Blue Shark

History of the Fishery

Blue sharks (*Prionace glauca*) are not a major target of California's recreational or commercial fisheries. Urea stored in their blood system quickly turns to ammonia when the shark dies, thus rendering the meat unpalatable. Development of a quality meat product has been the limiting factor in creating commercial interest. Only two serious attempts at developing a quality food product in California have occurred. The first took place in 1979 and 1980 when one vessel fished blue sharks experimentally with longline gear. Product quality was judged to be good enough to establish blue shark as a viable alternate fishery, and 150,000 pounds dressed meat were sold at about $0.25 per pound. Although market interest developed in several western states, a steady demand could not be assured and the fishery was discontinued.

The second attempt at developing a food product began in 1988 with an experimental longline fishery directed at shortfin mako and blue shark. Participants in the fishery were required to develop a market for human consumption with the bycatch of blue sharks, which were not released alive. In 1989 and 1990, a total of 54,000 pounds of blue shark was sold for making jerky and "fish and chips." It was clear from these attempts, however, that a quality food product and related market had not been achieved. Participants in the fishery substantially reduced the incidental mortality of blue sharks by developing a hook removal tool, which allowed up to 88 percent of the blue shark catch to be released alive. As a result, the requirement to develop a wholesale market for blue sharks was dropped in 1991. Between 1991 and 1999, the commercial harvest of blue sharks dropped to 37,500 pounds.

The recreational catch of blue sharks grew tremendously throughout the 1980s. Estimated annual catch increased ten-fold between 1981 and 1988 with over 400,000 angler-trips on private boats, which had "sharks" (including mako sharks) as the primary or secondary target species. Although angler effort for "sharks" remained high throughout the 1990s, blue shark harvest continually declined. This may be due to the fact that most blue sharks are released alive. Shark fishing trips aboard commercial passenger fishing vessels (CPFVs) are offered from most southern California sport fishing landings from two to seven nights per week during the summer.

The greatest source of fishing mortality for southern California blue sharks in the past three decades probably occurred as a result of their incidental capture during the developing years of the drift gillnet fishery for swordfish and thresher sharks. Annual estimated bycatch in the late 1970s and early 1980s was between 15,000 and 20,000 blue sharks. Changes in season length, fleet size, time-area closures and the use of large mesh nets substantially reduced blue shark mortality, although there are no reported estimates of current mortality in this fishery.

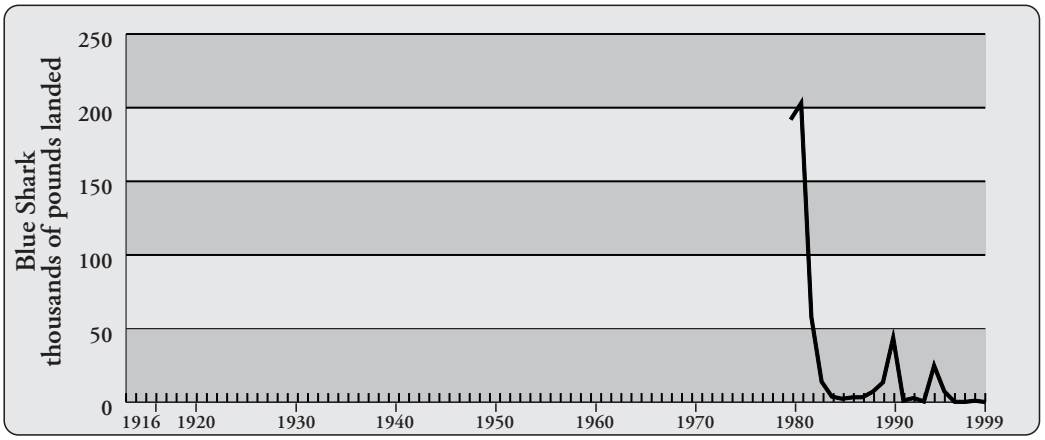
Blue Shark, *Prionace glauca*
Credit: DFG

Status of Biological Knowledge

The blue shark is an oceanic-epipelagic and fringe littoral species with a circumglobal distribution. It is found in all temperate and tropical oceans and is thought to be the most wide-ranging shark species. Although this species can be found in oceanic waters between 43˚F and 82˚F, it is most commonly found in cooler water temperatures between 45 F and 61˚F. In tropical waters, blue sharks show submergence and are typically found at greater depths. In temperate waters, blue sharks are caught within the mixed layer and generally range between the surface and the top of the thermocline, but have been documented as deep as 2,145 feet. In the Pacific, blue sharks are most predominant between 35˚N and 45˚N.

Age and growth studies of blue sharks indicate that they may reach maturity in six to seven years, although there may be regional differences in growth. They are thought to be opportunistic feeders at all life stages and prey primary on small pelagic fishes, crustaceans, and cephalopods. Blue sharks off southern California have also been shown to exhibit seasonal dietary shifts when prey such as squid become abundant during their mass spawning events.

The blue shark is viviparous with a yolk-sac placenta. Litter size is quite variable ranging from four to 135 pups and may be dependent on the size of the female. In the Pacific, it is thought that mating occurs during the summer months in the equatorial region from May through August. Gestation period is thought to range from nine to 12 months and may vary depending on location. Off California, mating occurs in late spring to early winter. The Southern California Bight is a major birthing area and is generally considered a nursery area for immature blue



Commercial Landings 1916-1999, Blue Shark
Data Source: DFG Catch Bulletins and commercial landing receipts. All shark landings were aggregated under the market category "unspecified shark" until 1977.

sharks. Female blue sharks have been shown to exhibit sperm storage, which may also explain variability in gestation period estimates. Late-term pregnant females are found in the northern Pacific in summer months where they give birth to large, well-developed pups averaging 14 inches. This suggests that mature females in the Pacific may only reproduce every other year.

Seasonal migrations are thought to occur in the Atlantic, Pacific, and Indian Ocean populations with seasonal periods of sexual segregation. A shark tagging program recently initiated by the department may further elucidate the migratory movements of blue sharks in the eastern Pacific. However, because no blue shark-tag and recapture programs have been initiated in the central Pacific, the extent of blue shark migration in the central Pacific is still unconfirmed.

Blue sharks appear to aggregate in loose schools and are generally caught more frequently over depths greater than 3,300 feet. They exhibit daily diving behavior similar to that of other pelagic fishes and sharks and appear to show a fair degree of niche overlap with swordfish. Blue sharks are incidentally caught in pelagic longline tuna and swordfish fisheries in the Pacific and can seasonally comprise the largest percentage of the catch in these fisheries. In recent years, there has been an increase in the number of blue sharks taken in the tuna and swordfish longline fishery in Hawaii, where sharks are "finned" at sea, and the fins are then sold to Asian markets. The meat is seldom landed and sold at market due its low commercial value.

Based on spatial and temporal changes in blue shark abundance in the Pacific, it is suspected that the north-south difference in catch rates of blue sharks is mediated by the transition zone. This is the area of water between the cooler Aleutian Current and the warmer water from the North Pacific Current. This transition zone shifts from 31° N and 36° N in the winter to 41° N and 36° N in the fall. Most of the larger catches of blue sharks have been made in or just south of this zone.

Diel movements of blue sharks acoustically tracked off southern California and in the North Atlantic indicate that adult blue sharks increase their activity at night and make shallower dives than during the day. Sharks tracked off southern California ventured inshore at night, presumably to feed on seasonally available spawning squid. The cyclical diving behavior is thought to serve as a hunting, orientation, and/or thermoregulatory function.

Although adult blue sharks are opportunistic feeders and prey mainly on small pelagic fishes, cephalopods, and crustacean, they have also been observed scavenging on marine mammal carcasses at sea. Unfortunately, there are few data on the diet composition of blue sharks in the central Pacific.

Status of the Population

The size of California's blue shark stock is unknown. Local abundance undergoes major seasonal fluctuations with juveniles to three year olds most abundant in the coastal waters from early spring to early winter. Mature adults are uncommon in coastal waters.

Fishery-dependent data needed for determining abundance, mortality, etc. are lacking because blue sharks are usually discarded at sea and the catch often goes undocumented. Local abundance depends on recruitment of juveniles and immigration of individuals from Mexico and offshore into California waters. Although there are no abundance estimates (local or Pacific-wide), some fishermen and field biologists speculate that there are fewer blue sharks than there were 10 to 20 years ago. The combined mortality from recreational anglers, commercial set net and drift net fisheries, Mexican fisheries and foreign high seas fisheries undoubtedly has the potential

to impact the population and the local blue shark stock to an unknown extent. Currently though, all research and statistics indicate that blue shark populations within California waters remain within healthy levels.

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