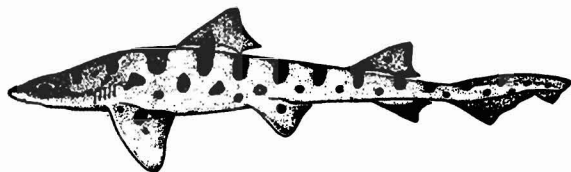


An Informational Summary on Elasmobranchs in Elkhorn Slough

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Abstract

Shark angling derbies have been held in Elkhorn Slough since 1946, and archery derbies since about 1973. Elkhorn Slough is an important pupping and breeding area for leopard sharks, *Triakis semifasciata*, and bat rays, *Myliobatis californica*, and a spawning or nursery area for many other species of fish. With the establishment of the Monterey Bay National Marine Sanctuary, these derbies, especially the archery derby, have become somewhat controversial.

Leopard sharks pup in late spring to early summer, peaking in June. Bat ray pupping peaks in July. Both species breed shortly after pupping.

Since 1988, most sharks and rays caught in the angling derbies have been tagged and released under a program developed by Moss Landing Marine Laboratories. No tags have been recovered, suggesting a large population in the area. Prior to the tagging program most sharks and rays taken in the angling derby were rendered at the local tallow works.

All sharks and rays that are taken in the archery derby are killed, but relatively few sharks and rays are taken by archers. In 1993, 43 sharks and rays were kept by anglers and 13 by archers.

The commercial catch of leopard sharks in California averaged 43,000 pounds from 1990 to 1992, and the estimated sport catch of leopard sharks is about 270,000 pounds annually. In comparison, the take during Elkhorn Slough shark derbies is not significant and is not considered a threat to the resource. However, the moral or ethical issue of conducting shark derbies in a marine sanctuary remains.

Introduction

The information provided in this report was compiled from existing data and literature. Life-history information about sharks and rays of Elkhorn Slough, information on shark derbies conducted there, and commercial and sport take of sharks and rays in California is provided.

Elkhorn Slough is part of the Monterey Bay National Marine Sanctuary. Conducting shark derbies in the sanctuary has raised moral and ethical questions, because the slough is essentially a pupping, breeding, or nursery area for elasmobranchs and other species. The purpose of the report is to serve as an information source for individuals interested in Elkhorn Slough, elasmobranchs, or shark derbies.

Elkhorn Slough

Elkhorn Slough is part of the Monterey Bay National Marine Sanctuary and is also the site of a National Estuarine Research Reserve. Fishing and hunting are permitted in the Sanctuary but not in the Reserve, which borders the southeast side of the slough but does not include the slough's waterways.

The slough is a shallow tidal embayment and seasonal estuary with a relatively small drainage basin located on the east side of Monterey Bay near Moss Landing, California. It is approximately 10 km long and 100 m wide near the mouth and consists of about 1,000 ha of tidal flats and salt marsh. The slough has a maximum depth of 4 to 5 m in the main channel (MLLW) near the mouth and is characterized by mudflats that are exposed during low tide.

Elkhorn Slough is a marine environment with strong tidal exchange and currents. During winter, salinities are reduced due to runoff from the surrounding area.

Fishes of Elkhorn Slough

There are more than 76 species of fish in at least 27 families that are known to occur in Elkhorn Slough (Nybakken et al. 1975). The slough is an important nursery area for many species including English sole, *Pleuronectes vetulus*, California halibut, *Paralichthys californicus*, sanddabs, *Citharichthys* spp., starry flounder, *Platichthys stellatus*,

surfperches, Embiotocidae, rockfishes, Scorpaenidae, Pacific herring, *Clupea pallasii*, jack smelt, *Atherinopsis californiensis*, top smelt, *Atherinops affinis*, northern anchovy, *Engraulis mordax*, lingcod, *Ophiodon elongatus*, turbot and sole, Pleuronectidae, leopard shark, *Triakis semifasciata*, and bat ray, *Myliobatus californica* (Yoklavich et al. 1991).

In addition to leopard sharks and bat rays, at least seven other species of elasmobranchs are known to inhabit Elkhorn Slough, including gray smoothhound, *Mustelus californicus*, brown smoothhound, *Mustelus henlei*, spiny dogfish, *Squalis acanthias*, shovelnose guitarfish, *Rhinobatos productus*, thornback, *Platyrrhinoidis triseriata*, round stingray, *Urolophus halleri*, and Pacific electric ray, *Torpedo californica*. Leopard sharks and bat rays are most abundant while shovelnose guitarfish, thornback, spiny dogfish, round stingray, and Pacific electric ray are rare. Leopard sharks and bat rays are the only known elasmobranchs to pup and breed in Elkhorn Slough (Talent 1985). In general, sharks and rays are seasonally abundant during spring and summer months.

Life history information on leopard sharks and bat rays

Pupping and breeding

Leopard sharks produce from 7 to 36 embryos per female (Ackerman 1971). Pupping occurs from late spring to summer and usually peaks in June. Bat rays produce from 2 to 7 embryos per female and pupping usually peaks in July (Martin and Cailliet 1988a). Both species probably mate shortly after pupping. The gestation period is about one year.

Growth and maturity

Leopard sharks are about 20 cm (8 inches) total length at birth. Males first mature at 7 years of age and 71 cm (28 inches); all are mature by age 13 and 127 cm (50 inches). Females mature at 10 to 15 years of age and 104 to 135 cm (41 to 53 inches). Leopard sharks may live 25 to 30 years. Female leopard sharks attain a length of about 2.1 m (7 ft); males reach about 1.5 m (5 ft) (Kusher et al. 1992, Smith 1992).

Bat rays range from 23 to 30.5 cm (9 to 12 inches) disc width (wing tip to wing tip) at birth. Males mature at 2 to 5 years of age and 46 to 61 cm (18 to 24 inches). Males attain a maximum age of 10 years

and a maximum size of 84 cm (33 inches). Fifty percent of females are mature at age 5 and 91 cm (36 inches) (Martin and Cailliet 1988a). Females attain an age of 24 years and reach 1.8 m (71 inches) (Martin and Cailliet 1988b, Zorzi and Martin 1992).

Seasonal distribution

Leopard sharks are found year-round in the slough (Talent 1985). Generally, adults over 104 cm (41 inches) are more frequent during late winter through early summer. During summer and fall, after pupping, juveniles under 104 cm are more common (Talent 1985).

Adult bat rays are also found year-round in the slough and are more common in the spring, summer, and fall; birthing occurs during July and August (Talent 1985).

Food

Leopard sharks feed on benthic worms, mollusks, cephalopods, crustaceans, and fish (Talent 1976). Bat rays feed primarily on mollusks and benthic worms (Barry and Cailliet 1981)

Sport Fishery

The average annual northern California sport catch of leopard sharks from 1980 to 1987 was estimated at 270,000 pounds (Smith 1992).

No records are available for bat rays, which are not commonly eaten by humans and are considered a nuisance by many anglers, except for those participating in shark derbies.

Commercial Fishery

Leopard sharks are taken for the fresh fish market, but landing data are not available prior to 1986 because leopard sharks were reported with miscellaneous sharks. The statewide catch of leopard sharks was 74,000 pounds in 1986 and averaged 43,000 pounds from 1990 to 1992.

The Monterey area catch declined from a peak of 9,400 pounds in 1989 to less than 500 pounds in 1991 and 1992. The cause of this decline may be related to the decline of gillnetting for California halibut; leopard sharks were frequently taken in halibut gill nets. San Francisco Bay area landings peaked in 1986 at 33,000 pounds and averaged about 12,000 pounds from 1990 to 1992.

Catches generally peak during January through April and decline during the summer months. Leopard sharks are caught by a variety of gear including trawls, gill nets, and hook and line.

History of Elkhorn Slough Shark Derbies

The first shark derby sponsored by Pajaro Valley Rod and Gun Club (PVRGC) was held in 1946, and for several years Castroville Rod and Gun Club also sponsored a separate derby. About 20 years ago the California Bowmen Hunters began an additional derby where fish were taken by archery.

King and Cailliet (1992) reported that 5,389 elasmobranchs have been taken in 48 angler derbies from 1951 through 1990; 55% were bat rays and 26% leopard sharks. Information from archery derbies is scanty, but the take is reportedly from 10 to 20 fish per derby, with part taken from Monterey Bay waters and part from Elkhorn Slough. Prior to 1988, all elasmobranchs entered in both types of derbies were killed and most were sent to the local tallow works.

In 1988, Moss Landing Marine Laboratories (MLML) began tagging fish taken in the PVRGC derby. The study has been well accepted by the PVRGC. The program is run by volunteers associated with MLML. In 1993, about 80% of the sharks and rays taken in the PVRGC derby were weighed, tagged, and released alive. This program is yielding valuable information on the life history and distribution of Elkhorn Slough elasmobranchs.

Archery does not allow fish to be released alive, but about the same numbers have been taken in archery derbies that were kept by anglers in recent fishing derbies.

An analysis of data from 48 angler derbies (King and Cailliet, unpub. ms.) indicates that there has been no significant change in the size distribution of leopard sharks or bat rays taken in the angler derbies since 1951. Shovelnose guitarfish, which were commonly taken in early derbies, have declined since the late 1970s.

Tagging studies

After 5 years and about 300 fish tagged in shark derbies, MLML has not recovered any tags from derbies, research trawling and gill netting in the

slough, or from commercial and sport fisheries in the Monterey Bay area. One interpretation of the lack of tag recoveries is that there are large populations of sharks and rays in the area. Overall sport and commercial catches, in addition to scientific collecting, support this theory.

In the past, tag recoveries from other tagging studies of leopard sharks indicate movement between San Francisco Bay and Elkhorn Slough, suggesting that the two areas contain populations that are not genetically distinct (Smith and Abramson 1990). No similar information is available on movements of bat rays.

Tag recoveries from leopard sharks in San Francisco Bay indicate a movement out of the bay in fall and winter with leopard sharks returning to the bay between March and August.

1993 shark derbies

At the request of MLML, PVRGC moved its 1993 derby from June to July 25, after the peak leopard shark pupping season. However, bat ray birthing peaks in July.

Approximately 400 anglers in 99 boats participated in the 1993 PVRGC derby. Participation peaked in 1985 with 609 anglers.

A total of 127 fish (91 bat rays, 16 leopard sharks, 9 shovelnose guitarfish, 8 gray smoothhounds, and 3 thornbacks) was taken in the 1993 PVRGC derby, of these 84 were tagged and released alive (G. M. Cailliet, MLML, pers. comm.). Two adult bat rays were dissected; both had already given birth. Five of the leopard sharks caught by anglers were adults over 91 cm. Two of the adult leopard sharks were dissected and had small developing embryos, indicating pupping and mating for 1993 had already taken place.

The archery derby is held each year on a weekend around the Fourth of July. The 1993 derby was on July 3. The archery derby is much smaller than the angling derby, usually drawing about 50 bowmen per derby. In 1993, 33 bowmen participated.

Only 13 elasmobranchs were taken by bowmen in the 1993 derby. Three blue sharks, *Prionace glauca*, were taken from Monterey Bay waters, while two leopard sharks, three bat rays, two shovelnose guitarfish, and three "sand sharks" (grey or brown

smoothhound) were taken from Elkhorn Slough waters (Bert Malech, California Bowmen Hunters, pers. comm.).

Discussion

The Elkhorn Slough National Estuarine Research Reserve annually attracts thousands of people that come to enjoy hiking on the Reserve's many miles of trails. The Marine Sanctuary's waterways also attract many boaters, kayakers, and canoeists. One of the Sanctuary's and Reserve's popular summer attractions is elasmobranchs, which can be viewed by hikers and boaters as the fish swim in the shallow areas of the slough. Many visitors to the Sanctuary are naturalists, not anglers, and no angling is permitted from the Reserve. The aesthetic value of viewing elasmobranchs in the natural environment is difficult to quantify, but nonetheless important.

Because of slow growth rates and late sexual maturity, elasmobranchs are more susceptible to fishing pressure than most other fishes (Cailliet 1992). However, compared to the overall sport and commercial catches of elasmobranchs in central California, relatively few elasmobranchs are taken and kept in the Elkhorn Slough shark derbies. Also, valuable biological data on the life history of elasmobranchs in Elkhorn Slough can be gained from shark derbies. The suggestion to move the 1993 PVRGC derby to late July prevented the take of leopard sharks with mature embryos.

The new size limit of 36 inches and three fish daily bag limit on leopard sharks did not pose a problem for bowmen; no violations were observed by the Department's Wildlife Protection personnel in the 1993 bowmen's derby. As with any form of hunting, it is the responsibility of the archer to make sure his target is legal, whether it is a deer, turkey, or elasmobranch.

Recommendations

The moral or ethical issue of taking even a small number of elasmobranchs from a Marine Sanctuary during the pupping or breeding season is a difficult one. However, moving the PVRGC derby to late July appears to alleviate this concern for leopard sharks.

This practice should be continued and further evaluated. Conducting the bow hunting derby about a month later would have little impact because so few elasmobranchs are taken in this derby.

Any regulation changes could have a broader impact than just Elkhorn Slough. Organized derbies also occur in other areas of the State, and bow hunting is known to occur in San Diego Bay, Morro Bay, and probably in other coastal estuaries.

No changes in regulations are needed to protect the elasmobranchs of Elkhorn Slough. The limited take of elasmobranchs during the derbies is not a threat to the resource.

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