

# VOICES of the BAY



# Balance in the Bay

An introduction to ecosystem-based management and the Monterey Bay market squid fishery.



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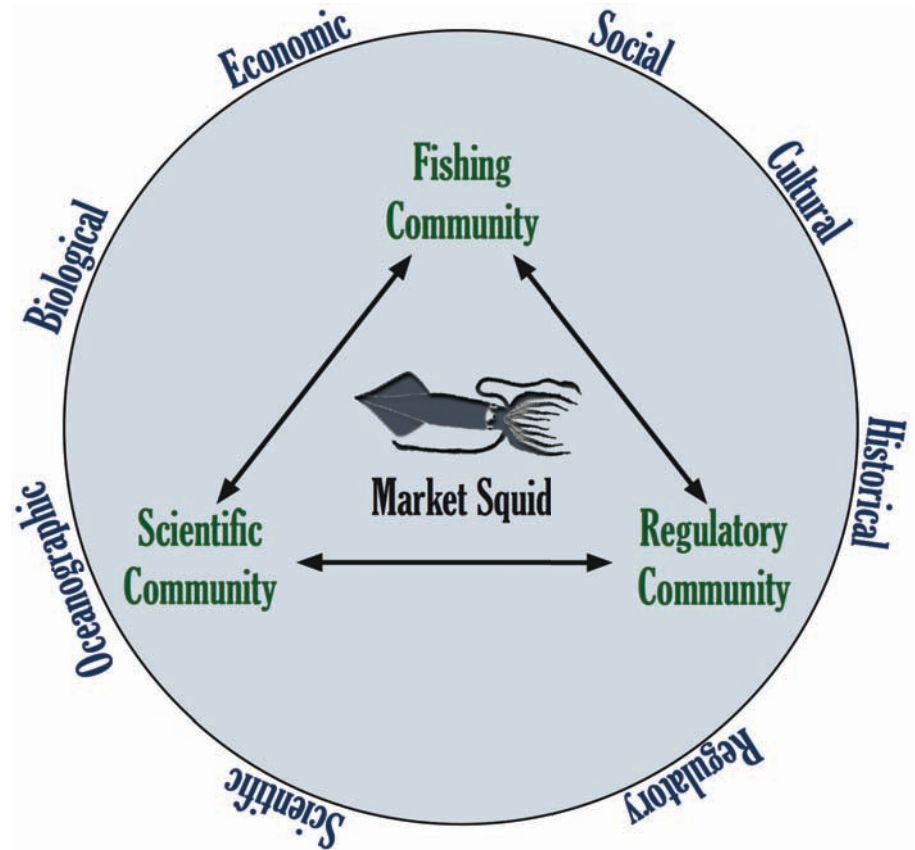
# Fisheries Management

- Sustaining the greatest number of boats for the longest period of time while maintaining a healthy fish population can be challenging!
- Accounting for all factors – biological, regulatory, historical, economic – can help maintain balance within an ecosystem and the communities supported by that ecosystem.



# Ecosystem-Based Management

- Takes into account the interaction of ecological, economic, cultural, and regulatory factors impacting the overall health of an ecosystem and the communities dependent on that ecosystem.
- Specific factors may include pollution, coastal development, harvest pressure, predator/prey and other ecological interactions, as well as nearby watershed management.



# California Market Squid



**Scientific name:** *Doryteuthis opalescens*

**Habitat:** Pelagic (open ocean)

**Lifespan:** Approximately 6 months

**Growth rate:** Fast

**Maximum size/weight:** Approximately 12 inches (305 mm) and 2-3 ounces (56-84 g).

**Reproductive maturity:** Squid spawn at the end of their lifecycle around 6 months.



Newly hatched squid (paralarvae)

# Life History

**Spawning season:** Peaks in April in Monterey Bay, but year-round between Northern and Southern California.

**Spawning grounds:** Nearshore areas with sandy or muddy bottoms.



Squid spawning in Monterey Bay. Photo: Roger Hanlon, SIMoN NOAA.



Range of Market Squid.

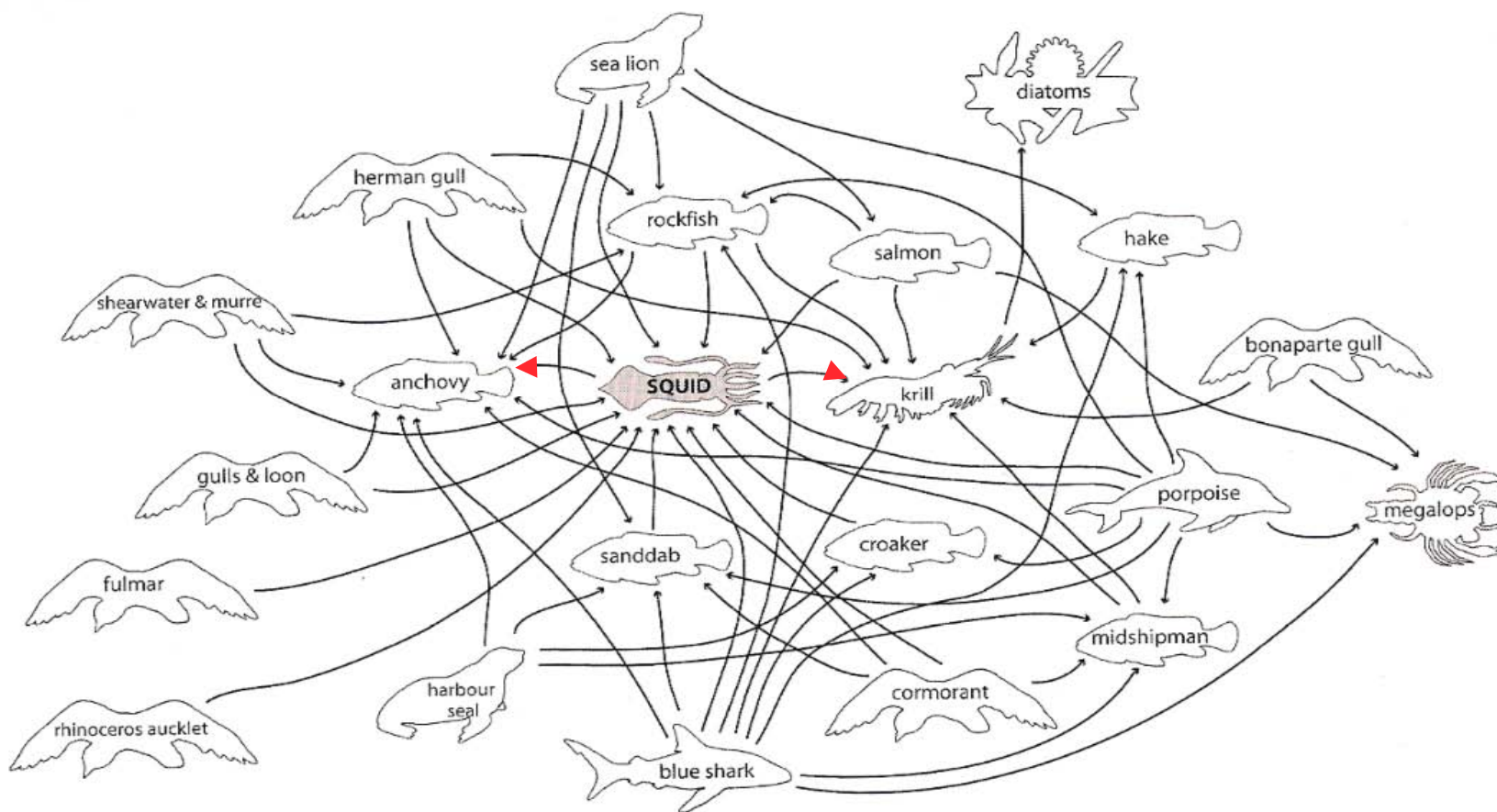
**Range:** Southeast Alaska to Baja, Mexico.

**Preferred Food:** Small crustaceans, small fish, and other squid.

**Predators:** Many species rely on squid for food.

# Squid Food Web

Food web involving commercially important or abundant fish, birds, mammals, and market squid.

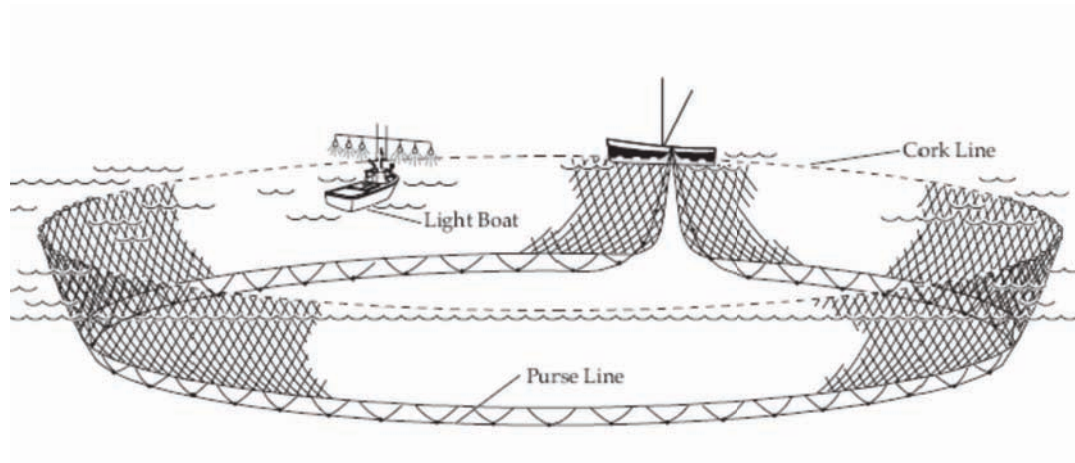
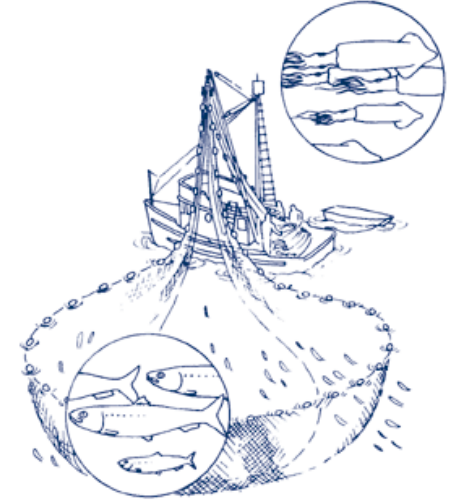


adapted from Morejohn *et al.* 1978 in Boyle & Rodhouse 2005

# Squid Fishing: Gear

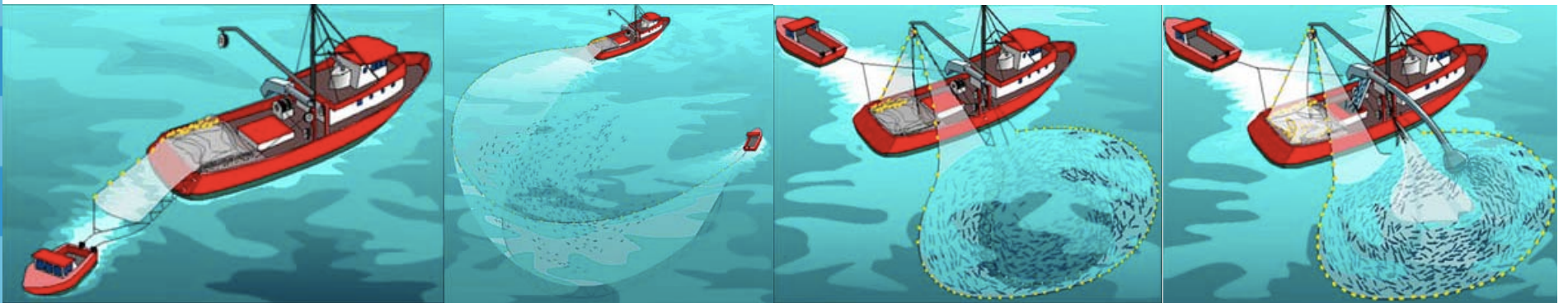
**Purse seine:** a large net used to encircle a school of squid or fish (typically 200-400m long and < 50m deep).

**Light boat:** a smaller boat equipped with high-powered lights that attract squid to the surface.



# Squid Fishing: How it Works

1. A skiff (small boat) is released from the purse seine boat with one end of the net.
2. The purse seine boat “sets” the net around a school of squid.
3. The end of the net attached to the skiff is connected with the purse seine boat to close the circle.
4. Fishermen purse the bottom of the net to tighten up the catch bringing the concentrated squid close to the boat. The squid are then pumped from the net into the hold with a fish pump.





# Squid Fishing: At Night

Squid are attracted to light, a behavior called ***positive phototaxis***. Most squid fishing is done at night using high-powered lights to attract schooling squid to the water's surface.

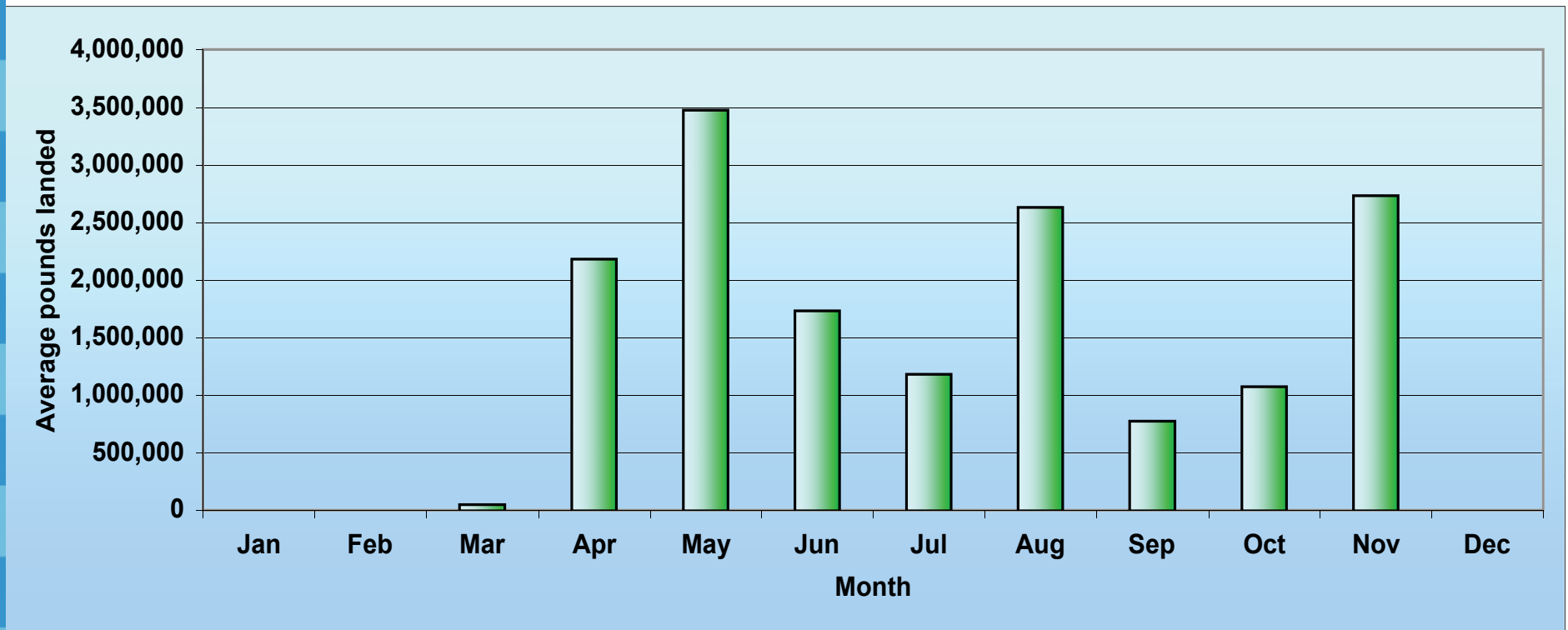


A light boat at night.

Squid fishing at night. Courtesy California Wetfish Producers Association.

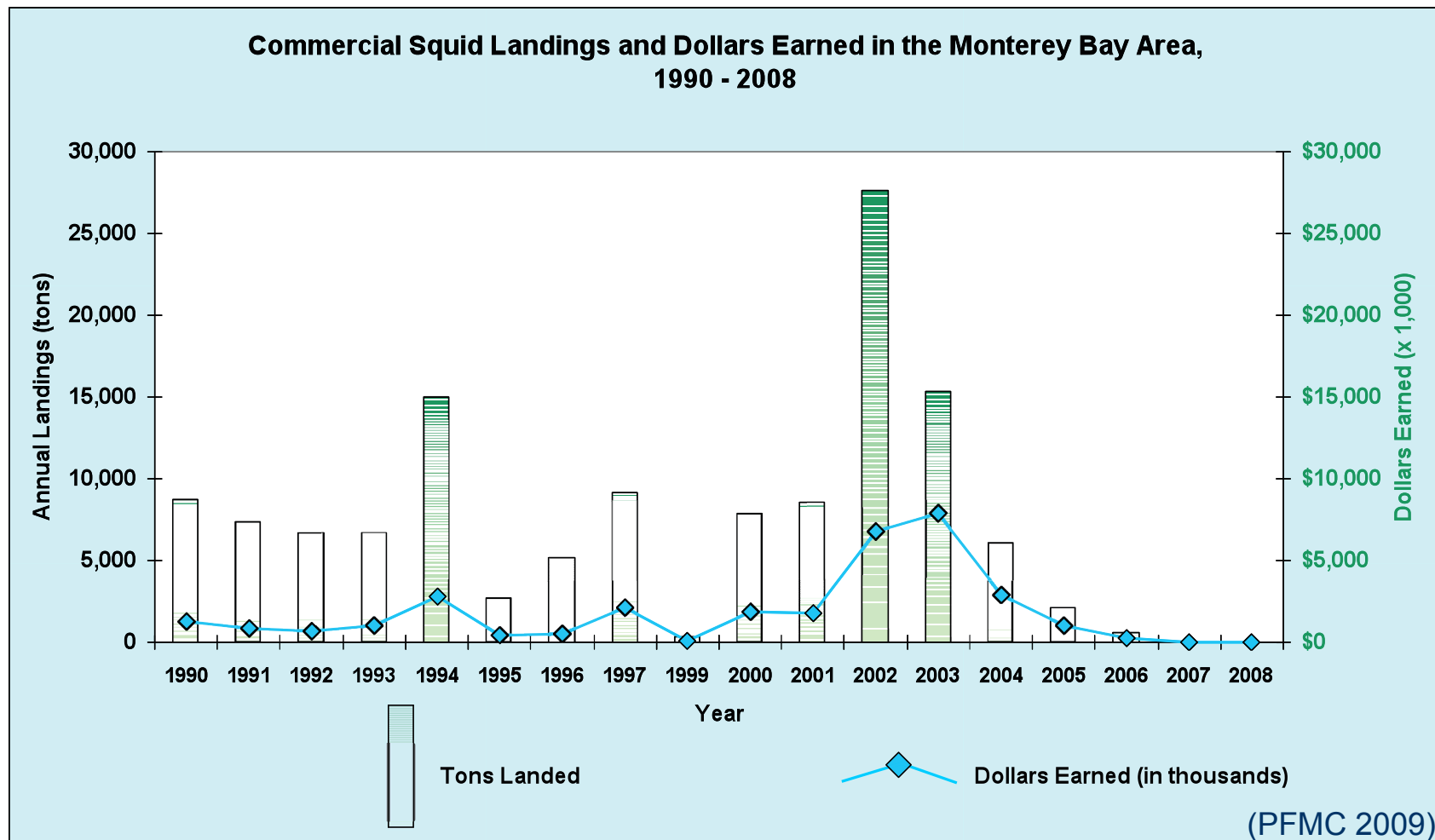
# Squid Fishing Season

Average Pounds of Squid Landed in Monterey Bay Per Month  
(2003-2005)



During good fishing years squid are typically caught in Monterey Bay from April through November.

# Economic Importance



What do you think happened to the squid catch in 1998-1999?

# Squid Products

- 40-65% landed in California exported to 36 countries
  - Over 70% to China
  - Next largest markets: Vietnam, Greece, Spain, United Kingdom
- Human consumption of bait for recreational and commercial fisheries
- Types of products:
  - Frozen
  - Fresh
  - Canned



# Squid Fishing History

**Mid-1800's:** Chinese immigrants started the commercial market squid fishery.

**Early-1900's:** Italian immigrants introduced lampara nets to fish for squid. And small brail nets were used to lift squid out of the net onto the fishing vessel.



Using a brail net to bring fish on the boat. Courtesy Monterey Maritime and History Museum.



Courtesy Monterey Maritime and History Museum.

**1970's:** motorized pumps were used to lift squid onto the boats.

**Today:** modern technology, purse seines, high power lights, and fish pumps aid fishermen in squid fishing.

# Squid Fishery Management: Players

*Scientists* study squid and provide fishery managers data on biology, ecology, and population abundance.



*Pacific Fishery Management Council* develops a squid fishery management plan.

*California Department of Fish and Game (CDFG)* manages and enforces squid fishing regulations in California.



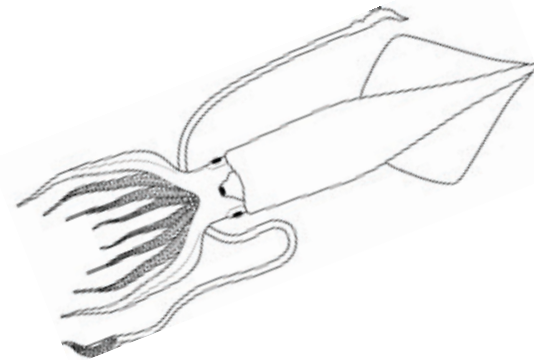
Courtesy California Department of Fish Game.

# Squid Fishery Management: How it Works

- Limited entry fishery – Need a permit
- The permits can be traded or transferred between people
- Need to provide information about where fishing in a logbook
- Total Allowable Catch per year = 107,048 metric tons
- No fishing around Farallon Islands (because of birds)

# Squid Fishing Challenge

- Fishermen, Regulatory Agency Representatives, and Marine Scientists all work together to sustain a fishery.
- In addition to the above, nature also plays an important role, often creating challenges that require a specific human action or response.
- In future fishing seasons, Ecosystem-based Challenge Cards will be drawn to simulate natural and man-made challenges.
- Use and modify your sustainability strategies to maintain a “balance in the bay.”





# Community-wide Objective

Sustain the greatest number of fishing boats for the longest period of time while also maintaining a healthy squid population season to season.



# Fishermen – Fishing



The challenge:

Gather as many squid (paperclips) as you can, using your left hand only, during the fishing season (1 minute).

# Fishermen — Calculations

1. Count your catch.
2. Calculate your seasonal earnings.
3. As a fishing fleet, decide if you would like to purchase additional boats.

**VOICES of the BAY** \*SAMPLE\* Balance in the Bay Fishing Fleet Computation Worksheet

Student Fishing Fleet Member Names: Team 1

FISHING SEASON (circle one) 1 2 3 4 5

1. How many paperclips did your fleet collect?  
A = 132 paperclips

2. If one paperclip is equal to 1,000 pounds of squid, how many pounds of squid did your fleet catch? B = A paperclips x 1,000 lbs/paperclip  $132 \times 1,000 = 132,000$   
B = 132,000 lbs

3. If only 98% of the total number of pounds that your fleet caught were actually squid (the rest are called bycatch, fish that are not squid), how many pounds of squid did you catch? C = B lbs x 0.98  
C = 129,360 lbs  $132,000 \times 0.98 = 129,360$

4. If it costs 50,000 pounds of squid per boat to keep it operating, how many pounds of squid are needed to pay the operating costs for your fleet? D = 50,000 lbs/boat x Number of Your Boats Fishing  
D = 50,000 lbs  $50,000 \times 1 = 50,000$

# Regulatory Agency Representatives



1. Announce the beginning and end of each season.
2. Ensure fishing fleets are following regulations and fair fishing practices.
3. Randomly choose 1 fleet per season and count their catch to ensure accurate reporting of catch.

# Marine Scientists



1. Draw an Ecosystem-based Challenge Card. The class must adhere to the card directions.
2. Record data on the Community Fishery Summary Sheet for all fleets to view.
3. Calculate the number of paperclips to return to the fishing grounds for the next season.

# VOICES of the BAY



In Partnership with:

NOAA's Monterey Bay National Marine Sanctuary  
Monterey Maritime and History Museum  
David and Lucile Packard Foundation  
Friends of Moss Landing Marine Lab  
Monterey County Office of Education  
Community Foundation for Monterey County  
California Department of Fish and Game

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