	10	169			4	9	3	3	18	183	0.04
ODO	<i>Odontaspis ferox</i>	1	150									1	150	0.04
ELE	<i>Callorhinchus milius</i>			2	11			3	110	2	25	7	146	0.03
HYP	<i>Hydrolagus trolli</i>	2	17	2	6	3	13	2	9	9	100	18	145	0.03
RSK	<i>Zearaja nasuta</i>							3	90	5	27	8	117	0.03
FRS	<i>Chlamydoselachus anguineus</i>	2	3	2	11			2	44	5	28	11	86	0.02
GOB	<i>Mitsukurina owstoni</i>	5	94									5	94	0.02
HYB	<i>Hydrolagus homonycterus</i>			1	6			10	49	5	44	16	99	0.02
LSK	<i>Arhynchobatis asperrimus</i>							7	23	20	45	27	68	0.02
BER	<i>Typhlonarke aysoni</i>									7	42	7	42	0.01
BRA	<i>Dasyatis brevicaudata</i>	1	6									1	6	0
BRL	<i>Brochiraja leviveneta</i>									2	2	2	2	0
BTH	<i>Notoraja</i> spp.									1	1	1	1	0

Code	Scientific name	2012		2013		2014		2015		2016		Total		
		tows	kg	tows	kg	tows	kg	tows	kg	tows	kg	tows	kg	% kg
CPN	<i>Chimaera panthera</i>			1	10			1	9			2	19	0
DCS	<i>Bythaelurus dawsoni</i>							1	1			1	1	0
EMO	<i>Etomopterus molleri</i>									1	1	1	1	0
IBR	<i>Isistius brasiliensis</i>			1	1							1	1	0
PCS	<i>Parmaturus macmillani</i>							3	6	4	5	7	11	0
SNR	<i>Deania histricosa</i>	1	2									1	2	0
SSH	<i>Gollum attenuatus</i>							2	4	1	6	3	10	0
Total			23913		25198		9324		116733		249697		424865	

Table 3. Chondrichthyan catch reported by New Zealand trawlers operating in the SPRFMO Area from 2012-2016 calendar years. Tows = number of tows the species was recorded in; kg = green/unprocessed weight.

		2012		2013		2014		2015		2016		Total		
Code	Scientific name	Tows	Kg	Tows	Kg	Tows	Kg	Tows	Kg	Tows	Kg	Tows	Kg	% Kg
DWD, OSD	Unidentified sharks	211	6522	178	4685	118	2918	262	34028	486	84947	1255	133100	53.87
SND	<i>Deania calcea</i>	50	2241	65	1064	50	865	208	19421	83	8624	456	32215	13.04
BSH	<i>Dalatias licha</i>	34	1467	187	7668	51	1316	112	11914	86	4693	470	27058	10.95
SPD	<i>Squalus acanthias</i>	9	1820	43	5635	56	3978	12	3830	16	4676	136	19939	8.07
ETB	<i>Etomopterus granulosus</i>			68	1047	59	699	137	8609	57	2244	321	12599	5.10
CHI	<i>Chimaera</i> spp.			3	47			44	3344	44	4279	91	7670	3.10
NSD	<i>Squalus griffini</i>	2	30	36	490	20	221	74	1593	23	497	155	2831	1.15
SCH	<i>Galeorhinus galeus</i>	22	815	16	493	17	213	22	590	7	105	84	2216	0.90
MAK	<i>Isurus oxyrinchus</i>	3	320	1	150	3	600	1	250	5	676	13	1996	0.81
LCH	<i>Harriotta raleighana</i>	37	869	21	80	9	94	15	687	9	163	91	1893	0.77
RCH	<i>Rhinochimaera pacifica</i>							6	735	11	510	17	1245	0.50
SSK	<i>Dipturus innominatus</i>	5	76					15	820	1	50	21	946	0.38
SPO	<i>Mustelus</i> sp.			3	43	4	105	2	100	1	200	10	448	0.18
CYP	<i>Centroscymnus crepidater</i>							1	400	1	1	2	401	0.16
THR	<i>Alopias vulpinus</i>	1	100	1	88	1	200					3	388	0.16
GSH	<i>Hydrolagus novaezealandiae</i>	6	181	2	7	2	2	3	19	3	90	16	299	0.12
PLS	<i>Centroscymnus macracanthus</i>									7	291	7	291	0.12
GSP	<i>Hydrolagus bemisi</i>	13	89	11	24	4	12	8	79	6	72	42	276	0.11
BWH	<i>Carcharhinus brachyurus</i>					1	200					1	200	0.08
BWS	<i>Prionace glauca</i>	2	110	1	80							3	190	0.08
SSH	<i>Gollum attenuatus</i>							13	185			13	185	0.07
CYO	<i>Centroscymnus owstoni</i>							3	40	1	100	4	140	0.06
DSK	<i>Amblyraja hyperborea</i>									3	150	3	150	0.06

		2012		2013		2014		2015		2016		Total		
Code	Scientific name	Tows	Kg	Tows	Kg	% Kg								
CAR	<i>Cephaloscyllium isabellum</i>									2	97	2	97	0.04
CYL	<i>Centroscymnus coelolepis</i>							1	100			1	100	0.04
CHG	<i>Chimaera lignaria</i>					1	10	3	9	3	21	7	40	0.02
CHP	<i>Chimaera</i> sp.	1	5			5	41					6	46	0.02
EBI	<i>Euprotomicrus bispinatus</i>	13	56									13	56	0.02
CSQ	<i>Centrophorus squamosus</i>									1	18	1	18	0.01
POS	<i>Lamna nasus</i>							1	20			1	20	0.01
ETL	<i>Etomopterus lucifer</i>							1	1			1	1	0
RSK	<i>Zearaja nasuta</i>			1	5							1	5	0
Total			14701		21606		11474		86774		112504		247059	

Table 4. Observed chondrichthyan catch by New Zealand line vessels operating in the SPRFMO Area from 2012-2016 calendar years. Sets = number of sets the species was recorded in; kg = green/unprocessed weight.

Species code	Scientific name	2012		2013		2014		2015		2016		Total			
		Sets	Kg	Sets	Kg	Sets	Kg	Sets	Kg	Sets	kg	Sets	Kg	% Kg	
NSD	<i>Squalus griffini</i>	9	39	46	2006	26	217	32	1401			113	3663	43.67	
SCH	<i>Galeorhinus galeus</i>	10	142	11	257	8	95	20	747			49	1241	14.80	
HEX	<i>Hexanchus griseus</i>			4	820							4	820	9.78	
BSH	<i>Dalatias licha</i>			3	14			5	630			8	644	7.68	
SND	<i>Deania calcea</i>					4	17	5	550	6	71	15	638	7.61	
SSH	<i>Gollum attenuatus</i>			15	171	4	11	13	222			32	404	4.82	
SSK	<i>Dipturus innominatus</i>	1	30					6	330			7	360	4.29	
SPD	<i>Squalus acanthias</i>			10	40	1	10			7	101	18	151	1.8	
MAK	<i>Isurus oxyrinchus</i>			1	150							1	150	1.79	
BWS	<i>Prionace glauca</i>	1	50					2	63			3	113	1.35	
CAR	<i>Cephaloscyllium isabellum</i>			7	51					3	25	10	76	0.91	
POS	<i>Lamna nasus</i>							1	50			1	50	0.60	
CYO	<i>Centroscymnus owstoni</i>			1	20							1	20	0.24	
HEP	<i>Heptranchias perlo</i>			3	15							3	15	0.18	
SPO	<i>Mustelus</i> sp.			3	15							3	15	0.18	
ETL	<i>Etomopterus lucifer</i>					6	6			3	4	9	10	0.12	
IBR	<i>Isistius brasiliensis</i>			1	5							1	5	0.06	
MSH	<i>Cirrhigaleus barbifer</i>			1	5							1	5	0.06	
OSD	unidentified sharks									1	4	1	4	0.05	
CYP	<i>Centroscymnus crepidater</i>	3	3									3	3	0.04	
Total				264		3569		356		3993		205		8387	

Table 5. Chondrichthyan catch reported by New Zealand line vessels operating in the SPRFMO Area from 2012-2016 calendar years. Sets = number of sets the species was recorded in; kg = green/unprocessed weight.

Species code	Scientific name	2012		2013		2014		2015		2016		Total			
		Sets	Kg	Sets	kg	Sets	kg	Sets	kg	Sets	Kg	Sets	Kg	% Kg	
SPD	<i>Squalus acanthias</i>	9	1820	39	5555	56	3978	12	3830	16	4676	132	19859	53.44	
BSH	<i>Dalatias licha</i>			1	300			16	4250			17	4550	12.24	
NSD	<i>Squalus griffini</i>	2	30	36	490	20	221	74	1593	23	497	155	2831	7.62	
SND	<i>Deania calcea</i>					6	25	15	2400	7	164	28	2589	6.97	
SCH	<i>Galeorhinus galeus</i>	22	815	16	493	17	213	22	590	6	102	83	2213	5.95	
MAK	<i>Isurus oxyrinchus</i>	3	320	1	150	3	600	1	250	4	650	12	1970	5.30	
OSD	Unidentified sharks			2	205			5	720	3	11	10	936	2.52	
SSK	<i>Dipturus innominatus</i>							15	820			15	820	2.21	
SPO	<i>Mustelus</i> sp.			3	43	4	105	1	50	1	200	9	398	1.07	
THR	<i>Alopias vulpinus</i>	1	100	1	88	1	200					3	388	1.04	
BWH	<i>Carcharhinus brachyurus</i>					1	200					1	200	0.54	
BWS	<i>Prionace glauca</i>	2	110	1	80							3	190	0.51	
SSH	<i>Gollum attenuatus</i>							13	185			13	185	0.50	
POS	<i>Lamna nasus</i>							1	20			1	20	0.05	
CAR	<i>Cephaloscyllium isabellum</i>									1	10	1	10	0.03	
RSK	<i>Zearaja nasuta</i>			1	5							1	5	0.01	
Total			3195		7409			5542		14708		6310		37164	

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Appendix 1. Chondrichthyans occurring below 200 m depth in the western SPRFMO Area

Order	Family	Scientific Name	Common name
Hexanchiformes	Chlamydoselachidae	<i>Chlamydoselachus anguineus</i>	frilled shark
Hexanchiformes	Hexanchidae	<i>Heptranchias perlo</i>	Sharpnose sevengill shark
Hexanchiformes	Hexanchidae	<i>Hexanchus griseus</i>	Bluntnose sixgill shark
Hexanchiformes	Hexanchidae	<i>Hexanchus nakamurai</i>	Bigeye sixgill shark
Squaliformes	Echinorhinidae	<i>Echinorhinus brucus</i>	Bramble shark
Squaliformes	Echinorhinidae	<i>Echinorhinus cookei</i>	Prickly shark
Squaliformes	Centrophoridae	<i>Centrophorus granulosus</i>	Gulper shark
Squaliformes	Centrophoridae	<i>Centrophorus harrissoni</i>	Harrisson's gulper shark
Squaliformes	Centrophoridae	<i>Centrophorus moluccensis</i>	Smallfin gulper shark
Squaliformes	Centrophoridae	<i>Centrophorus squamosus</i>	Leafscale gulper shark
Squaliformes	Centrophoridae	<i>Centrophorus tessellatus</i>	Mosaic gulper shark
Squaliformes	Centrophoridae	<i>Centrophorus zeehaani</i>	Southern dogfish
Squaliformes	Centrophoridae	<i>Deania calcea</i>	Birdbeak dogfish
Squaliformes	Centrophoridae	<i>Deania hystricosa</i>	Rough longnose dogfish
Squaliformes	Centrophoridae	<i>Deania quadrispinosa</i>	Longsnout dogfish
Squaliformes	Dalatiidae	<i>Dalatias licha</i>	Kitefin shark
Squaliformes	Dalatiidae	<i>Euprotomicrus bispinatus</i>	Pygmy shark
Squaliformes	Dalatiidae	<i>Isistius brasiliensis</i>	Cookiecutter shark
Squaliformes	Dalatiidae	<i>Isistius plutosus</i>	Largetooth cookiecutter shark
Squaliformes	Dalatiidae	<i>Squaliolus aliae</i>	Smalleye pygmy shark
Squaliformes	Etmopteridae	<i>Centroscyllium granulatum</i>	Granular dogfish
Squaliformes	Etmopteridae	<i>Centroscyllium kamoharai</i>	Bareskin dogfish
Squaliformes	Etmopteridae	<i>Etomopterus bigelowi</i>	Blurred smooth lanternshark
Squaliformes	Etmopteridae	<i>Etomopterus brachyurus</i>	Shorttail lanternshark
Squaliformes	Etmopteridae	<i>Etomopterus caudistigma</i>	Tailspot lanternshark

Squaliformes	Etmopteridae	<i>Etmopterus dianthus</i>	Pink lanternshark
Squaliformes	Etmopteridae	<i>Etmopterus dislineatus</i>	Lined lanternshark
Squaliformes	Etmopteridae	<i>Etmopterus evansi</i>	Blackmouth lanternshark
Squaliformes	Etmopteridae	<i>Etmopterus granulosus</i>	Southern lanternshark
Squaliformes	Etmopteridae	<i>Etmopterus lucifer</i>	Blackbelly lanternshark
Squaliformes	Etmopteridae	<i>Etmopterus molleri</i>	Slendertail lanternshark
Squaliformes	Etmopteridae	<i>Etmopterus pseudosqualiolus</i>	False lanternshark
Squaliformes	Etmopteridae	<i>Etmopterus pusillus</i>	Smooth lanternshark
Squaliformes	Etmopteridae	<i>Etmopterus samadiae</i>	Lantern shark
Squaliformes	Etmopteridae	<i>Etmopterus splendidus</i>	Splendid lanternshark
Squaliformes	Etmopteridae	<i>Etmopterus viator</i>	Traveller lanternshark
Squaliformes	Oxynotidae	<i>Oxynotus bruniensis</i>	Prickly dogfish
Squaliformes	Somniosidae	<i>Centroscymnus coelolepis</i>	Portuguese dogfish
Squaliformes	Somniosidae	<i>Centroscymnus owstonii</i>	Roughskin dogfish
Squaliformes	Somniosidae	<i>Centroselachus crepidater</i>	Longnose velvet dogfish
Squaliformes	Somniosidae	<i>Proscymnodon macracanthus</i>	Largespine velvet dogfish, Plunket's shark
Squaliformes	Somniosidae	<i>Scymnodalatias albicauda</i>	Whitetail dogfish
Squaliformes	Somniosidae	<i>Scymnodalatias sherwoodi</i>	Sherwood's dogfish
Squaliformes	Somniosidae	<i>Scymnodon ringens</i>	Knifetooth dogfish
Squaliformes	Somniosidae	<i>Somniosus antarcticus</i>	Southern sleeper shark
Squaliformes	Somniosidae	<i>Somniosus longus</i>	Pygmy sleeper shark
Squaliformes	Somniosidae	<i>Zameus squamulosus</i>	Velvet shark
Squaliformes	Squalidae	<i>Cirrhigaleus australis</i>	Mandarin dogfish
Squaliformes	Squalidae	<i>Squalus albifrons</i>	Eastern highfin spurdog
Squaliformes	Squalidae	<i>Squalus bucephalus</i>	Bighead spurdog
Squaliformes	Squalidae	<i>Squalus chloroculus</i>	Greeneye spurdog
Squaliformes	Squalidae	<i>Squalus griffini</i>	New Zealand spurdog / northern spiny dogfish
Squaliformes	Squalidae	<i>Squalus cf. japonicus</i>	Longnose spurdog

Squaliformes	Squalidae	<i>Squalus megalops</i>	Shortnose spurdog
Squaliformes	Squalidae	<i>Squalus cf. megalops</i>	Shortnose spurdog
Squaliformes	Squalidae	<i>Squalus melanurus</i>	Blacktailed spurdog
Squaliformes	Squalidae	<i>Squalus cf. mitsukurii</i>	Shortspine spurdog
Squaliformes	Squalidae	<i>Squalus montalbani</i>	Shortspine spurdog
Squaliformes	Squalidae	<i>Squalus rancureli</i>	Cyrano spurdog
Squaliformes	Squalidae	<i>Squalus raoulensis</i>	Kermadec spiny dogfish
Lamniformes	Mitsukurinidae	<i>Mitsukurina owstoni</i>	Goblin shark
Lamniformes	Odontaspidae	<i>Odontaspis ferox</i>	Smalltooth sand tiger
Lamniformes	Odontaspidae	<i>Odontaspis noronhai</i>	Bigeye sand tiger
Lamniformes	Pseudocarchariidae	<i>Pseudocarcharias kamoharai</i>	Crocodile shark
Lamniformes	Alopiidae	<i>Alopias superciliosus</i>	Bigeye thresher
Lamniformes	Cetorhinidae	<i>Cetorhinus maximus</i>	Basking shark
Lamniformes	Lamnidae	<i>Carcharodon carcharias</i>	Great white shark
Lamniformes	Lamnidae	<i>Isurus oxyrinchus</i>	Mako
Lamniformes	Lamnidae	<i>Isurus paucus</i>	Longfin mako
Lamniformes	Lamnidae	<i>Lamna nasus</i>	Porbeagle
Carcharhiniformes	Pentanchidae	<i>Apristurus albisoma</i>	White-bodied catshark
Carcharhiniformes	Pentanchidae	<i>Apristurus ampliceps</i>	Roughskin catshark
Carcharhiniformes	Pentanchidae	<i>Apristurus australis</i>	Pinocchio catshark
Carcharhiniformes	Pentanchidae	<i>Apristurus exsanguis</i>	Pale catshark
Carcharhiniformes	Pentanchidae	<i>Apristurus garricki</i>	Longnose catshark
Carcharhiniformes	Pentanchidae	<i>Apristurus longicephalus</i>	Longhead catshark
Carcharhiniformes	Pentanchidae	<i>Apristurus melanoasper</i>	Deepwater catshark
Carcharhiniformes	Pentanchidae	<i>Apristurus nakayai</i>	New Caledonian catshark
Carcharhiniformes	Pentanchidae	<i>Apristurus pinguis</i>	Bulldog catshark
Carcharhiniformes	Pentanchidae	<i>Apristurus platyrhynchus</i>	Spatulasnout catshark
Carcharhiniformes	Pentanchidae	<i>Apristurus sinensis</i>	
Carcharhiniformes	Pentanchidae	<i>Asymbolus galacticus</i>	Starry catshark

Carcharhiniformes	Pentanchidae	<i>Bythaelurus dawsoni</i>	Dawson's catshark
Carcharhiniformes	Pentanchidae	<i>Galeus corriganae</i>	Sawtail catshark
Carcharhiniformes	Pentanchidae	<i>Galeus gracilis</i>	Sawtail catshark
Carcharhiniformes	Pentanchidae	<i>Galeus priapus</i>	Sawtail catshark
Carcharhiniformes	Pentanchidae	<i>Parmaturus albimarginatus</i>	whitemargin catshark
Carcharhiniformes	Pentanchidae	<i>Parmaturus albipenis</i>	whiteclasper catshark
Carcharhiniformes	Pentanchidae	<i>Parmaturus bigus</i>	Beige catshark
Carcharhiniformes	Pentanchidae	<i>Parmaturus macmillani</i>	New Zealand filetail catshark
Carcharhiniformes	Scyliorhinidae	<i>Cephaloscyllium albipinnum</i>	Whitefin swellshark
Carcharhiniformes	Scyliorhinidae	<i>Cephaloscyllium signourum</i>	flagtail swell shark
Carcharhiniformes	Scyliorhinidae	<i>Cephaloscyllium cf. signourum</i>	swell shark
Carcharhiniformes	Scyliorhinidae	<i>Cephaloscyllium stevensi</i>	Steven's swellshark
Carcharhiniformes	Scyliorhinidae	<i>Cephaloscyllium variegatum</i>	Saddled swellshark
Carcharhiniformes	Scyliorhinidae	<i>Cephaloscyllium zebrum</i>	Narrowbar swellshark
Carcharhiniformes	Scyliorhinidae	<i>Figaro boardmani</i>	Australian sawtail catshark
Carcharhiniformes	Scyliorhinidae	<i>Figaro striatus</i>	Northern sawtail catshark
Carcharhiniformes	Scyliorhinidae	<i>Scyliorhinus garmani</i>	Brownspotted catshark
Carcharhiniformes	Pseudotriakidae	<i>Gollum attenuatus</i>	Slender smoothhound
Carcharhiniformes	Pseudotriakidae	<i>Pseudotriakis microdon</i>	False catshark
Carcharhiniformes	Triakidae	<i>Gogolia filewoodi</i>	Sailback houndshark
Carcharhiniformes	Triakidae	<i>Galeorhinus galeus</i>	School shark
Carcharhiniformes	Triakidae	<i>Hemitriakis cf. abdita</i>	Deepwater sicklefin hound shark
Carcharhiniformes	Triakidae	<i>Hypogaleus hyugaensis</i>	Blacktip tope shark
Carcharhiniformes	Triakidae	<i>Iago garricki</i>	Longnose houndshark
Carcharhiniformes	Triakidae	<i>Mustelus manazo</i>	Starspotted smoothhound
Carcharhiniformes	Triakidae	<i>Mustelus walkeri</i>	Eastern spotted gummy shark
Carcharhiniformes	Carcharhinidae	<i>Carcharhinus albimarginatus</i>	Silvertip shark
Carcharhiniformes	Carcharhinidae	<i>Carcharhinus altimus</i>	Bignose shark

Carcharhiniformes	Carcharhinidae	<i>Galeocerdo cuvier</i>	Tiger shark
Rajiformes	Torpedinidae	<i>Tetronarce nobiliana</i>	Electric ray, Torpedo
Rajiformes	Torpedinidae	<i>Tetronarce cf. tokionis</i>	Slender electric ray
Rajiformes	Arhynchobatidae	<i>Arhynchobatis asperimus</i>	Longtail skate
Rajiformes	Arhynchobatidae	<i>Bathyraja leucomelanos</i>	Softnosed skate
Rajiformes	Arhynchobatidae	<i>Bathyraja pacifica</i>	Blonde skate
Rajiformes	Arhynchobatidae	<i>Bathyraja richardsoni</i>	Richardson's skate
Rajiformes	Arhynchobatidae	<i>Bathyraja shuntovi</i>	Longnose deepsea skate
Rajiformes	Arhynchobatidae	<i>Brochiraja albilibiata</i>	Whitemouth skate
Rajiformes	Arhynchobatidae	<i>Brochiraja asperula</i>	Smooth skate
Rajiformes	Arhynchobatidae	<i>Brochiraja heuresa</i>	Eureka skate
Rajiformes	Arhynchobatidae	<i>Brochiraja leviveneta</i>	Blue skate
Rajiformes	Arhynchobatidae	<i>Brochiraja macrospinifera</i>	Dwarf skate
Rajiformes	Arhynchobatidae	<i>Brochiraja spinifera</i>	Prickly skate
Rajiformes	Arhynchobatidae	<i>Brochiraja vittacula</i>	Ribbontail skate
Rajiformes	Arhynchobatidae	<i>Insetiraja laxipella</i>	Eastern looseskin skate
Rajiformes	Arhynchobatidae	<i>Notoraja alisae</i>	Velcro skate
Rajiformes	Arhynchobatidae	<i>Notoraja azurea</i>	Blue skate
Rajiformes	Arhynchobatidae	<i>Notoraja fijiensis</i>	Fiji skate
Rajiformes	Arhynchobatidae	<i>Notoraja inusitata</i>	Softnosed skate
Rajiformes	Arhynchobatidae	<i>Notoraja longiventralis</i>	Softnosed skate
Rajiformes	Arhynchobatidae	<i>Notoraja ochroderma</i>	Pale skate
Rajiformes	Arhynchobatidae	<i>Notoraja sapphira</i>	Sapphire skate
Rajiformes	Arhynchobatidae	<i>Notoraja sereti</i>	Seret's skate
Rajiformes	Arhynchobatidae	<i>Notoraja sticta</i>	Blotched skate
Rajiformes	Arhynchobatidae	<i>Pavoraja arenaria</i>	Sandy skate
Rajiformes	Arhynchobatidae	<i>Pavoraja mosaica</i>	Mosaic skate
Rajiformes	Arhynchobatidae	<i>Pavoraja nitida</i>	Peacock skate
Rajiformes	Arhynchobatidae	<i>Pavoraja pseudonitida</i>	False peacock skate

Rajiformes	Arhynchobatidae	<i>Pavoraja umbrosa</i>	Dusky skate
Rajiformes	Rajidae	<i>Amblyraja hyperborea</i>	Thorny skate, Boreal skate
Rajiformes	Rajidae	<i>Dipturus acrobelus</i>	Deepwater skate
Rajiformes	Rajidae	<i>Dipturus apricus</i>	Pale tropical skate
Rajiformes	Rajidae	<i>Dipturus canutus</i>	Grey skate
Rajiformes	Rajidae	<i>Dipturus grahami</i>	Graham's skate
Rajiformes	Rajidae	<i>Dipturus gadgeri</i>	Bight skate
Rajiformes	Rajidae	<i>Dipturus innominatus</i>	Smooth skate
Rajiformes	Rajidae	<i>Dipturus melanospilus</i>	Blacktip skate
Rajiformes	Rajidae	<i>Dipturus polyommata</i>	Argus skate
Rajiformes	Rajidae	<i>Dipturus queenslandicus</i>	Queensland deepwater skate
Rajiformes	Rajidae	<i>Dipturus wengi</i>	Weng's skate
Rajiformes	Rajidae	<i>Rajella challenger</i>	Challenger skate
Rajiformes	Anacanthobatidae	<i>Sinobatis filicauda</i>	Eastern leg skate
Myliobatiformes	Plesiobatidae	<i>Plesiobatis daviesi</i>	Giant stingaree
Myliobatiformes	Hexatrygonidae	<i>Hexatrygon bickelli</i>	Sixgill stingray
Myliobatiformes	Urolophidae	<i>Spinilophus armatus</i>	New Ireland stingaree
Myliobatiformes	Urolophidae	<i>Urolophus deforgesii</i>	de Forges' stingaree
Myliobatiformes	Urolophidae	<i>Urolophus neocalledoniensis</i>	New Caledonian stingaree
Myliobatiformes	Urolophidae	<i>Urolophus papilio</i>	Butterfly stingaree
Myliobatiformes	Urolophidae	<i>Urolophus piperatus</i>	Coral Sea stingaree
Chimaeriformes	Chimaeridae	<i>Chimaera carophila</i>	Brown chimaera
Chimaeriformes	Chimaeridae	<i>Chimaera fulva</i>	Southern chimaera
Chimaeriformes	Chimaeridae	<i>Chimaera lignaria</i>	Purple chimaera, Giant chimaera, Giant purple ghostshark
Chimaeriformes	Chimaeridae	<i>Chimaera macrospina</i>	Longspine chimaera
Chimaeriformes	Chimaeridae	<i>Chimaera obscura</i>	Shortspine chimaera
Chimaeriformes	Chimaeridae	<i>Chimaera panthera</i>	Leopard chimaera
Chimaeriformes	Chimaeridae	<i>Chimaera cf. phantasma</i>	Silver chimaera

Chimaeriformes	Chimaeridae	<i>Hydrolagus affinis</i>	Giant black ghostshark, smalleyed rabbitfish
Chimaeriformes	Chimaeridae	<i>Hydrolagus bemisi</i>	Pale ghostshark, Brown ghostshark
Chimaeriformes	Chimaeridae	<i>Hydrolagus homonycteris</i>	Little black ghostshark
Chimaeriformes	Chimaeridae	<i>Hydrolagus lemures</i>	Blackfin ghostshark
Chimaeriformes	Chimaeridae	<i>Hydrolagus marmoratus</i>	Marbled ghostshark
Chimaeriformes	Chimaeridae	<i>Hydrolagus novaezealandiae</i>	Dark ghostshark, Mottled ghostshark
Chimaeriformes	Chimaeridae	<i>Hydrolagus ogilbyi</i>	Ogilby's ghostshark
Chimaeriformes	Chimaeridae	<i>Hydrolagus trolli</i>	Purple ghostshark, Pointy-nosed blue chimaera
Chimaeriformes	Rhinochimaeridae	<i>Hariotta haekeli</i>	Smallfin spookfish
Chimaeriformes	Rhinochimaeridae	<i>Hariotta raleighana</i>	Smallfin spookfish
Chimaeriformes	Rhinochimaeridae	<i>Rhinochimaera pacifica</i>	Pacific spookfish