

= Leopard shark =

The leopard shark ( *Triakis semifasciata* ) is a species of houndshark , in the family Triakidae . It is found along the Pacific coast of North America , from the U.S. state of Oregon to Mazatlán in Mexico . Typically measuring 1 @. @ 2 ? 1 @. @ 5 m ( 3 @. @ 9 ? 4 @. @ 9 ft ) long , this slender @-@ bodied shark is immediately identifiable by the striking pattern of black saddle @-@ like markings and large spots over its back , from which it derives its common name . Large schools of leopard sharks are a common sight in bays and estuaries , swimming over sandy or muddy flats or rock @-@ strewn areas near kelp beds and reefs . They are most common near the coast , in water less than 4 m ( 13 ft ) deep .

Active @-@ swimming predators , groups of leopard sharks often follow the tide onto intertidal mudflats to forage for food , mainly clams , spoon worms , crabs , shrimp , bony fish , and fish eggs . Most leopard sharks tend to remain within a particular area rather than undertaking long movements elsewhere , which has led to genetic divergence between populations of sharks living in different regions . This species is aplacental viviparous , meaning that the young hatch inside the uterus and are nourished by yolk . From March to June , the female gives birth to as many as 37 young after a gestation period of 10 ? 12 months . It is relatively slow @-@ growing and takes many years to mature .

Harmless to humans , the leopard shark is caught by commercial and recreational fisheries for food and the aquarium trade . This species is mostly fished in the waters off California where , after a period of population decline in the 1980s , new fishing regulations in the early 1990s reduced harvesting to sustainable levels . The International Union for Conservation of Nature has assessed this species as of Least Concern , while noting that local stocks may easily become overfished because of the shark 's slow growth and limited migratory habits .

= = Taxonomy and phylogeny = =

The first scientific name applied to the leopard shark was *Triakis californica* , coined by British zoologist John Edward Gray in the 1851 List of the specimens of fish in the collection of the British Museum . However , Gray did not furnish the name with a proper description , rendering it a nomen nudum . In December 1854 , American ichthyologist William Orville Ayres gave a lecture describing the species as *Mustelus felis* , which included the first scientific description of the species . His lecture was reprinted first in *The Pacific* , a San Francisco newspaper , and then in the journal *Proceedings of the California Academy of Natural Sciences* . In April 1855 , French biologist Charles Frédéric Girard published another description of this species , naming it *Triakis semifasciata* .

Despite *M. felis* being the senior synonym , an error in recording the dates of publication resulted in the widespread use of *T. semifasciata* as the leopard shark 's scientific name . As a result of this long @-@ standing error , *Triakis semifasciata* came to be recognized as the valid name ( as a nomen protectum ) and *Mustelus felis* was invalidated ( as a nomen oblitum ) . The specific epithet *semifasciata* comes from the Latin words *semi* ( " half " ) and *fasciatus* ( " banded " ) , describing this shark 's dorsal pattern of saddle @-@ like markings . In older literature , this species may be referred to as " tiger shark " or " catshark " .

The genus *Triakis* contains two subgenera , *Triakis* and *Cazon* . The leopard shark is placed within the subgenus *Triakis* along with the banded houndshark ( *T. ( Triakis ) scyllium* ) . A 2006 phylogenetic analysis by J. Andrés López and colleagues , based on protein @-@ coding genes , revealed that *Triakis* and *Cazon* are in fact not closely related , and additionally that the leopard shark may be the most basal member of its family .

= = Distribution and habitat = =

The leopard shark occurs in the cool to warm @-@ temperater continental waters of the northeastern Pacific Ocean , from Coos Bay , Oregon to Mazatlán , Mexico , including the Gulf of California . It favors muddy or sandy flats within enclosed bays and estuaries , and may also be

encountered near kelp beds and rocky reefs , or along the open coast . Numbers have been known to gather near discharges of warm effluent from power plants . Leopard sharks generally swim close to the bottom and are most abundant from the intertidal zone to a depth of 4 m ( 13 ft ) , though they may be found as deep as 91 m ( 299 ft ) . Many leopard sharks , particularly in the north , leave their coastal habitats in winter and return in early spring . A study in Tomales Bay in northern California determined that they depart when the water temperature drops below 10 ? 12 ° C ( 50 ? 54 ° F ) ; one tagged shark was found to have swum some 140 km ( 87 mi ) south .

While a few leopard sharks have been documented traveling hundreds of kilometers , most individuals tend to remain in a localized area for much of their lives . This low level of dispersal has led to genetic divergence across its range . Seven discrete gene pools have been identified along the Californian coast between Humboldt Bay and San Diego . Of these , the Humboldt Bay subpopulation is perhaps the most isolated , with the sharks there maturing at a larger size and producing fewer offspring than those from other areas . By contrast , the area around Los Angeles represents a genetic transitional zone between subpopulations whose boundaries are more diffuse . Off Baja California , the leopard sharks on the Pacific side are probably distinct from those in the northern Gulf of California . Although there is equivocal evidence for natal philopatry ( returning to one 's birthplace to breed ) in this species , proximity to established breeding grounds likely contributes to the structuring of these different subpopulations .

#### = = Description = =

The leopard shark has a moderately stout body , with a short , rounded snout . There are well @-@ developed , triangular flaps of skin in front of the nares . The eyes are large and oval , with a nictitating membrane ( a protective third eyelid ) . The line of the mouth is strongly curved . There are furrows at the corners of the mouth extending onto both jaws , with those on the lower jaw almost long enough to meet at the midline . The tooth rows number 41 ? 55 in the upper jaw and 34 ? 45 in the lower jaw ; each tooth has a slightly oblique , smooth @-@ edged cusp in the center and 1 ? 2 small cusplets on either side . These teeth are arranged into a flat , " pavement " -like surface with overlapping ridges .

The large first dorsal fin is positioned about halfway between the pectoral and pelvic fins ; the second is almost as large as the first and much larger than the anal fin . The pectoral fins are wide and triangular . The lower lobe of the caudal fin is well @-@ developed in adults but less than half the length of the upper lobe , which has a strong ventral notch near the tip . The coloration is unique , consisting of prominent black " saddles " and large black spots running along the back , on a silvery to bronzy gray background . Adult sharks often have more spots and saddles with lighter centers compared to juveniles . The underside is whitish and plain . The average length of a leopard shark is 1 @.@ 2 ? 1 @.@ 5 m ( 3 @.@ 9 ? 4 @.@ 9 ft ) . Rarely males may grow to 1 @.@ 5 m ( 4 @.@ 9 ft ) and females 1 @.@ 8 m ( 5 @.@ 9 ft ) , and there is a record of an exceptional female that measured 2 @.@ 1 m ( 6 @.@ 9 ft ) long . The heaviest known leopard shark weighed 18 @.@ 4 kg ( 41 lb ) .

#### = = Biology and ecology = =

An active species that swims with a strong undulating motion , the leopard shark is commonly spotted cruising in or just beyond the surf zone . It is more active at night than during the day , and sometimes lies still on the bottom . In Tomales Bay and elsewhere , the leopard shark follows the tide onto mudflats to forage for food , retreating just fast enough to prevent being stranded or trapped as the water recedes . At Santa Catalina Island , resident sharks spend the day together in the shallows and at night disperse into deeper water , ranging up to 10 km ( 6 @.@ 2 mi ) away .

From birth , leopard sharks form large schools generally segregated by age and sex , which may intermingle with grey or brown smoothhounds ( *Mustelus californicus* and *M. henlei* ) or spiny dogfish ( *Squalus acanthias* ) . These schools are apparently nomadic , often appearing suddenly in an area for a few hours and then vanishing just as quickly . In captivity , larger sharks have been

observed establishing their dominance over smaller individuals via light nips to the pectoral fins . During summer days , large aggregations of mature females assemble in shallow bays and estuaries , dispersing at night . As these females follow the warmest patches of water , allowing them to raise their internal body temperatures by up to 3 ° C ( 5 @. @ 4 ° F ) , they are speculated to be taking advantage of the heat to speed their growth and that of their gestating young . The membership of these aggregations is inconstant , with individual females periodically switching between different sites scattered over several kilometers .

Compared to the related grey and brown smoothhounds that share its range , the leopard shark has smaller and more numerous red blood cells , allowing it to process oxygen more efficiently . This may be an adaptation for foraging in deoxygenated estuary environments . Their eyes contain very few cone cells , likely due to the murky water they inhabit . Small leopard sharks fall prey to larger sharks such as the great white shark ( *Carcharodon carcharias* ) and the broadnose sevengill shark ( *Notorynchus cepedianus* ) . On one occasion , a sevengill shark was seen ambushing a leopard shark on a tidal mudflat in Humboldt Bay , striking with such momentum that the larger predator momentarily beached itself . Known parasites of this species include the tapeworms *Phyllobothrium riseri* , *Lacistorhynchus dollfusi* and *Paraorygmatobothrium barber* , as well as the copepods *Echthrogaleus eoleoptratus* and *Achtheinus oblongatus* .

### = = = Feeding = = =

The diet of the leopard shark consists of small benthic and littoral animals , most significantly crabs ( *Cancridae* , *Grapsidae* , and *Hippoidea* ) , shrimp , bony fish ( including anchovies , herring , topsmelt , croakers , surfperch , gobies , rockfish , sculpins , flatfish , and midshipmen ) , fish eggs , clams , and the echiurid fat innkeeper worm ( *Urechis caupo* ) . This opportunistic hunter has also been known to eat ghost shrimp , polychaete worms , and the young of smoothhounds , shovelnose guitarfish ( *Rhinobatos productus* ) , and bat rays ( *Myliobatis californicus* ) . Eelgrass ( *Zostera* ) and algae may be swallowed incidentally .

The leopard shark captures prey by expanding its buccal cavity to create a suction force , which is facilitated by its labial cartilages swinging forward to form the mouth into a tube . Simultaneously , the shark protrudes its jaws forward to grip the prey between its teeth . As with other sharks , the teeth of the leopard shark are periodically shed and replaced ; it takes 9 ? 12 days for a replacement tooth to move into position . Leopard sharks have been caught with stomachs filled with clam siphons , which the sharks seize before the clams can retract and break off with a levering motion of their bodies . On occasion , the shark tears the entire clam body out of its shell this way . Other sharks examined have had stomachs containing whole innkeeper worms with no bite marks , suggesting that the sharks sucked them out of their burrows . Under a hollow bridge support in San Francisco Bay , a group of leopard sharks and spiny dogfish have been observed feeding on a dense school of anchovies by slowly swimming counterclockwise through the clockwise @-@ swimming school , and swallowing any anchovies that accidentally entered their open mouths .

In some places , this species feeds only on a few prey types and little else ( e.g. innkeeper worms and cancrid crabs in Tomales Bay , jack silverside ( *Atherinopsis californiensis* ) eggs and the crabs *Romaleon antennarium* and *Metacarcinus magister* in Humboldt Bay ) . The predominant prey taken depends on location , time of year , and age . For example , in the Elkhorn Slough at Monterey Bay , cancrid crabs and innkeeper worms are mostly eaten in winter and spring , fish eggs from winter to early summer , bony fish in summer , and grapsid crabs and clams in fall . Young sharks feed mostly on crabs and transition to clam siphons , fish eggs , and innkeeper worms once they reach 70 ? 80 cm ( 2 @. @ 3 ? 2 @. @ 6 ft ) long . The largest sharks are the ones that consume the most fish .

### = = = Life history = = =

The leopard shark is aplacental viviparous , with the developing embryos sustained by a yolk sac until birth . In northern areas , females use bays and sloughs as nursery areas , while to the south they give birth in more open areas . Known breeding grounds along the coast of California include

Humboldt Bay , Tomales Bay , Bodega Bay , San Francisco Bay , Elkhorn Slough , Morro Bay , Santa Monica Bay ( Los Angeles ) , Catalina Harbor ( Santa Catalina Island ) , and San Diego Bay .

Females give birth to 1 ? 37 young annually from March and July ( most in April or May ) , with the number of pups increasing with female size . In Humboldt and San Francisco Bays , females drop their pups in beds of eelgrass that provide both shelter and food . In Catalina Harbor , females give birth on flats in 1 m ( 3 @. @ 3 ft ) of water , their backs and dorsal fins exposed ; the pups stay in even shallower water less than 30 cm ( 12 in ) deep . Mating occurs in early summer following birth ; the only known observation of this in the wild was in 2004 off La Jolla , amongst nine sharks gathered 19 m ( 62 ft ) from shore in water 0 @. @ 3 ? 3 m ( 0 @. @ 98 ? 9 @. @ 84 ft ) deep .

Newborn leopard sharks measure around 20 cm ( 7 @. @ 9 in ) long . Relatively slow @- @ growing after the first 3 ? 4 years of life , male leopard sharks grow an average of 2 @. @ 0 cm ( 0 @. @ 79 in ) per year , reaching maturity at an age of 7 ? 13 years and a length of 0 @. @ 7 ? 1 @. @ 2 m ( 2 @. @ 3 ? 3 @. @ 9 ft ) , while females grow an average of 2 @. @ 3 cm ( 0 @. @ 91 in ) per year , reaching maturity at an age of 10 ? 15 years and a length of 1 @. @ 1 ? 1 @. @ 3 m ( 3 @. @ 6 ? 4 @. @ 3 ft ) . Individuals of the same age can vary significantly in size and large sharks are especially slow @- @ growing : one specimen was documented to have gained only 4 cm ( 1 @. @ 6 in ) in length over 12 years . The maximum lifespan of this species is estimated to be 30 years .

= = Human interactions = =

Wary and quick to flee , leopard sharks pose almost no danger to humans . There is a single record from 1955 of a leopard shark harassing a skin diver with a nosebleed , though no injuries resulted . This species is caught by commercial fisheries using gillnets and longlines , and by recreational anglers and spearfishers ; it is also caught as bycatch in bottom trawls . The meat is considered excellent eating and is sold fresh or frozen . However , leopard sharks living alongside human development may accumulate pollutants such as mercury , pesticides , and polychlorinated biphenyls ( PCBs ) within their bodies , and the California Department of Fish and Wildlife warns against eating them regularly . The leopard shark is prized by the aquarium trade for its attractive appearance and hardiness ; this led to many newborn pups being captured with hook @- @ and @- @ line off southern California in the late 1980s and early 1990s . It may live for over 20 years in captivity .

Most of the fishing for leopard sharks occurs in the waters off California , where commercial landings peaked at 45 @, @ 953 kg ( 101 @, @ 309 lb ) in 1983 and has averaged 14 @, @ 060 kg ( 31 @, @ 000 lb ) annually since 1991 . These figures are believed to be underestimates , as an unknown portion of the leopard shark catch is recorded simply as " shark " . In recent decades the number of sharks taken recreationally has exceeded those taken commercially , with sport fishers catching an average of 52 @, @ 000 sharks per year from 1980 ? 1988 , and 45 @, @ 000 sharks per year since 1993 . This species contributes negligibly to fishery landings off Oregon . The status of leopard sharks off Mexico is uncertain , although Mexican shark fisheries tend to focus more on larger species .

The International Union for Conservation of Nature ( IUCN ) has assessed the leopard shark as of Least Concern . It is highly susceptible to local depletion due to its slow growth rate and low level of exchange between regional stocks . It was considered for , but is not managed under , the U.S. Pacific Fishery Management Council 's ( PMC ) 1982 Groundfish Management Plan . In 1992 , the State of California imposed a recreational minimum size limit of 91 cm ( 36 in ) and a possession limit of three fish , a move that was strongly supported and promoted by the sport fishing community . In 1993 , the State also instituted a minimum size limit of 46 cm ( 18 in ) for the commercial harvesting of all sharks and rays , including for the aquarium trade . In addition , Californian restrictions on the use of certain types of fishing gear in near @- @ shore waters confer good protection to this shark 's core population . These management measures seem to have successfully reduced fishing mortality and halted the population decline from the 1980s ; the status of the leopard shark off California is regarded as secure , with demographic models estimating an annual population increase of 3 ? 6 % with sustainable fishing .

