ISC/16/SHARKWG-1/

Blue Shark (Prionace glauca) bycatch statistics in Canadian fisheries[1]

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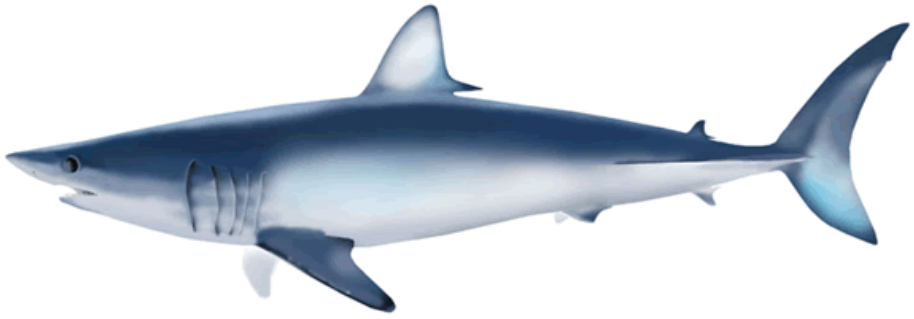

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Introduction

There are no directed Blue Shark (*Prionace glauca*) fisheries conducted within Canadian waters; as such, all catch statistics are incidental encounters. Blue Shark have been encountered as incidental catch in a number of modern and historical Canadian fisheries, including groundfish trawl and longline fisheries; troll, gillnet and seine fisheries for salmon (*Oncorhynchus* spp.), Pacific Sardine (*Sardinops sagax*), Albacore Tuna (*Thunnus alalunga*), and Neon Flying Squid (*Ommastrephes bartrami*); as well as foreign and joint-venture fisheries for Pacific Hake (*Merlucius productus*). All commercial fisheries in Canada are covered by a dockside monitoring program which provides validated landings. There are very few landings of incidentally encountered Blue Shark. Currently, only the groundfish trawl and longline fisheries have 100% observer coverage, with either an at-sea observer program or electronic monitoring to record discards of incidental catches at sea. Discards at sea of incidental catches by other commercial fisheries are based solely on fisher logbook data.

Methods

Data were obtained from Fisheries and Oceans Canada (DFO) research staff at the Pacific Biological Station, from a variety of databases maintained by the Fishery and Assessment Data Section, (DFO Pacific Region) and the Regional Catch Statistics Unit (DFO Pacific Region), as well as from the literature. All data sources included details of individual fishing trips or catch offloading events associated with a date (capture date or offload date), fishing gear, species code, catch weight and/or count, and catch utilization (whether the catch was landed or discarded). Fishing gear types were categorized as "trawl" (bottom trawl, midwater trawl, surface trawl, and unknown trawl), "line" (longline, handline, and jig gear e.g. squid experimental fishery gear), and "other" (troll, trap, seine, gillnet). For non-trawl gears where the gear type was not specified, gear type was assumed to be "line" unless the vessel's fishing history indicated an alternative gear type. Commercial catches were either retained on the vessel and landed for sale, or discarded/released at sea. Landed catch for most commercial fisheries is validated by a third party at the landing port through dockside monitoring programs (DMP) and recorded on sales slips, while discarded catch is generally based on observer log books for observed fisheries, or on fisher log books for non-observed fisheries. Discard information varies in quality depending on the data source and time period. As requested by the ISC Shark Working Group, Canadian Blue Shark catch statistics are compiled for 1979-2015.

<u>Groundfish Fisheries</u>

Trawl data from 1945 – 1995 are archived in the GFCatch database (Fishery and Assessment Data Section, DFO Pacific Region); however, discard information is considered unreliable for this time period, and no Blue Sharks were recorded. Post-1995, commercial catch data for the groundfish trawl fishery were obtained from the PacHarvTrawl database for 1996 – 2006 and the GFFOS database for 2007 – 2015 (Fishery and Assessment Data Section, DFO Pacific Region). Trawl data from 1996 is based on 100% observer coverage of the fishery, consisting of tow-by-tow information including

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georeferenced capture location, as well as estimates of discarded weight (kg), and is generally considered reliable. Landings are based on validation records from the dockside monitoring program.

Prior to 1997, discard information for groundfish line fisheries is not available. Landings from 1982 – 1995 are available from sales slip data archived in the PacHarv3 database (Fisheries and Oceans Canada, Pacific Region, Regional Data Services Unit); however there were no Blue Sharks landed by the groundfish line fisheries during this period. From 1997 onwards, commercial catch data for the groundfish line fisheries were obtained by fishery from the PacHarvHL database (1997 – 2005), PacHarvSable database (2000 – 2005) and the GFFOS database for 2006 – 2015 (Fishery and Assessment Data Section, DFO Pacific Region). Line data include landings based on validation records from the dockside monitoring program, as well as records of retained and discarded catch from fisher logbooks when available. Landings based on validation records are considered reliable (catch is weighed at the dock). Logbooks provide tow-by-tow information including georeferenced capture location, retained catch, and discarded catch, but retained and discarded catch may be visual estimates, and are often only available as piece counts. The quality and completeness of logbook records prior to 2005 is variable, and may be poor; from 2006 onwards, data from logbook records including discard information may be more reliable due to electronic monitoring. Catch by piece counts were converted to weight (kg) using mean weight of 21.07 kg per piece based on logbooks from the 1999 – 2004 longline fishery.

Salmon Fishery

Data on incidental catches of sharks in the commercial salmon troll, gillnet, and seine fisheries for 2001 – 2015 were provided by the Salmon Data Unit (S. Hamilton, DFO Pacific Region, pers. comm) and include landing date, area of capture, landings, and discards. Catches are reported in pieces and are based on daily phoned-in catch reports and annual fisher logbook submissions. The quality and completeness of the information is unknown. Piece counts were converted to estimated catch weights using mean weight per piece (21.07 kg) from logbooks for the 1999 – 2004 groundfish longline fishery. Prior to 2001, no discard information for salmon fisheries is available.

Sardine Fishery

The Canadian Pacific Sardine fishery is an opportunistic fishery dependent on the migration of Pacific Sardine into British Columbia waters. Pacific Sardine was absent from much of the west coast of North America from the late 1940s to the early 1980s , and commercial harvest of Pacific Sardine in British Columbia did not resume until 2002 (DFO 2012). A purse seine fishery for Pacific Sardine operated in British Columbia from 2002 – 2012; from 2013 onwards, Pacific Sardine have again been absent from British Columbia waters (DFO 2015). Data on incidental catches of sharks in the sardine fishery in 2002 – 2012 were provided by L. Flostrand (DFO Pacific Region, pers. comm) and include landing date, area of capture, validated landings, and discards based on fisher logbooks. The quality and completeness of discard information is unknown. All shark catches were recorded as piece counts.

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Estimated catch weights for Blue Shark was were estimated using mean weight per piece (21.07 kg) from logbooks for the 1999 – 2004 groundfish longline fishery.

Albacore Tuna Fishery

The North Pacific Albacore Tuna troll fishery is operated under a treaty between the governments of Canada and the United States (US) which allows Canadian and US vessels to fish inside both Canadian and US waters. Data on incidental catches of sharks in Canadian waters by Canadian vessels in the tuna troll fishery in 1995 – 2015 were provided by J. Holmes (DFO Pacific Region, pers. comm) and include capture date, georeferenced capture location, and discards (pieces) based on fisher logbooks. There were no incidental catches of sharks in Canadian waters recorded by US vessels in the tuna troll fishery (J. Childers, NOAA, pers. comm). The quality and completeness of the discard information is unknown, although the quality is thought to increase from about 2006 onwards (J. Holmes, DFO Pacific Region, pers. comm). Blue Shark catches were converted to estimated catch weight using mean weight per piece (21.07 kg) from logbooks for the 1999 – 2004 groundfish longline fishery.

Squid Experimental Commercial Fisheries

Experimental fishing for Neon Flying Squid (*Ommastrephes bartrami*) was conducted using drift gillnets on 12 commercial trips in 1979, 1980, 1983, and 1985 - 1987 off the west coast of British Columbia. Experimental fishing trips were conducted with an observer on board whose duties included accurately identifying bycatch species, including sharks. Data from each trip are available in six reports (Bernard 1980 , Bernard 1981, Sloan 1984, Robinson and Jamieson 1984, Jamieson and Heritage 1987, Jamieson and Heritage 1988) and consist of tow by tow information, including georeferenced fishing locations and incidental catches recorded as weights (kg) and/or counts (pieces). Data are considered reliable. Where catches were recorded in pieces only, total catch weights in kg were provided by species for the trip and were used to estimate mean weight of Blue Shark per piece (ranging from 4.18 kg to 8.13 kg) to convert Blue Shark catches to kg.

Experimental fishing for flying squid using jig gear occurred in 1987 and 1990 – 1991. Experimental fishing trips were conducted with an observer on board whose duties included accurately identifying bycatch species, including sharks. Data from each trip are summarized in two reports (Jamieson and Heritage 1988; Shaw and Smith 1995) and include total catch weight of incidental species by trip for catches within and outside Canadian waters; no detailed catch locations are available. Data are considered reliable.

Pilot commercial jig fisheries were conducted in 1996 – 1998 (Gillespie and Shaw 1997; Campagna et al. 2000). A portion of the commercial trips were observed; however, even on observed trips, bycatch reporting may have been incomplete (Campagna et al. 2000). No sharks were reported.

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Joint Venture / Foreign Fisheries

Foreign trawl fisheries for Pacific Hake (*Merluccius productus*) in Canadian waters occurred from 1966 – 1992 off the west coast of Vancouver Island (Hicks et al. 2013); data on incidental catches from foreign "national" fisheries are available from the Groundfish Biological Samples (GFBio) database (Fishery and Assessment Data Section, DFO Pacific Region) for 1977 – 1992, and include shark catches recorded as weights or as piece counts; the quality and completeness of the data is unknown. Piece counts were converted to estimated catch weights using mean weight per piece (21.07 kg) from logbooks for the 1999 – 2004 groundfish longline fishery.

From 1978 – 2011, Canadian and foreign vessels participated in a joint venture trawl fishery for Pacific Hake, whereby Canadian catcher vessels delivered Pacific Hake and incidental species to foreign processing vessels in cooperative fishing arrangements. In addition, foreign processing vessels involved in the joint venture fishery at times fished directly (supplemental fishing) when Canadian domestic vessels could not supply sufficient quantities of Pacific Hake. Data on incidental catches in the joint-venture and foreign "supplemental" fisheries are available from the Groundfish Biological Samples (GFBio) database (Fishery and Assessment Data Section, DFO Pacific Region) and include shark catches recorded as weights or as piece counts. Piece counts were converted to estimated catch weights using mean weight per piece (21.07 kg) from logbooks for the 1999 – 2004 groundfish longline fishery. All joint venture catches are monitored by at-sea observers; therefore the quality of the data is assumed to be reliable.

Results

Catch estimates (tonnes) by gear type and utilization (landed or discarded) are presented in Table 1. Blank cells reflect years in which there were no records of Blue Shark incidental catch, yet it is unknown if those values are actually zero. Large Blue Shark catches in the 1980s reflect the activity of the experimental squid fisheries which operated during that time. Subsequent to the experimental squid fisheries, groundfish line fisheries encountered the majority of Blue Sharks within Canadian commercial fisheries. The sustained increase in discarded Blue Shark statistics in the groundfish line fisheries after 2006 likely reflect the change in requirement for 100% electronic monitoring of discards. Blue Shark are only intermittently landed in the groundfish line fisheries, and in amounts less than approximately 1 tonne per year (Table 1).

Spatial distribution of commercial Blue Shark catches (1979-2015) in British Columbia are presented in Figure 1. Catches westward of the 200 m depth contour are dominated by the experimental squid fisheries in the 1980s, while the concentration of catches inside the 200 m depth contour represent groundfish trawl and line fisheries. Salmon and sardine catch data do not include georeferenced catch locations and are not represented in the figure.

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Discussion

The catch statistics reported here replace all previous catch data supplied by Canada for Blue Shark incidental catches in King (2012). Since the last report, effort has been made by DFO to improve shark catch statistics, including verification of species codes in databases. In addition, catch recorded in the experimental squid fisheries were not previously included in total annual catch estimates.

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Table 1. Catches (tonnes) of Blue Shark (*Prionace glauca*) from British Columbia commercial fisheries in 1979 – 2015. Catches are reported by gear type, and utilization (landed or discarded). "Trawl" includes bottom, midwater, surface, and unspecified trawl gears. "Line" includes longline, handline, and jig gears. "Other" includes trap, troll, seine, and gillnet. Note that catch utilization for commercial Trawl and Other gears was discarded only.

Year	Gear type					All gears		
	Line			Trawl	Other			
	Landed	Discarded	Total	Total	Total	Landed	Discarded	Total
1979					0.89		0.89	0.89
1980					10.97		10.97	10.97
1981								
1982								
1983					24.57		24.57	24.57
1984								
1985					60.43		60.43	60.43
1986					90.31		90.31	90.31
1987					158.74		158.74	158.74
1988				0.46			0.46	0.46
1989				0.19			0.19	0.19
1990		4.39	4.39	0.02			4.41	4.41
1991		0.32	0.32	0.09			0.41	0.41
1992								
1993								
1994				0.09			0.09	0.09
1995				0.03			0.03	0.03
1996				0.65			0.65	0.65
1997	0.05		0.05	0.59		0.05	0.59	0.65
1998	1.05	0.08	1.13	0.85		1.05	0.93	1.98
1999	0.08	0.32	0.40	0.34		0.08	0.66	0.74
2000	0.10	0.62	0.72	0.71		0.10	1.33	1.43
2001		3.79	3.79	0.14	0.74		4.67	4.67
2002	0.04	5.27	5.31	0.09	0.06	0.04	5.43	5.46
2003		17.22	17.22	0.04	0.23		17.49	17.49
2004		3.74	3.74	0.05	0.05		3.84	3.84
2005	0.01	0.18	0.19	0.01	0.11	0.01	0.30	0.30
2006	1.05	18.12	19.17	0.26	0.48	1.05	18.87	19.91
2007	0.17	8.75	8.92	0.06	0.13	0.17	8.94	9.11
2008	0.40	5.23	5.63			0.40	5.23	5.63
2009	0.19	7.94	8.13		0.11	0.19	8.05	8.24
2010		7.21	7.21	0.12			7.33	7.33
2011	0.29	11.42	11.71	0.05	0.74	0.29	12.20	12.50
2012	0.23	8.39	8.62	0.09	0.19	0.23	8.67	8.90
2013	0.17	25.20	25.37	0.11	0.13	0.17	25.44	25.61
2014	0.36	8.53	8.89	0.08	0.19	0.36	8.80	9.16
2015	0.27	22.40	22.67		0.23	0.27	22.63	22.90

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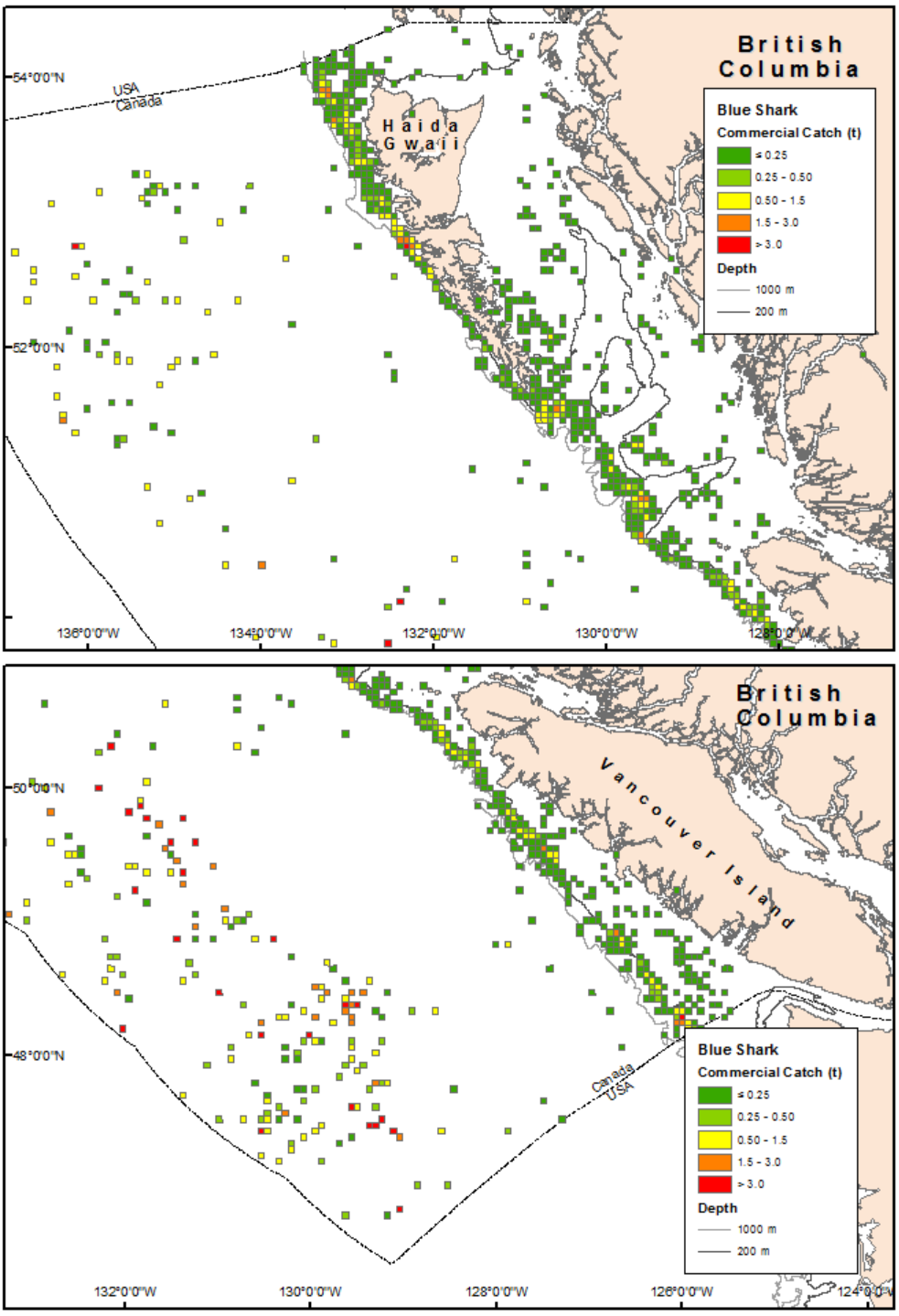

Figure 1. Spatial distribution of catches (tonnes) of Blue Shark (Prionace glauca) from British Columbia (upper panel: northern region; lower panel: southern region) commercial fisheries in 1979 – 2015. Catches are summed over a 5 km^2 grid for records with valid geographic coordinates.

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