

Skates and Rays

History of the Fishery

Skates and rays are not specifically sought by commercial fishermen, but are taken incidentally, primarily by bottom trawlers in central and northern California waters. Of the species identified in the commercial catch the most common are the shovelnose guitarfish (*Rhinobatos productus*), bat ray (*Myliobatis californica*), big skate (*Raja binoculata*), and thornback (*Platyrrhinoidis triseriata*). This does not represent the true catch composition, however, as 98 percent of the landings are listed as "unidentified skate." A few nearshore species, most commonly the bat ray and shovelnose guitarfish, are the target of small sport fisheries.

Only the wings of skates caught in the commercial fishery are marketed. The bodies are either discarded at sea or occasionally sold as bait for the rock crab fishery. Skate wings are sold fresh and frozen, predominantly in the Asian fresh fish markets in southern California. Wings are also dried or salted and dehydrated for the Asian markets. At times, skates have been processed for fishmeal, but most such enterprises experienced economic failure. Seafood restaurants and retail markets have been suspected of punching out rounds of skate wing to serve as cheap substitutes for scallops.

Historically, the economic value of the skate fishery compared to other seafood fisheries was relatively small. From 1958 to 1969 the ex-vessel price for skate wings ranged from \$.01 to \$.02 per pound. Prices increased from \$.12 per pound in the 1970s to \$.25 per pound in 1991. This increase has continued through the 1990s ranging as high as \$1 or more and averaging around \$.40. In 1999, the total ex-vessel value of skates and rays was approximately \$340,000.

Central California (Monterey and San Francisco) shared the majority of the skate catch from 1948 through 1989, accounting for 41 to 100 percent of the annual landings and more than 70 percent of the total catch during the period. The northern California areas (Eureka, Crescent City, and Fort Bragg) have played an increasing role since about 1975. Over the period from 1989 through 1999, the northern California catch has increased dramatically, accounting for nearly 75 percent of the total catch. Areas south of Monterey remain relatively insignificant in terms of total landings.

From 1916 to 1990, skate landings, which ranged from 36,247 pounds (1916) to 631,240 pounds (1981), comprised two to 90 percent of the total elasmobranch catch (11.8 percent average). Like the shark fishery, which had peaks from 1937 to 1948, and more recently from 1976 to 1990, the skate catch has fluctuated widely during the last half century. In the past 10 years, however, skate and ray landings have increased nearly ten-fold in California,

from around 228,566 pounds in 1989 to 1,912,695 pounds in 1999. This trend is most notable in the trawl fishery after 1994.

Some of the apparent increase may be due to increased landings of previously discarded catch. In 1994, the commercial groundfish fishery was divided into limited entry and open access components, each with new regulations and quotas. Groundfish quotas for both components were significantly reduced in the period from 1994 through 1999, leaving more space in the boats' holds for non-quota species. Trawl vessels have supplemented their groundfish landings with skate and ray bycatch. There is considerable uncertainty whether the total impact on the skate and ray resource has increased or if more of the catch is being retained and landed.

Status of Biological Knowledge

Skates and rays (batoids) can be distinguished from sharks by having pectoral fins which extend above and in front of the gills, attaching to the head and forming an expanded and flattened disc with gill slits located completely on the underside. They can be thought of as sharks flattened to accommodate a life spent on the sea floor. Twenty species of rays and skates have provisionally been recorded from California waters.

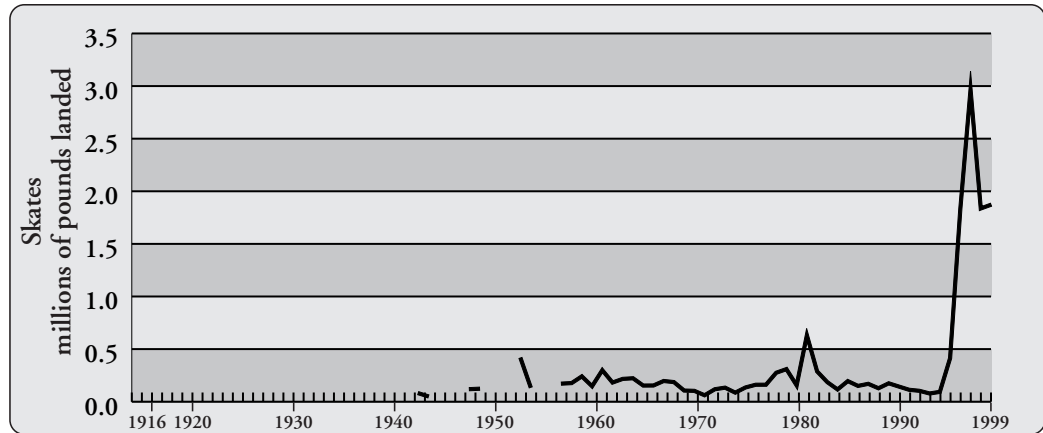
Rays and skates occur in all marine habitats, from protected bays and estuaries to open seas, ranging from the surface to 9,500 feet deep. While some species are common, others are known from only a few specimens. So far as is known, batoids follow the typical elasmobranch reproductive strategy in which sexual maturity is attained relatively late in life, brood size is relatively small, and fecundity is generally low. These characteristics make populations more susceptible to overfishing.

All batoids have internal fertilization, but two different modes of development exist. The skates are egg layers, or oviparous. Following fertilization, the yolk is enclosed in a



Longnose Skate, *Raja rhina*
Credit: DFG

Commercial Landings
1916-1999, Skates
 Data Source: DFG Catch
 Bulletins and commercial
 landing receipts. Landings data
 are not available prior to 1943,
 1945-1947, 1950, 1952, and
 1955-1956.



tough, permeable egg case, which is deposited on the sea floor. The embryo develops within the egg case, feeding on nourishment stored in the attached yolk mass. Hatched egg cases (commonly known as “mermaid’s purses”) are washed ashore and frequently found by beachcombers. All other batoids are live bearing, or viviparous. The embryo is protected by, and develops within, a portion of the female’s oviduct, which functions as a uterus. The gestation period for skates and rays varies widely; depending on the species it may range from two to 18 months.

Batoids feed on a variety of worms, mollusks, crustaceans, other invertebrates, and fishes. Some lie buried on the bottom to wait for prey, while others actively forage. As a group they have a large variety of feeding strategies, ranging from straining plankton (manta), to electric shock (electric ray), to excavation and suction (bat ray). In turn, marine mammals, sharks, and other large fishes prey upon batoids. An adult giant sea bass (*Stereolepis gigas*) was found to have three whole thornbacks in its stomach. Batoid predator avoidance adaptations include cryptic (camouflage) coloration and burying themselves in sand or mud. In some species, rows of sharp spines on the back and/or tail also serve as protection. Only a few of the batoid species are dangerous to humans. Electric rays are capable of producing a powerful shock, and stingrays can inflict serious wounds on unwary anglers and bathers.

The Skates and Softnose Skates - Families Rajidae and Arhynchobatidae

The skates are the largest group of batoid fishes. Nine species in three genera are presently known to occur in California waters. California’s three commercially important skates are the California skate (*Raja inornata*), big skate (*R. binoculata*), and longnose skate (*R. rhina*).

The skates have a greatly flattened, usually rhomboidal shaped disc. Most species have enlarged thorns or sharp spines (denticles) on disc and tail. Adult males have rows

of enlarged, hooked thorns along the front edge (malar thorns) and lateral edge (alar thorns) of the disc. The tail is slender, with two small dorsal fins located near the tip. The caudal fin is small or absent, and there are no stinging spines. Skates have paired electric organs along the sides of their tails, which generate weak, low-voltage electric currents believed to be used in intra-specific communication, possibly for mate recognition or to demonstrate aggression. These electric currents are not harmful to humans.

The California skate ranges from the Strait of Juan De Fuca to southern Baja California. It is common inshore in shallow bays at depths of 60 feet or less, but also occurs in deeper water to a depth of 2,200 feet. Females and males both reach sexual maturity at a total length of about 30 inches. They feed on shrimp and other invertebrates.

The big skate ranges from the Bering Sea to southern Baja California, but is relatively rare south of Point Conception. It occurs at depths from 10 to about 2,600 feet, being most common at moderate depths. It is the only known Californian skate with more than one embryo per egg case. The big skate grows to a length of up to eight feet, but usually does not exceed six feet and about 200 pounds. Females mature at 12 to 13 years and a length of 51 to 55 inches; males mature at seven to eight years and a length of 39 to 43 inches. It feeds on crustaceans and fishes.

The longnose skate also ranges from the Bering Sea to central Baja California, and is usually found on the bottom at depths from 80 to 2,250 feet. It attains a maximum length of about 4.5 feet. Females mature at eight years and a length of 28 inches; males mature at five years and a length of 24 inches.

Other skate species include the sandpaper skate (*Bathyrhaja interrupta*) and starry skate (*Raja stellulata*) occurring in moderate depths and the deep-sea skate (*B.*

abyssicola), roughtail skate (*B. tachura*), and white skate (*B. spinosissima*) occurring in deep water up to 9,500 feet (deep skate). One other species, the broad skate (*Amblyraja badia*) is very rare with only two records from California.

The Guitarfishes and Thornbacks - Families Rhinobatidae and Platyrhinidae

The guitarfishes derive their name from their similarity in shape to the musical instrument; head tapered or round, flattened, and somewhat broader than their sturdy, shark-like tail. Thornbacks share this general body shape, but have rows of spines down the dorsal surface. Guitarfishes and thornbacks are usually found on the bottom and close inshore. All are viviparous, the embryos being nourished by nutrients stored in their yolksac. They have small, blunt teeth used for crushing, and feed on invertebrates such as worms, crustaceans, and mollusks, as well as small fishes, and are generally harmless to humans. Three species are known from California waters.

The shovelnose guitarfish (*Rhinobatos productus*) has a sharply pointed snout and a tapered, somewhat shovel-shaped disc. It ranges from San Francisco to the Gulf of California, but is rare north of Monterey Bay. It is found in shallow coastal waters, bays, sloughs and estuaries over sandy or muddy bottoms to a depth of about 50 feet. Mating occurs during the summer months in southern California and the females give birth to live young the following spring or summer. Newborn guitarfish are six inches long, with up to 28 pups per litter. Females reach a length of 5.5 feet and a weight of about 40 pounds; males are smaller. The banded guitarfish (*Zapteryx exasperata*) has a more rounded snout and dark banding across the disc. It inhabits rocky reefs and gravel beds and occurs rarely in southern California.

The thornback (*Platyrhinoidis triseriata*) is identified by three parallel rows of large, curved spines running down the back and base of its tail to just past the first dorsal fin. Adults reach a length of 2.5 to three feet. Thornbacks occur in shallow water to depths of 150 feet resting on sandy bottoms partially or completely buried. Thornbacks are common in the southern part of the state and Baja California, becoming more rare to the north.

The Electric Rays - Family Torpedinidae

Electric rays are found worldwide in all tropical and warm-temperate seas. They have a greatly expanded sub-circular disc that is fleshy toward the margins, and specialized to accommodate the two kidney-shaped electric organs. These organs are modified muscles capable of producing a powerful electrical shock. Only one species is known from California waters.

The Pacific electric ray (*Torpedo californica*) ranges from northern British Columbia to central Baja California, at depths from 10 to 1,400 feet. Commonly found over sandy bottoms, it also occurs in rocky areas and kelp beds. Females reach a length of over 4.5 feet, while males may reach three feet. It feeds exclusively on fish, including anchovies, herring, kelp bass, mackerel, and halibut. One four-foot female ray was observed to consume a two-foot silver salmon. Unlike most predatory fish, however, it does not initially seize its prey with its mouth, but first immobilizes it with electric discharges. It then manipulates the prey toward its mouth, using its remarkably dexterous disc, before swallowing it.

Sometimes aggressive when approached or provoked by divers, it may swim toward them with pectoral fins curled downward in a challenging manner. While its electric shock may be quite powerful, reaching up to 60 volts in larger individuals, it does not extend a great distance from the ray's body. The shock is apparently not fatal to humans, but often snaps the backbone of prey fish.

The Myliobatidiform Rays (Stingrays) - Families Urolophidae, Myliobatidae, Dasyatidae, Gymnuridae, and Mobulidae

The stingrays are a large and rather diverse group, most of which have a greatly flattened disc and whiplike tail with one or more serrated stinging spines that are readily replaced when they become old or worn. This group includes both the smallest and largest batoids. Most are bottom-dwellers, occurring in shallow inshore waters, bays, estuaries and sloughs, but some are also found in deeper waters. At least one species of stingray and all mantas and mobulas are epipelagic, occurring in the upper water column of the open ocean.

The stingrays bear live young and are unique among the elasmobranchs in their method of nourishing the developing embryo. A nutritive fluid called uterine milk is secreted from hair like processes called trophonemata, which line the oviduct wall. Adults feed on soft benthic invertebrates, mollusks, crustaceans, and benthic, mid-water, and schooling nektonic fishes.

Rays are usually popular when displayed in public aquaria; bat rays are especially suited for shallow petting tanks. Although used by cultures throughout the world for food, myliobatidiform rays are of little interest to California commercial fishermen, who mostly consider them a nuisance. Because most species have a stinging spine, care should be taken when handling them.

The round stingray (*Urolophus halleri*), our most common stingray, has a nearly round disc and short, stout tail with well-developed caudal fin and stinging spine. It ranges from northern California to Panama, but is most abundant south of Point Conception. A benthic species

with restricted habitat requirements, this ray is limited to a relatively shallow coastal zone at depths from three to 100 feet, occurring primarily in water less than 50 feet deep. It can be found off beaches and in protected bays, sloughs, channels and inlets, where it inhabits loose sand or mud bottoms.

The round stingray's stinging spine is located far enough back on its tail to afford a powerful stinging reflex. When large numbers of round stingrays congregate off beaches, injuries to bathers can result. This danger can usually be avoided, however, by shuffling one's feet or pushing a stick along the bottom. Injuries from the spine may also result when rays are removed from nets or hooks. While the wounds do not appear to be fatal, they can be severely painful, and can cause vomiting, diarrhea, sweating, cramps, and difficulty breathing.

The bat ray (*Myliobatis californica*) is a common seasonal inhabitant of shallow inshore waters from Oregon to the Gulf of California. It occurs in muddy or sandy bays and sloughs as well as rocky areas and in kelp beds from near the surface to depths of 150 feet.

Gestation is estimated to take from nine to 12 months, with two to 12 young per litter. Size range at birth is 8.7 to 13.8 inches disc width (wingtip to wingtip). Onset of sexual maturity in males occurs at an age of two to three years and a disc width of 17.7 to 24.5 inches; maturity in females occurs at five to seven years and disc width of 35 to 40 inches.

Female bat rays reach a greater size than males, attaining a maximum disc width of 70.9 inches and weight of 210 pounds. The largest reported male is 40 inches wide at a weight of 37 pounds. Bat rays grow slowly, reach sexual maturity relatively late, have few young, and seem to be fairly long-lived. A 60-inch disc width female was estimated to be 24 years old.

Bat rays feed on clams, abalones, oysters, marine snails, worms, shrimps, and crabs. Bat ray predation on oysters is a major reason for the fencing seen around commercial oyster beds. Pieces of backbone (centra), tooth plates, and sting fragments have been identified from coastal shell-mounds, suggesting that bat rays were a regular diet item of early California natives.

The diamond stingray (*Dasyatis brevis*) is found in shallow waters to a depth of 55 feet. It ranges from southern California (with a possible record from British Columbia) to Peru inhabiting sand and mud bottoms, often around kelp beds. Maximum reported size is 38.5 inches disc width.

A truly open ocean species, the pelagic stingray (*Pteroplatytrygon violacea*) is commonly found swimming in open water well above the bottom. Found worldwide in warm-temperate and tropical waters the pelagic stingray

reaches a maximum disc width of 32 inches. It is a frequent incidental catch of drift longline gear.

The California butterfly ray (*Gymnura marmorata*) inhabits shallow bays and sandy beaches. It has a very wide disc, reaching widths up to five feet. The butterfly ray is found from Point Conception to Peru, including the Gulf of California.

Found worldwide in tropical seas the Pacific manta (*Manta birostris*) is seen on rare occasions in southern California. The manta can reach a maximum width of 25 feet. Its close relative, the mobula (*Mobula japonica*), which occurs in temperate waters of the Pacific, is also rarely seen in southern California. Mobulas are smaller than mantas, reaching a maximum width of four to seven feet. Mantas and mobulas are unique among the batoids in being filter feeders. They pass huge volumes of water across complex filter plates at the gills, straining out small pelagic crustaceans and schooling fishes.

Status of the Populations

Based on existing data, little can be said about the current or past population levels of California's skates and rays. While landings are increasing dramatically, this may or may not reflect an actual threat to the resource. Fish that were discarded in the past, dead and alive, are now being retained and landed. The increase in landings, however, certainly warrants close monitoring. Although some skate species may have higher growth rates than other elasmobranchs, compared with bony fishes they have slow growth rates, late age at maturity, and low fecundity. Other regions have already witnessed decreases in skate and ray populations. In Japan and the Irish Sea, landings have decreased and overfishing has apparently occurred.

The impact of sport fisheries on skates and rays is relatively unknown. Data from 48 shark derbies in Elkhorn Slough from 1950 to 1990 show, however, that shovelnose guitarfish, which in the 1950s and 1960s were the second, and in some years the most abundantly caught elasmobranch, virtually disappeared from the catch in later years. In the 1990s, there was a two-thirds decrease in the catch-per-unit effort for bat rays compared to the 1950s catch rates in these derbies. Pacific States Marine Fisheries Commission recreational fisheries sampling, however, shows continued catches of bat rays, big skates, shovelnose guitarfish, and thornback. The total numbers caught are hard to determine from the numbers of sampled skates and rays, as sampled catch numbers vary widely from year to year.

Management Considerations

See the Management Considerations Appendix A for further information.

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