

SEARCHING  
FOR  
SEA LIFE



# Sharks, Skates and Rays



**Sharks, Skates and Rays Field Notes .....158**

**Searching for More about  
Sharks, Skates and Rays.....161**

Who Likes Sharks?.....161

Shark Math .....162

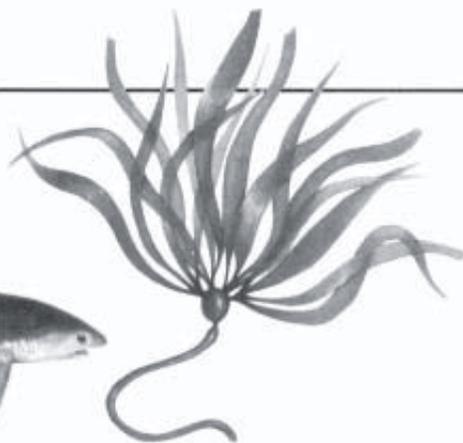
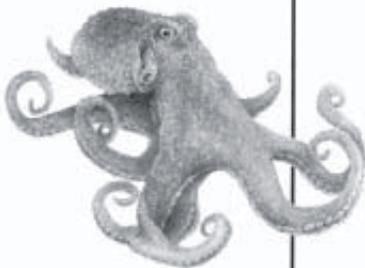
Sidewalk Sharks .....163

Design a Shark.....164

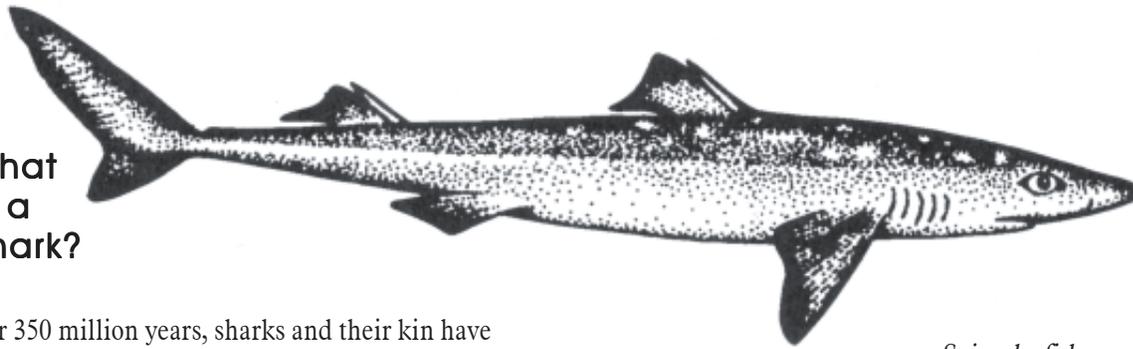
Shark Trivia.....164

A Shark's Story .....165

**Shark, Skates and Rays Field Guide.....166**



**What Is a Shark?**



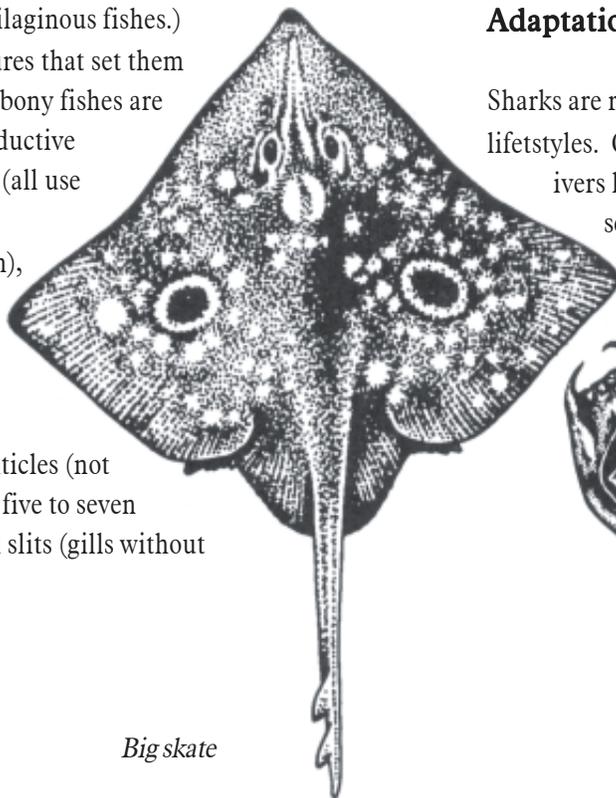
*Spiny dogfish*

For 350 million years, sharks and their kin have been swimming the seas. Sharks have always inspired our admiration and fear, but for all our fascination with them, we still know surprisingly little about their lives.

Sharks swim in all the world's oceans - even some freshwater rivers and lakes. There are about 800 species of sharks, skates and rays worldwide and about 25 species in Monterey Bay, California.

Unlike most fishes, whose skeletons are made of bone, sharks and their kin have skeletons of cartilage. (Their class, Chondrichthyes, means cartilaginous fishes.)

Other features that set them apart from bony fishes are their reproductive techniques (all use internal fertilization), skin covered with toothlike dermal denticles (not scales) and five to seven pairs of gill slits (gills without covers).



*Big skate*

Though sharks, skates and rays are closely related, many differences distinguish them from one another. Most sharks have streamlined, torpedo-shaped bodies, while skates and rays are flattened and have disc- or diamond-shaped bodies. Rays have blunt noses and smooth skin; skates have pointed noses and rough or spiny skin. Another major difference is that skates lay eggs and rays give birth to live young. Sharks may do either, depending on the species.

**Adaptations for survival**

Sharks are remarkably well-adapted for their varied lifestyles. Cartilaginous skeletons and huge oily livers help increase the buoyancy of open sea swimmers like the blue shark. An adaptation that helps sharks, skates and rays succeed as predators is the ability to replace worn and missing teeth. Numerous rows of new, growing teeth line up behind the front teeth; as a tooth is worn or lost, the one behind it moves forward to take its place.

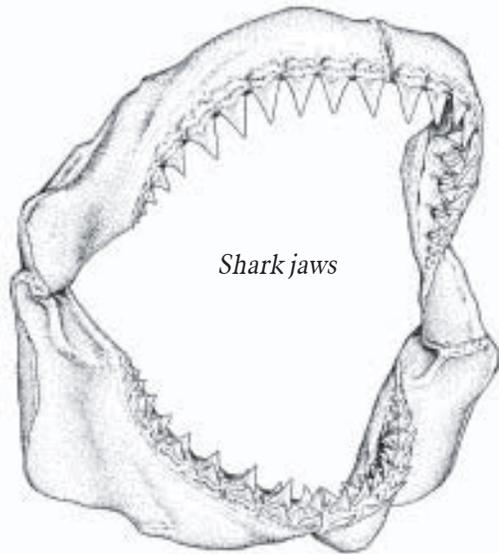


*Big skates egg case*

# SHARKS, SKATES, RAYS

## FIELD NOTES

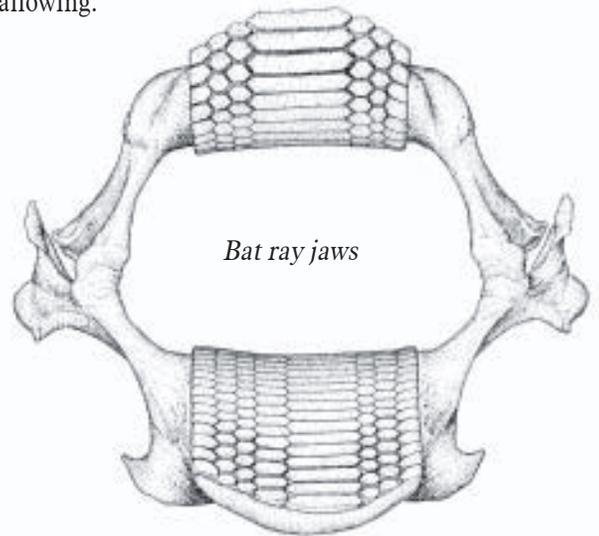
Sharks, skates and rays have a wider range of sensory abilities than any other group of fishes. They sense their surrounding and find prey through taste and smell, their chemical-sensitive skin and tiny cup-shaped pores, called pit organs, scattered over the skin's surface.



*Shark jaws*

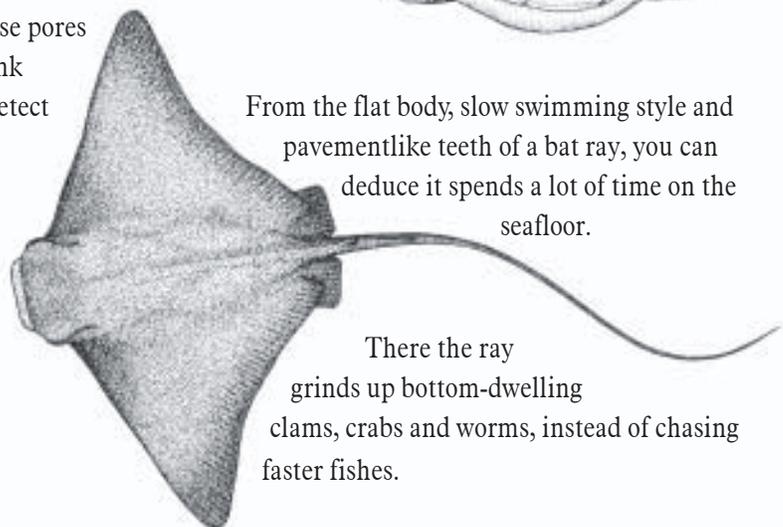
### Clues to lifestyles

Look at the teeth and body shape of a shark, skate or ray and you can guess where it lives, how it moves and what it eats. The streamlined shape of open sea sharks, like the white shark, is a clue that they can swim quickly and smoothly through the water to capture fast-moving prey. The razor-sharp teeth indicate their prey is large enough to be grasped and cut before swallowing.



*Bat ray jaws*

Under a microscope, these pores look like tiny taste buds, but researchers don't fully understand their function. Some think these pores may indeed be taste buds; others think they detect vibrations. A shark can detect predators and prey at close range by sensing the electrical impulses and tiny changes in water motion made by other animals. Most sharks, skates and rays also have good vision and excellent hearing.



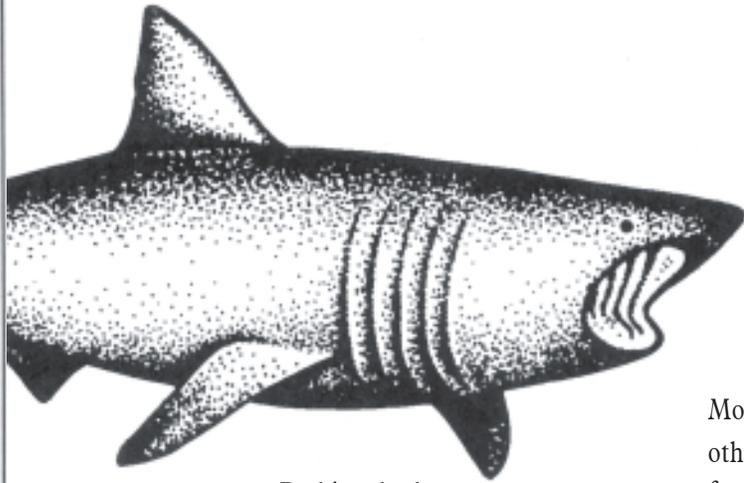
*Bat ray*

From the flat body, slow swimming style and pavementlike teeth of a bat ray, you can deduce it spends a lot of time on the seafloor.

There the ray grinds up bottom-dwelling clams, crabs and worms, instead of chasing faster fishes.

# SHARKS, SKATES, RAYS

## FIELD NOTES



*Basking shark*

A shark's size indicates its diet, but not always in the way you might think. The largest sharks eat the smallest prey. The 45-foot-long basking shark, the largest in Monterey Bay, has filtering gill rakers and hundreds of tiny teeth suited not for catching large prey, but for sieving tiny fishes and invertebrates.

### Sharks and people

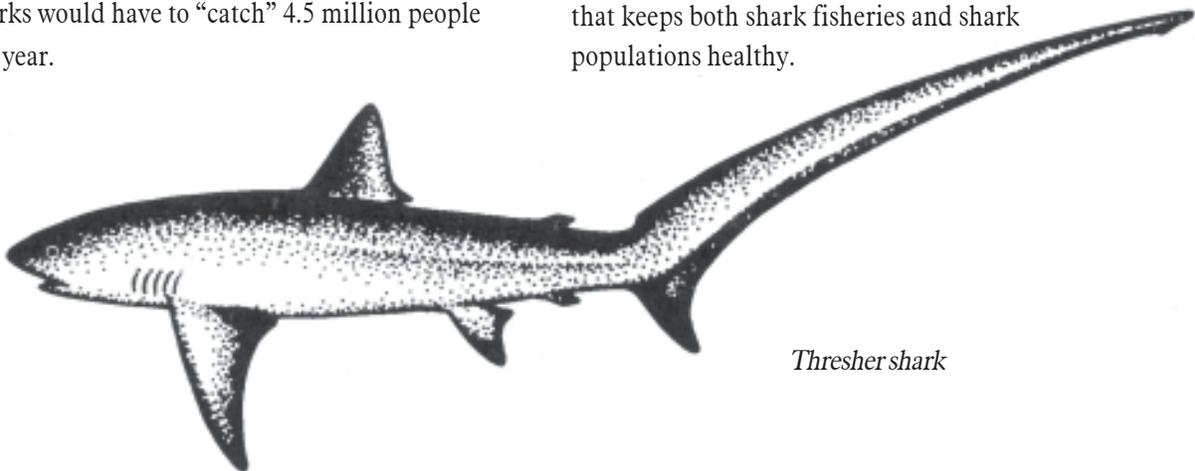
Though many people think of sharks as vicious killers, fewer than 30 people per year worldwide are attacked by sharks. Only 68 of the 350 known species are dangerous or potentially dangerous to humans. Statistics on sharks caught by fishermen show sharks have more to fear from people than people have to fear from sharks. To even the score, sharks would have to "catch" 4.5 million people per year.



*Copepods*

More market products come from sharks than any other group of fishes. The flesh is used for food, fertilizer or fish meal; the liver, vitamins and oils, the skin, leather; the teeth, jewelry and weapons. And besides being a popular sport fish, they're used for medical research and biology and anatomy courses. Harpoon fishermen once hunted basking sharks in the bay, obtaining 200-400 gallons of liver oil from each. Spiny dogfish and soupfin sharks were also fished extensively off the central California coast for oil and meat. Today leopard, thresher, soupfin, bonito and blue sharks as well as skates are caught in the bay and sold in local fish markets.

Because sharks, skates and rays bear few young (which grow and mature slowly) overfishing can greatly reduce their numbers. By studying how these fishes grow, age and reproduce, scientists and regulating agencies hope to manage them in a way that keeps both shark fisheries and shark populations healthy.



*Thresher shark*

# SHARKS, SKATES, RAYS

## SEARCHING FOR MORE

### Who Likes Sharks?



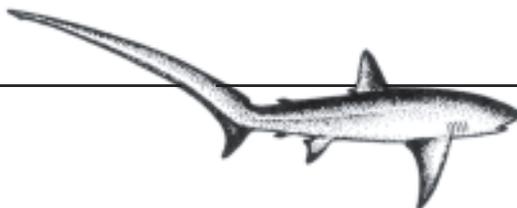
#### MATERIALS

- Paper
- Pen or pencil
- Graph paper

Conduct a survey of your own and other people's attitudes towards sharks.

Record responses of "strongly agree," "agree," "disagree" and "strongly

disagree" to statements like: "I'm afraid of sharks," "Sharks are a major menace to humans," or "Most sharks are very large." Make a bar graph that shows the frequency of each of the four responses to your questions. What's the general attitude toward sharks? How do you feel about this? How do people use sharks and shark products? (People use sharks for sportfishing and research, and they use sharks for commercial products like shark liver oil, shark cartilage, oil and meat.)



#### START A SHARK CAMPAIGN!

What do you think would be the best way to educate people about sharks? Consider doing things like making "Save the Shark" posters to hang on school walls, writing radio spots and TV commercials, producing music and videos to share with your class, family or friends, decorating T-shirts and sending letters to elected officials, magazines and the editors of local newspapers.

Do you like sharks?

STATEMENT	RESPONSE			
	Strongly agree	Agree	Disagree	Strongly disagree
I'm afraid of sharks.		X		
All sharks attack people.				X
Sharks play an important role in nature.	X			
I like sharks.	X			
Most sharks are very large.			X	

# SHARKS, SKATES, RAYS

## SEARCHING FOR MORE

### Shark Math

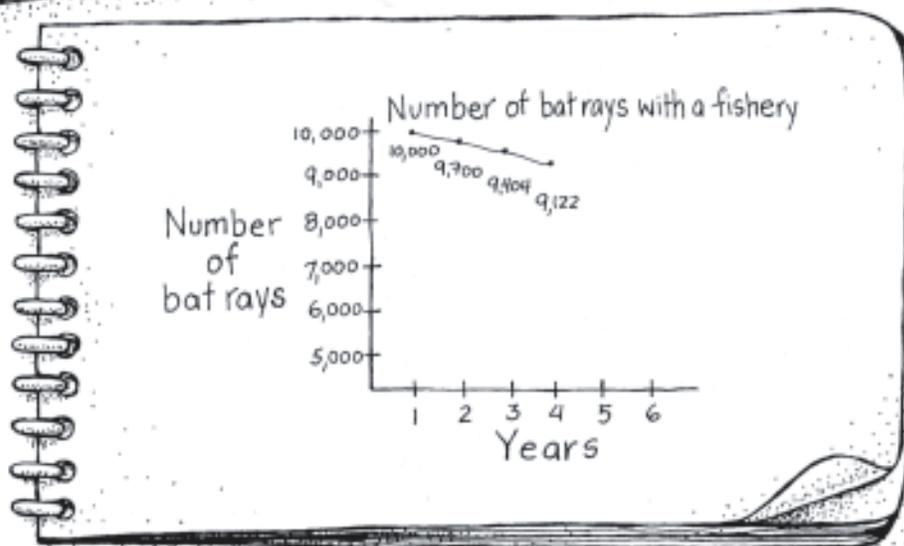
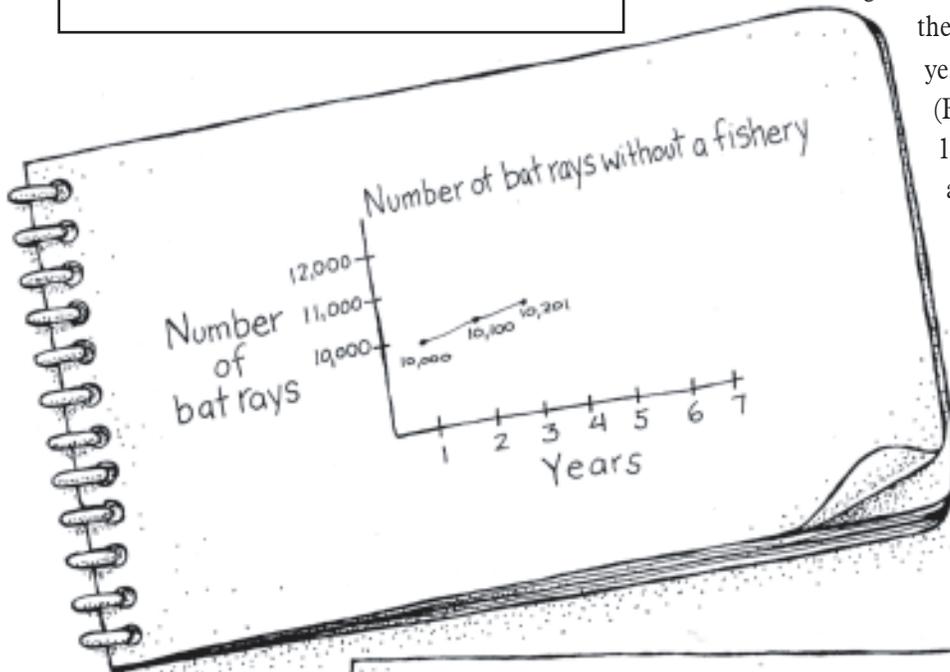


#### MATERIALS

- Paper
- Pen or pencil
- Graph paper

Imagine you're a research biologist. Your studies show there are 10,000 bat rays in your local bay and the population is growing one percent per year. If a fishery for bat rays opens next year and removes three percent of the population each year, how long will it be before half the population is gone? Make a bar graph to show

the total population each year for the next six years. (Begin this year with 10,000 bat rays.) Make another graph of the population if there were no fishery. What limits would you set on the number of bat rays which could be caught each year to protect the rays and the fishermen?



# SHARKS, SKATES, RAYS

## SEARCHING FOR MORE

### Sidewalk Sharks

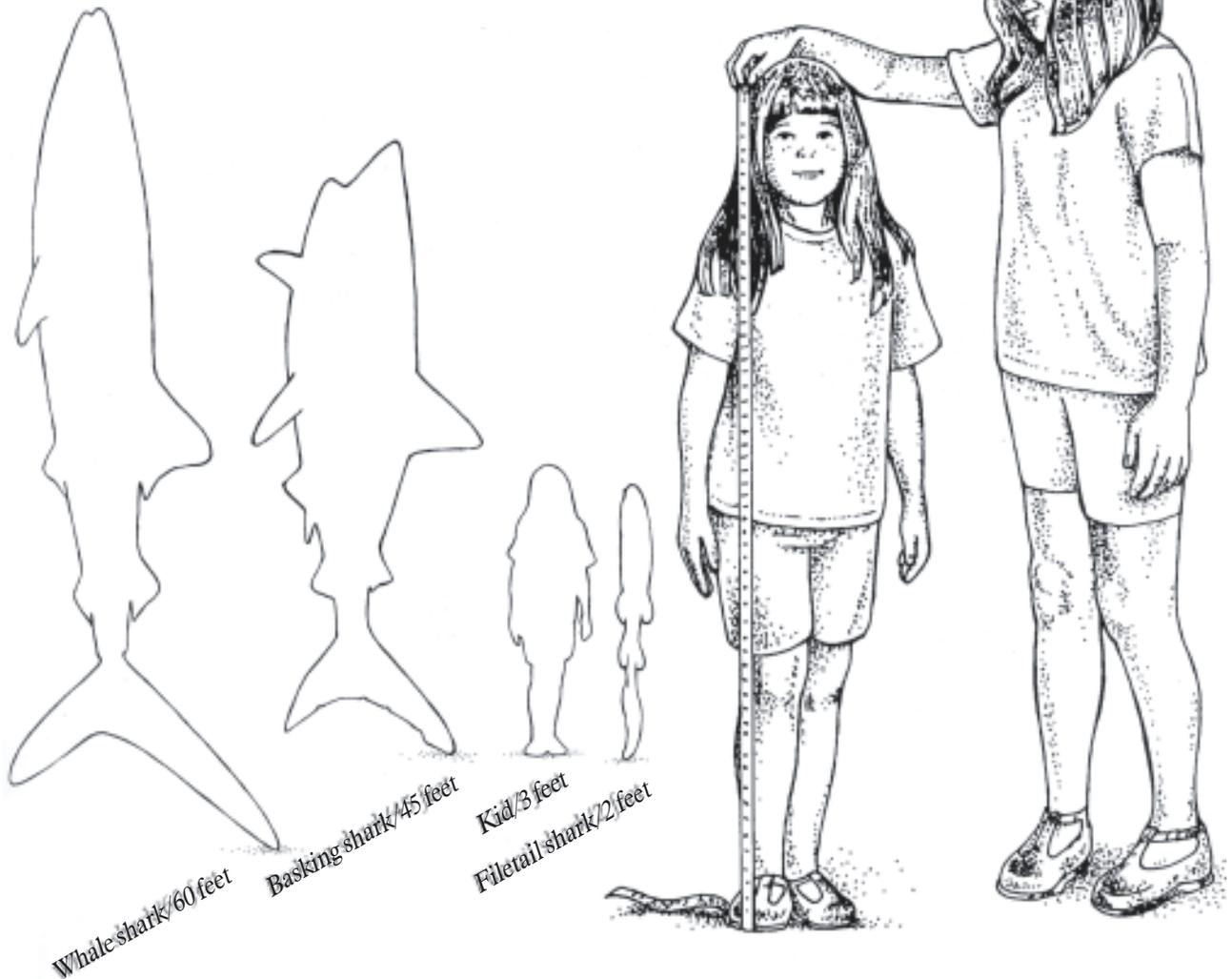


#### MATERIALS

- Sidewalk chalk
- Sharks Field Guide (on pages 166-170)

The largest shark in Monterey Bay is the basking shark (45 feet) and the smallest is the filetail catshark (two feet). The largest shark in the world is the whale shark (60 feet).

On the sidewalk or on the blacktop at a playground or school yard, mark with chalk the length of these sharks. How tall are you? Compare these to the lengths of the other sharks in the Shark Field Guide. What's the largest shark in the waters nearest you?



# SHARKS, SKATES, RAYS

## SEARCHING FOR MORE

### Design a Shark



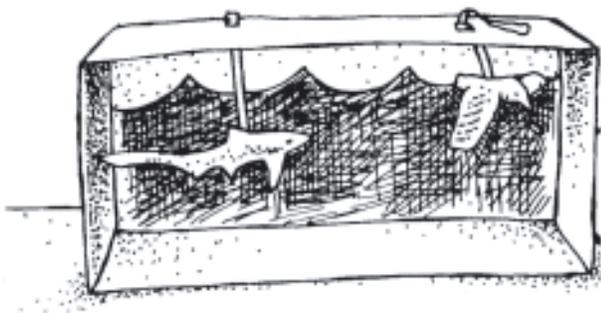
#### MATERIALS

- Paper
- Shoe box or cardboard box
- Favorite drawing materials
- Variety of arts and crafts materials

Invent, draw or build an ocean habitat and a shark, skate or ray adapted for life there.

Use a shoe

box or other container to create the habitat and list the habitat's major characteristics. For instance, the deep sea is cold and has little or no light. How is our animal adapted to find and catch food? How does it protect itself, reproduce and cope with its habitat's conditions?

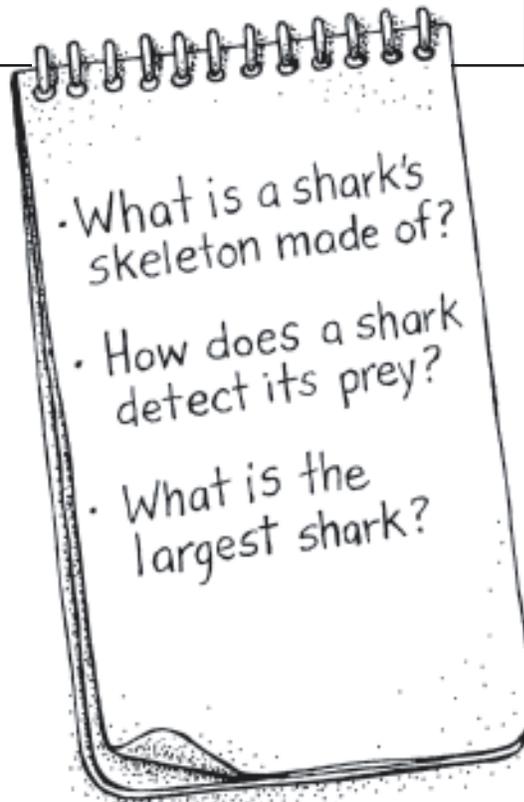


### Shark Trivia



#### MATERIALS

- Pencil
- Paper
- Shark Field Notes (pages 158-160) and Field Guide (pages 166-170)



Design a shark trivia game.

Use the information in the Shark Field Notes and Field Guide to write trivia questions, then hold a competition with your friends, family or classmates.

# SHARKS, SKATES, RAYS

## SEARCHING FOR MORE

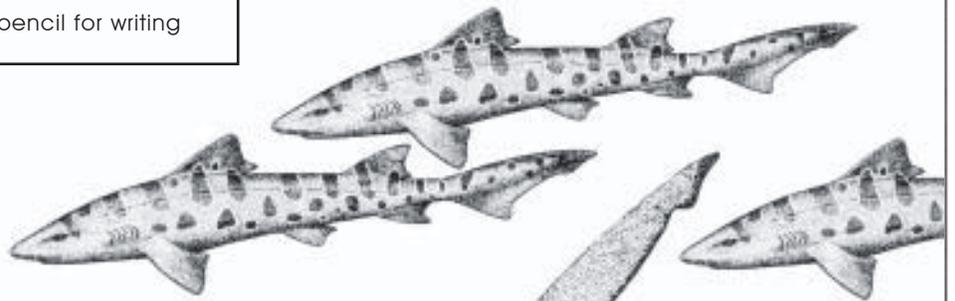
### A Shark's Story



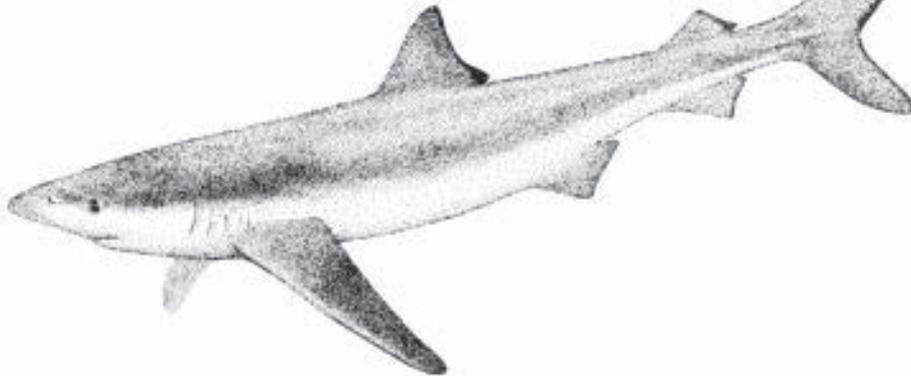
#### MATERIALS

- Paper
- Pen or pencil for writing

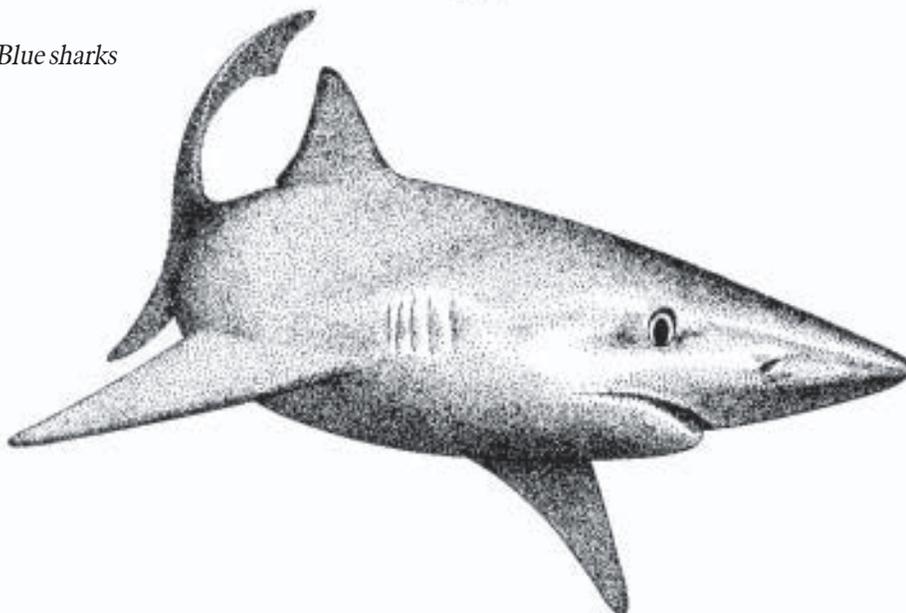
Research the role sharks play in the stories, traditions, art and food of cultures from around the world. Write our own story about a shark that tells the role it really plays in the ocean world. Draw pictures to illustrate your tale.



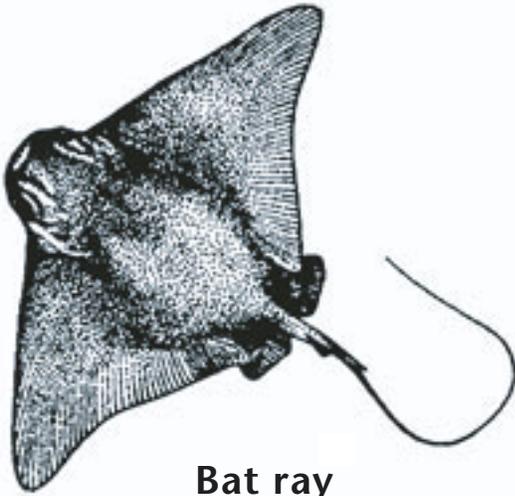
*Leopard sharks*



*Blue sharks*



## Critter Cards - Sharks, Skates and Rays



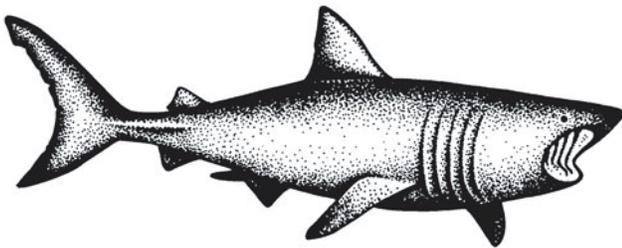
**Bat ray**

### **Bat ray**

*Myliobatis californica* [size: to 6 ft. wide (1.8 m)]

Bat rays prey on clams, shrimp, worms and other invertebrates that live in the mud. Flapping their wings to clear away mud, rays suck up their prey, crushing the shells with their strong jaws and hard, flat teeth.

In summer, bat rays enter sloughs and bays where they give birth to live young. It's a trait they share with several other members of the shark family.



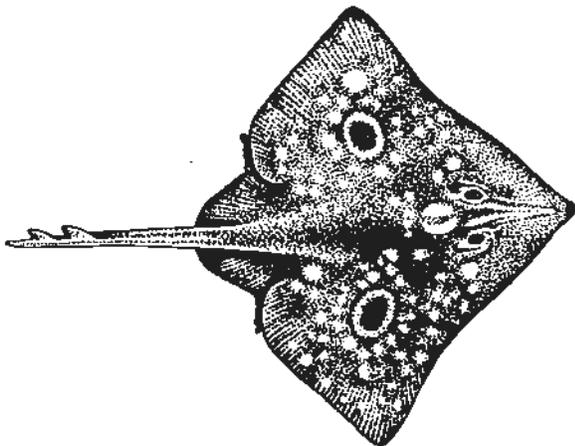
**Basking shark**

### **Basking shark**

*Cetorhinus maximus* [size: to 45 ft. (13.7 m)]

These large sharks live both offshore and near the coast and are often seen near the surface.

Basking sharks eat zooplankton (small, drifting animals like copepods and krill). To gather and strain their food, basking sharks have large mouths and long, stiff, hair-like projections called gill rakers lining their gills. Their numerous teeth are tiny.



**Big skate**

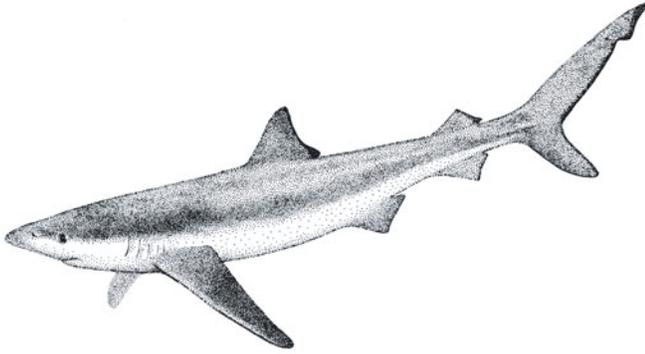
### **Big skate**

*Raja binoculata* [size: to 8 ft. (2.4 m) wide]

The largest skate in the area, big skates live on the bottom in shallow water, to 360 ft (110 m). Instead of giving birth to live young, they lay egg cases called "mermaid's purses."

Big skates eat fishes, crabs and shrimp. Their predators include sevengill sharks. Fishers also catch skates. The "wings" of the skate are the part that people like to eat most.

## Critter Cards - Sharks, Skates and Rays



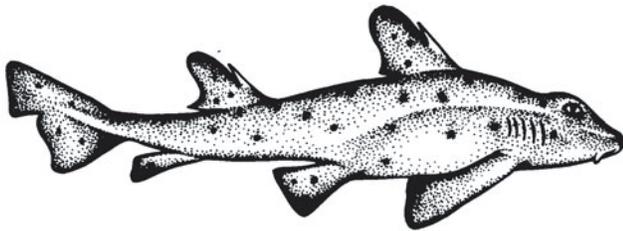
**Blue shark**

### **Blue shark**

*Prionace glauca* [Size: to 13.5 ft. (4 m)]

Blue sharks usually live offshore but visit the nearshore waters of Monterey Bay in late summer and fall. They make seasonal migrations of thousands of miles. Sleek and graceful, they use their front fins for gliding, a swimming method that is especially efficient at low speeds.

Blue sharks feed mostly on fishes and squid.



**Horn shark**

### **Horn shark**

*Heterodontus francisci* [size: to 4 ft. (1.2 m)]

Horn sharks live on the bottom nearshore, in rocky or sandy areas or in kelp forests. Their spots serve as camouflage, while flexible lower fins help them move easily over the seafloor.

Horn sharks eat small fishes and invertebrates such as shrimp and clams. Their low, flat back teeth help crush the shells of their prey.



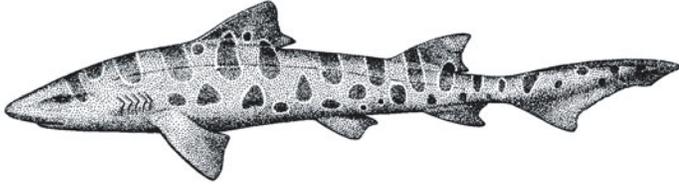
**Filetail catshark**

### **Filetail catshark**

*Parmaturus xaniurus* [Size: to 22 in. (56 cm)]

A filetail catshark swims gracefully along the muddy seafloor. Gray-brown above and pale below, this fish blends in with its benthic habitat. Catsharks lay eggs with curly corners. The curls catch on edges of rocks and sponges to anchor the egg case near the deep seafloor. Here it'll stay for two years while a tiny catshark grows inside.

## Critter Cards - Sharks, Skates and Rays



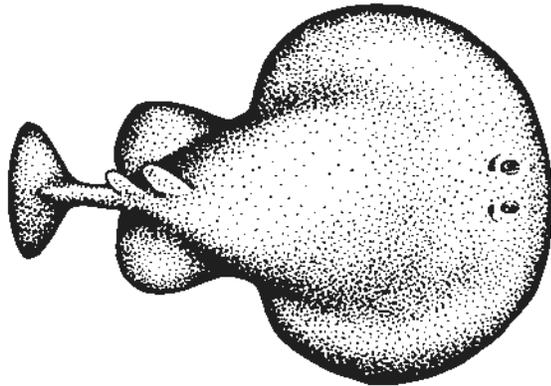
**Leopard shark**

### **Leopard shark**

*Triakis semifasciata* [size: to 7 ft. (2.1 m)]

Leopard sharks live on sandy or rocky bottoms of bays or other inshore areas. Their spotted and barred coloring camouflages them against the seafloor. Leopard sharks bear live young.

Leopard sharks eat fishes, fish eggs and invertebrates like crabs, worms and shrimps. Sevengills and other large sharks prey on leopard sharks.



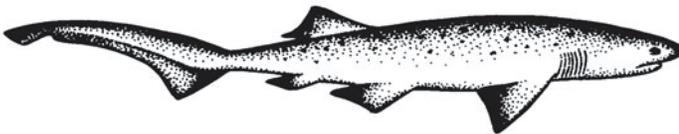
**Pacific electric ray**

### **Pacific electric ray**

*Torpedo californica* [size: to 5 ft. (1.5 m)]

Electric rays live on fine sandy bottoms, often in kelp forests or near rocky reefs. They prefer shallow to moderately deep water, to 640 ft. (195 m).

Electric rays eat mostly fishes. Though they're soft-bodied and slow-moving, these rays can stun prey and fend off enemies with electric shocks of up to 200 volts



**Sevengill shark**

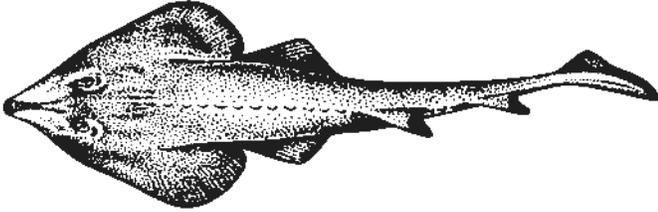
### **Sevengill shark**

*Notorynchus maculatus* [size: to 9 ft. (2.7 m)]

Sevengill sharks often live in shallow bays. They have seven gills on each side of the body, unlike most sharks, which have five. Because of their bulky bodies, sevengills and their relatives are called "cow sharks."

Sevengills eat crabs and fishes (including small sharks, skates and rays) as well as dead animals.

## Critter Cards - Sharks, Skates and Rays



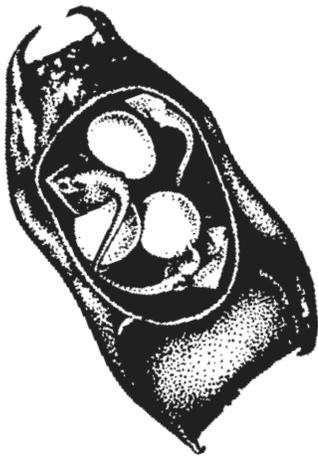
**Shovelnose guitarfish**

### **Shovelnose guitarfish**

*Rhinobatos productus* [size: to 6 ft. (1.8 m)]

Shovelnose guitarfish live on muddy or sandy bottoms inshore and in bays, burrowing in the sand when they're resting. They prefer shallow water, to 50 ft. (15 m).

Guitarfish eat small fishes and invertebrates like crabs, worms and shrimp. Their teeth are small and blunt for crushing their prey.



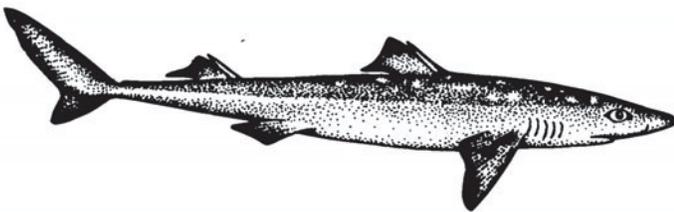
**Skate egg case**

### **Skate egg case**

*Raja binoculata* [size: to 12 in. (30 cm)]

Instead of giving birth to live young, skates lay a tough egg case containing one to seven skate embryos. The egg case, called a "mermaid's purse," has hooked corners that may help it catch in seaweed on the sand. The young skates grow and develop for many months, each nourished by a yolk.

(The picture gives you a cutaway view of the case.)



**Spiny dogfish**

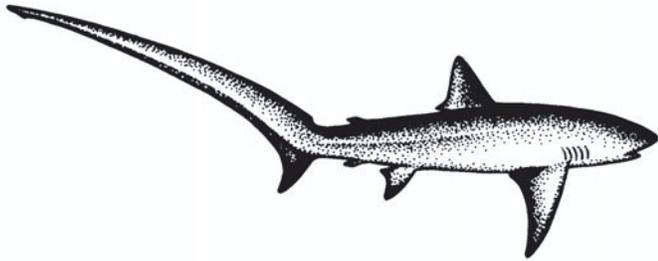
### **Spiny dogfish**

*Squalus acanthias* [size: to 5 ft. (1.5 m)]

Spiny dogfish live in schools, both near the coast (often in bays) and offshore as deep as 2,400 ft. (732 m). They've been known to live 80 years or more. A spiny dogfish has one poisonous spine in front of each dorsal fin.

They eat small fishes and invertebrates like crabs and shrimps; they're also caught by fishers for food.

## Critter Cards - Sharks, Skates and Rays



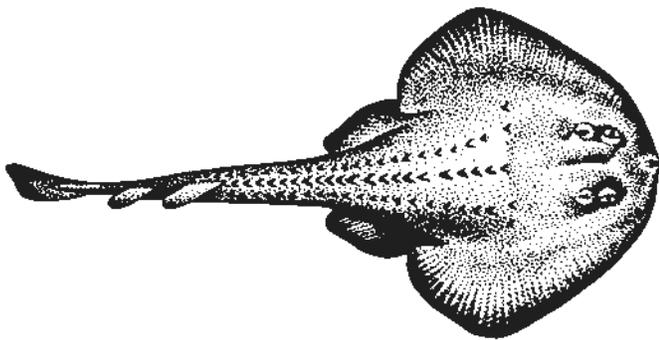
**Thresher shark**

### **Thresher shark**

*Alopias vulpinus* [size: to 20 ft. (6 m)]

Thresher sharks live in the open sea, sometimes coming closer to shore as they hunt. Their young are often found inshore off beaches and in bays.

They eat fishes, squid and other animals of the open sea. Biologists think thresher sharks use the long upper part of the tail to round up and stun prey. These sharks are caught by commercial fishers for food.



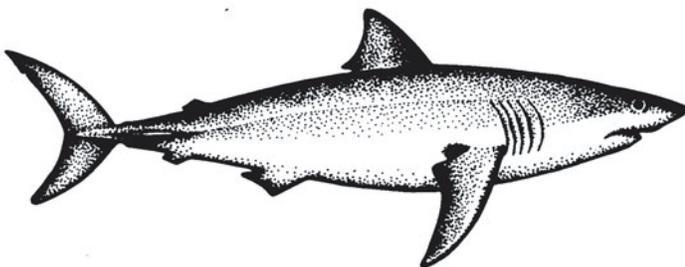
**Thornback ray**

### **Thornback ray**

*Platyrhinoidis triseriata* [size: to 3 ft. (91 cm)]

Thornback rays live on mud or sandy bottoms in shallow, nearshore areas to 150 ft. (46 m). They are often found off beaches or in bays, where they bury themselves in the sediment.

These rays eat sand-dwelling invertebrates like shrimps, clams and worms. The rows of hooked spines on their backs are probably for defense.



**White shark**

### **White shark**

*Carchardodon carcharias* [size: to 30 ft. (9.1 m)]

White sharks live both offshore and near the coast. Their torpedo-shaped bodies and symmetrical tails are adaptations for efficient swimming.

White sharks eat fishes (including sharks), sea birds and mammals, turtles and shellfish.