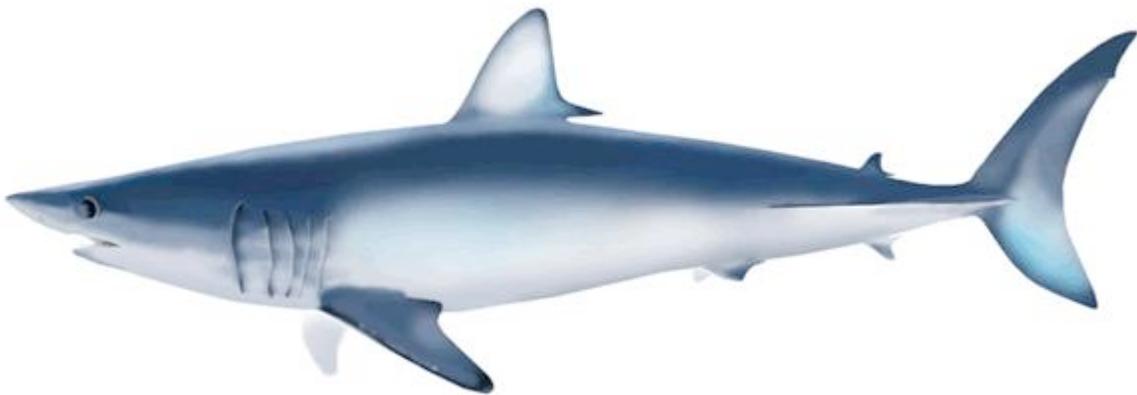


# Preliminary catch estimates of north Pacific blue shark from California experimental shark longline fisheries<sup>1</sup>

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## ABSTRACT

Two experimental longline fisheries targeting sharks were developed in California during two periods: 1979–1980 and 1988–1991. The first fishery from 1979–1980 (hereinafter called the SK fishery) consisted on a single vessel that was funded by a Saltonstall–Kennedy grant to investigate the development of a commercial fishery for north Pacific blue shark (*Prionace glauca*). The second fishery from 1988–1991 (hereinafter called the CFGC experimental permit fishery) developed after the California Fish and Game Commission (CFGC) issued permits for an experimental longline fishery targeting shortfin mako (*Isurus oxyrinchus*) and blue sharks starting in 1988. A report by the West Coast Fisheries Development Foundation provided direct records of number of blue sharks caught and landed weight by the SK fishery. Logbook data was used to estimate catch, dead discards, and total removals by the experimental permit fishery. The catch of this SK fishery in round weight was estimated to be 36.6 and 99.2 mt for 1979 and 1980, respectively. The estimated catch of the experimental permit fishery ranged from 35.18 mt in 1991 to 77.77 mt in 1988. However, due to the high discard rate and high proportion of discarded fish in good condition, the estimated total removals for this fishery ranged from 4.22 mt in 1991 to 37.91 mt in 1988.

## INTRODUCTION

Two experimental longline fisheries targeting sharks were developed in California during two periods: 1979–1980 and 1988–1991. The first fishery from 1979–1980 (hereinafter called the SK fishery) consisted on a single vessel that was funded by a Saltonstall–Kennedy grant to investigate the development of a commercial fishery for north Pacific blue shark (*Prionace glauca*) (West Coast Fisheries Development Foundation 1981). The second fishery from 1988–1991 (hereinafter called the CFGC experimental permit fishery) developed after the California Fish and Game Commission (CFGC) issued permits for an experimental longline fishery targeting shortfin mako (*Isurus oxyrinchus*) and blue sharks starting in 1988 (O’Brien and Sunada 1994). The CFGC, upon the recommendation from the California Department of Fish and Game (CDFG), declined the renewal of these permits in 1992.

Based on the reports for these experimental fisheries (West Coast Fisheries Development

Foundation 1981; O'Brien and Sunada 1994), they only caught relatively small amounts of blue shark. The objective of this document is to describe the data sources and methods used to develop preliminary catch estimates for both fisheries that are critical for the stock assessment of north Pacific blue conducted by the shark working group (SHKWG) of the International Scientific Committee on Tuna and Tuna-like species (ISC) in 2013.

## **MATERIALS AND METHODS**

### **SK Fishery**

The main source of information for the SK fishery, which operated in 1979 and 1980, is the report produced by the West Coast Fisheries Development Foundation (1981). Importantly for this paper, the report provided direct records of number of blue sharks caught and landed weight. A pdf copy of the report is available from the author of this paper. All sets occurred in the Southern California Bight area. Most of the sets occurred from June to September but several sets also occurred in October and November.

Based on Table B-79 and B-80 in the report, 3783 (53778 lbs) and 7980 (145855 lbs) blue sharks were landed in 1979 and 1980, respectively. Small numbers of unidentified sharks were lost (N=402) or released dead (N=119) (Tables 5-79 and 5-80 in the report), which were considered to be negligible in this study. The landed weight was assumed to be dressed weight. Dressed weight was converted to whole weight by assuming whole weight was 1.5 times dressed weight (the conversion factor used in PacFIN for this stock).

### **CFGC Experimental Permit Fishery**

For the CFGC experimental permit fishery, which operated from 1988 to 1991, logbooks were required for all vessels and observers from the CDFG observed about 19% of the effort during 1988 and 1989 (O'Brien and Sunada 1994). However, only partial records from the logbook and observer records have been recovered to date. Two logbook databases were recovered - Database A had effort data (number of hooks for each set) that are considered to be relatively complete but only catch information for mako sharks; while Database B had blue shark catches by sex but the

data are only available from 1989 to 1991 and only for a subset of the total effort during those years.

In addition, the vast majority of observer records have not been recovered, limiting the utility of this data. The highly limited amount of catch and effort data that have been recovered from the observer records were not considered to be useful for this study. However, several blue sharks (male N=8; female N=5) caught in this fishery were measured by observers. All sets occurred in the Southern California Bight area during season 2 (April–June) and 3 (July–September) (Fig. 1).

The sex-specific blue shark catch-per-unit-effort (CPUE) (fish per 1000 hooks) was calculated for each year and season where data were available from Database B. Data rows where effort was zero or not recorded were discarded prior to calculating CPUE. Data rows where catch in weight was greater than zero but catch in numbers of fish was zero were also discarded. The blue-shark CPUE for 1988 was assumed to be the mean CPUE for 1989 to 1991 because data for 1988 was not available. The effort for each year and season was estimated as the greater of the sum of the effort from Database A and Database B for each year and season.

The sex-specific blue shark catch in numbers was calculated from the above-mentioned CPUE and effort by year and season. The mean sex-specific weight of blue shark was estimated from the measured lengths recorded by observers, using the following length-weight relationship, which was derived from sharks measured and weighed during NOAA juvenile shark surveys ( $weight$  (kg) =  $5.00857 \times 10^{-6} \times fork\ length$  (cm)<sup>3.0541</sup>, N=138, R<sup>2</sup> = 0.8847). The mean weight for male and female blue sharks was 18.957 and 26.523 kg respectively. The catch in numbers was converted to catch in weight based on these mean weights.

Based on O'Brien and Sunada (1994; p225), 52% of blue sharks released in 1988 were observed to be in 'good' condition. In 1989, 88% of blue sharks released were observed to be in good condition. O'Brien and Sunada suggested that this increase in proportion of blue sharks released in good condition was due to "the development and wide use in the fishery of long-handled hook-removal pliers. Use of these pliers reduced injury and improved release condition because hooks could usually be removed without cutting the sharks' tissues". Blue sharks released in 'good' condition were assumed to survive for this paper. Since "interviews with longline permittees

indicated that the pliers were also widely used in 1990 and 1991” (O’Brien and Sunada 1994), 88% of blue sharks released in 1990 and 1991 were also assumed to be released in ‘good’ condition.

In order to estimate the quantity of dead discards in this experimental permit fishery, the difference between the estimated catch in weight and the recorded landings in weight (from O’Brien and Sunada 1994) was first assumed to be discarded. Out of this discarded amount, the proportion of blue sharks released in ‘good’ condition was assumed to have survived. The total mortality from this fishery was calculated as the sum of the landings and the dead discards in weight.

## **RESULTS AND DISCUSSION**

### **SK Fishery**

The catch of this SK fishery in round weight was estimated to be 36.6 and 99.2 mt for 1979 and 1980, respectively (Table 1). Since the number of discards in this fishery was considered to be negligible, the total removals for this fishery are the same as the catch. This catch has not been previously reported to the ISC shark working group.

### **CFGC Experimental Permit Fishery**

The estimated catch of this experimental permit fishery ranged from 35.18 mt in 1991 to 77.77 mt in 1988. However, due to the high discard rate and high proportion of discarded fish in good condition, the estimated total removals for this fishery ranged from 4.22 mt in 1991 to 37.91 mt in 1988. This has been previously reported in Table 2 of Walsh and Teo (2012), using a different method, which was based only on landings data and is now considered to be inferior. Therefore, the estimated total removals for California longline (inclusive of the California pelagic longline fishery described in Walsh and Teo 2012) from 1988 to 1991 should be updated to 37.9, 9.1, 22.7, and 5.3 mt, respectively. The estimated removals for 1991 should 5.3 mt instead of 4.2 mt (see Table 2) because of the 1.1 mt removed by the California pelagic longline fishery.

O’Brien and Sunada (1994) also described that the shark fishery using drift longline gear began developing in the mid-1980s before it was banned in 1987 within California waters by the CDFG (the experimental permit fishery started the next year in 1988). However, accurate records

for blue sharks caught by this fishery are currently not available. Given the high discard and survival rate from the experimental permit fishery, it is likely that the total removals of blue sharks by this fishery would likely be relatively small – on the order of the experimental permit fishery. Based on the substantially larger removals reported by other fisheries in the north Pacific, these removals from the mid-1980s to 1987 would likely have negligible impact on the upcoming stock assessment of north Pacific blue shark.

## REFERENCES

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Walsh, W. A., and S. L. H. Teo. 2012. Catch statistics, length data and standardized CPUE for blue shark *Prionace glauca* taken by longline fisheries based in Hawaii and California. ISC/12/SHARKWG-1/02. Working document submitted to the ISC Shark Working Group Workshop, 28 May - 4 June, National Research Institute of Far Seas Fisheries, Shizuoka, Japan.

West Coast Fishery Development Foundation. 1981. A report on the development of the Pacific blue shark as a commercial fishery. NMFS, S-K Contract No:80-ABH-00052, 225 pp.

Table 1. Catch and effort of the SK fishery. Other than round weight, all other numbers were extracted from Tables B-79 and B-80 in the report by West Coast Fisheries Development Foundation (1981). Discards were assumed to be negligible for this fishery.

Year	Number of hooks	Number of blue sharks caught	Dressed weight of blue sharks (mt)	Round weight of blue sharks (mt)
1979	21026	3783	24.4	36.6
1980	21246	7980	66.2	99.2

Table 2. Catch and effort of the experimental permit fishery.

Year	Number of sets	Number of hooks (1000 hooks)	Catch (mt)	Landings (mt)	Dead discards (mt)	Total removals (mt)
1988	474	123.58	81.49	1.12	38.58	39.69
1989	266	75.195	41.40	4.91	4.38	9.29
1990	329	81.09	55.82	19.42	4.37	23.79
1991	179	40.546	37.32	0.00	4.48	4.48

Figure 1. Map of total number of longline sets deployed by experimental permit fishery. All effort recorded by logbooks were summed and shown in 1x1 degree squares. Color indicate total number of sets within 1x1 degree square.

