

1 California Spiny Lobster, *Panulirus interruptus*



California spiny lobster, *Panulirus interruptus*. Credit: D Stein, CDFW.

History of the Fishery

California spiny lobster, *Panulirus interruptus*, have been fished in southern California since at least 1872. The commercial fishery originated in Santa Barbara County and expanded as the number of fishermen increased. By 1900, the fishery encompassed the entire Southern California Bight (SCB) and most of the offshore islands. Today's lobster population is the product of a century of commercial fishing with few areas historically off limits to fishermen.

Over the decades commercial landings have fluctuated, reaching a high in the early 1950s, followed by a decline until the mid 1970s (Figure 1-1). There were multiple reasons for this decline, but a major contributing factor was the landing of sub-legal size (short) lobster. Recognizing this problem, in 1957 the California Department of Fish and Wildlife (Department) implemented a minimum 2 inch by 4 inch (5 centimeter by 10.2 centimeter) mesh size requirement for commercial traps specifically to reduce the taking of short lobster. However, this gear requirement did not fully solve the problem. Consequently, in 1976, the Department required an escape port in all commercial traps. The size of this horizontal escape port enables a short lobster to freely exit the trap.

Requiring escape ports addressed the immediate problem of landing short lobster and initiated the rebuilding of the spawning stock, allowing for an associated increase in the number of legal size lobster entering the fishery. Beginning in 1976, total landings improved each season (October through March), reaching a high of 952,000 pounds (432 metric tons) during the 1997/98 season. Commercial landings have remained higher than the pre-1976 levels (pre-escape port), totaling 753,000 pounds (342 metric tons) and 695,000 pounds (316 metric tons) for the 2009-10 and 2010-11 seasons, respectively. Aside from total landings, other characteristics of the catch have been remarkably consistent over this same period of time.

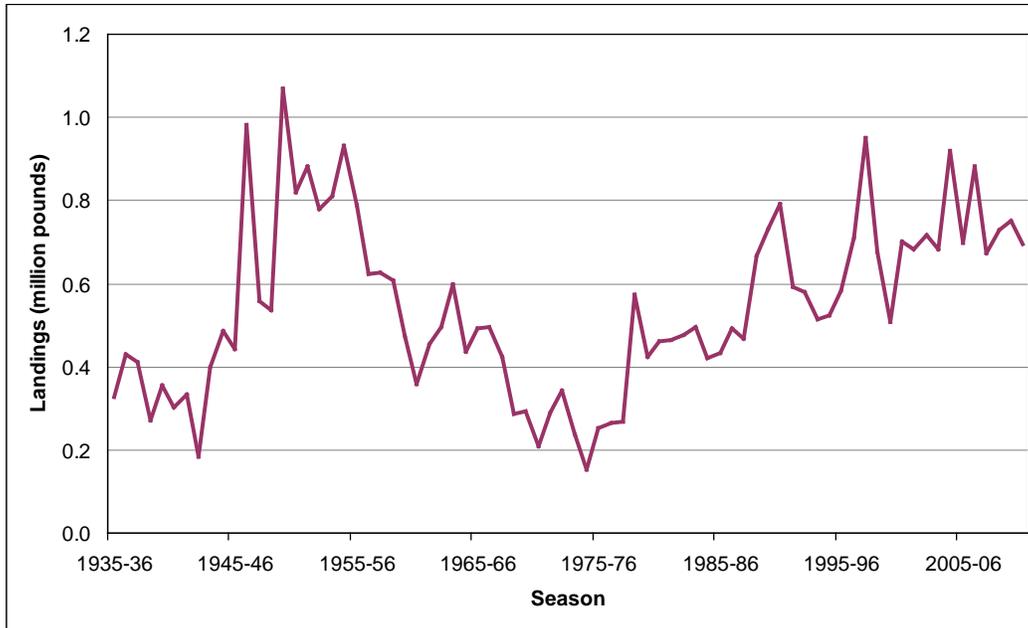


Figure 1-1. Spiny lobster commercial landings by season (October-March), 1935-36 to 2010-11. Data source: Department catch bulletins (1936-1989) and Commercial Fisheries Information System (CFIS) data (1990-2011), all gear types combined.

Since 2000, the total catch over time each season has accumulated at the same rate as each season progresses. The largest landings occur within the first two weeks of the 26-week season. Eighty percent of the season’s total catch is landed by the fifteenth week of the season. The catch is usually evenly divided between three regions: Santa Barbara/Ventura counties, Los Angeles/Orange counties, and San Diego County. A relatively small area extending from Point Loma to La Jolla in San Diego has dominated the catch since at least 1975, consistently accounting for approximately 15 percent of the total southern California catch.

The average weight of an individual lobster in the catch has been fairly consistent over the last decade at 1.4 pounds (0.6 kilograms). Department lobster survey data shows that both recreational and commercial catch are composed mostly of lobster that have attained legal size within the last one or two years. Although larger sized lobster exist, the majority of the lobster catch consists of individuals that have just reached legal size. Further support for this is found in the number of short lobster released each season. Over the last decade, fishermen have had to release 70 to 80 percent of the lobster caught within the SCB each season because they were undersized. Within each county, the percentage of lobster released has also remained fairly consistent over the last decade.

The number of commercial lobster permits issued in 1998 was 274. This number has steadily declined, and in 2011 there were 197 permits issued. Since 2008, the number of lobster permits actively fished has hovered around 150. In 2005, over two-thirds of the commercial lobster permits became transferable. Permit transfers were limited to

10 per season for the first three years, and now there is no restriction on the number of permits that may be transferred. Given the high cost of these permits (\$50,000-\$100,000) which are sold in private transactions, it's possible that fishermen with newly acquired permits will fish more traps to recoup the cost of the permit. It's not clear if this will adversely affect the lobster population, since the majority of spawning females are undersized and cannot be retained. Since 2005, there have been 92 permit transfers, and some of those permits have been transferred more than once.

In recent years, most of the lobster catch has been exported to Asian countries. The median ex-vessel price ranged from \$6.75 to \$8.00 per pound (\$14.90 to \$17.60 per kilogram) in 2000, but by the 2010-11 season market demand from China increased the price to as high as \$18.50 per pound (\$39.70 per kilogram). The total ex-vessel value for the 2010-11 lobster season was \$11.5 million.

In the fall of 2008, the Department required anyone recreationally fishing for lobster in California to purchase a spiny lobster report card. Prior to this, the Department had limited data on where recreational fishermen were fishing, what gear they were using, and how many lobsters were actually being caught. Now, every time a recreational fisherman is fishing for lobster, this information is required to be recorded along with the date of the trip. Lobster report cards are issued for the calendar year just like the annual fishing license. Approximately 30,000 report cards are sold each year. The return rate of cards fell from a high of 22 percent in 2008 to around 11 percent in 2010. Increased outreach, by both Department and recreational spokesmen, has helped to increase the number of cards returned. As of April 2012, a count of returned report cards from the 2011 calendar year has already reached 15 percent of the total sold.

Recreational fishermen are allowed to catch lobster by hand when skin or scuba diving, or by using hoop nets. Historically, diving was the dominant recreational method for catching lobster in southern California. In 1992, a Department recreational creel survey found that divers accounted for 80 percent of the total recorded lobster catch and hoop net gear accounted for the remaining 20 percent. In 2007, another Department recreational creel survey found the 1992 pattern had reversed, and 80 percent of the catch was made using hoop nets. This reversal is attributed to the popularization of hoop nets among the non-diving public.

Hoop nets have evolved into a more efficient gear for catching lobster. Traditional hoop nets lie flat on the bottom and only take their funnel shape when being pulled to the surface (Figure 1-2A). A slow or jerky pull can allow lobster to escape out the top or sides of the net before reaching the surface. The new hoop net design is a rigid, conical net with a smaller ring suspended above a base ring, with netting fully enclosing the space between and below. This new type of hoop net does not lie flat on the bottom, and the lobster must climb up and into the net to reach the bait (Figure 1-2B). Since the only exit is straight up through the smaller, suspended ring, and disturbed lobster tend to swim sideways, conical nets will retain more lobster during recovery regardless of the quality of the pull. A recent Department study found that conical nets caught 57 percent

more lobster than traditional style nets over the course of a season. Conical hoop nets have overtaken traditional hoop nets in usage by the majority of fishermen due to their effectiveness.

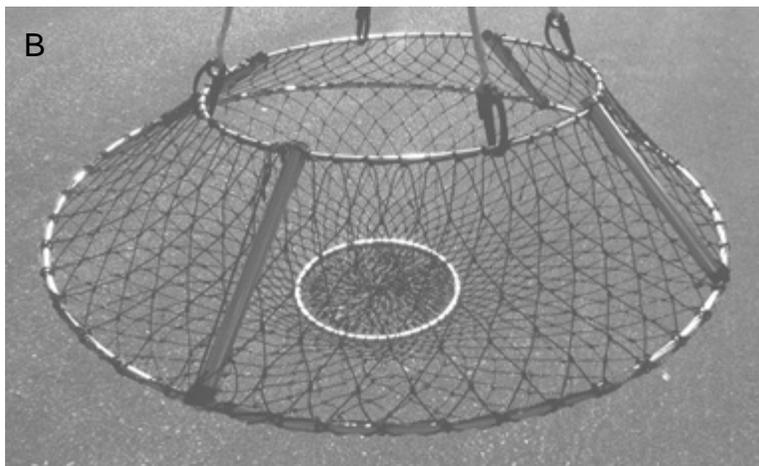
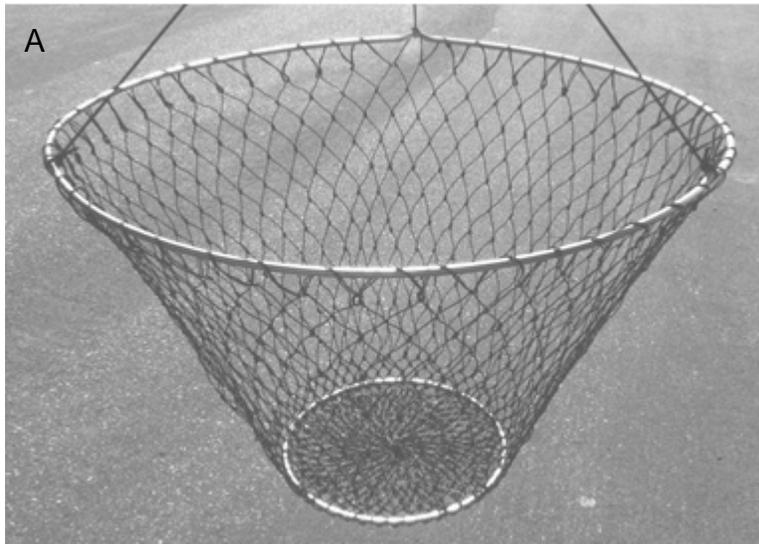


Figure 1-2. Lobster hoop net styles. A) Fully expanded traditional-style hoop net. This style lies flat on the bottom during deployment and takes the pictured, basket shape when pulled. B) Rigid, conical-style hoop net. This style maintains the same shape when pulled. Bait is placed in webbing inside the small ring in both types of net. Photo credit: D Nielson, CDFW.

Since the report cards were introduced, 12 to 14 percent of returned cards have consistently reported no fishing effort for any given year. For cards reporting fishing activity, there has been a consistent average of two lobster per trip and around four trips per card. Each year, approximately 40 percent of all lobster fishing trips result in a catch of zero lobster.

Extrapolating results from returned cards to the entire recreational lobster fishery requires that assumptions be made about how many unreturned card holders actually went fishing and how many zero catch trips are recorded. With a small return rate, the uncertainty associated with any estimated figure will be large. As a consequence, the Department estimates that the size of the recreational catch falls somewhere in the range of 30 to 61 percent of the total commercial catch. The traditional view that the recreational catch is insignificant relative to the commercial catch is inaccurate. However, the recent stock assessment performed by the Department took into account both the commercial and estimated recreational catch, and assessment results suggest the lobster population is healthy and the fisheries are sustainable.

Status of Biological Knowledge

The California spiny lobster is found along the west coast of California from Monterey to Bahía Magdalena, Baja California, Mexico, with a small isolated population in the northwest corner of the Gulf of California. Very few lobster are found north of Point Conception (Santa Barbara County).

Spiny lobster are commonly found in rocky areas from the intertidal zone to depths exceeding 240 feet (73 meters). These areas often consist of plant communities dominated by giant kelp, feather boa kelp, coralline algae, and surf and eel grasses.

Spawning occurs once per year during the late spring through summer months with maximum activity in May, June, and July. Male lobster attach a gummy packet of sperm, called a spermatophore, on the underside of the female's carapace. Females produce 50,000 to 800,000 eggs depending on the size of the female, which are carried on the underside of her tail. Females fertilize the eggs by ripping open the spermatophore with a small claw on the end of each of their last pair of walking legs, releasing the enclosed sperm. The fertilized eggs remain attached to the underside of the female's tail until they hatch approximately 10 weeks later.

After hatching, lobster pass through 11 larval stages known as phyllosoma, which have tiny flattened and transparent bodies with spider-like legs. Phyllosoma drift with the prevailing currents feeding on other planktonic animals for up to 10 months, and have been found from the surface to depths over 400 feet (121 meters). They appear to be concentrated by prevailing oceanographic currents mostly offshore, where they have been found as far as 350 miles (217 kilometers) off the coast. The final phyllosoma stage transforms into a puerulus larva which looks like a transparent, miniature adult with extremely long antennae. Pueruli are strong directional swimmers, and are thought to swim towards the shallow water along the coast. Pueruli eventually settle into shallow, vegetated habitats where they begin a bottom-dwelling existence that will last the rest of their lives.

The spiny lobster's outer shell serves as its skeleton, and is referred to as an exoskeleton. The shell does not grow; so, in order to make room as the lobster grows, the shell must be shed periodically. The process of shedding the exoskeleton, or

molting, is preceded by the formation of a new, soft shell under the old one. After shedding the old shell, an uptake of water expands the new shell which then hardens in place. Lobster usually remain secluded for several days after shedding the old shell to allow the new shell to harden sufficiently for protection. It may take several months for the shell to harden completely. Once the molting process is over, the lobster develops tissue in place of the water used to expand the shell, and effectively grows into its new exoskeleton. A lobster does not grow in length between molts.

The number of molts per year decreases as the lobster ages and is assumed to be similar to those of the Japanese spiny lobster. In Japan, spiny lobster go through 20 molts in their first year, four molts in their second, and three molts in their third. In California, by the time lobster reach sexual maturity (3 to 9 years of age) they are molting once each year. Lobster take from 7 to 13 years to reach the legal size of 3.25 inches (8.26 centimeters) carapace length. Males grow faster than females. Growth rates for both sexes are highly variable and affected by external conditions such as food availability, water temperature, and age. Injuries and disease will often result in a slowing or complete cessation of growth until the injury has been repaired. Lobster usually spawn at least 2 to 3 times before they reach the minimum legal harvest size. The largest lobster caught on record weighed 26 pounds (11.8 kilograms). The maximum age of the California spiny lobster is unknown, but it is thought that this species lives at least 30 years or more. The majority of fishable, legal size lobster are believed to be harvested within a couple years of becoming legal size.

Lobster are known to congregate together during the day in crevices. During the night, lobster may travel great distances, averaging almost 2000 feet (610 meters) in search of food. Lobster tend to utilize areas with high algal coverage and avoid areas of open sand or mud. While lobster do sometimes return to the previously occupied shelter, they more commonly return to the same general area.

Tagging and tracking studies of lobster over the years have not documented any organized migration of lobster between inshore and offshore waters. However, Department divers have observed what was interpreted as a seasonal movement of adults. During the winter months, they found both sexes offshore in 50 to at least 100 feet (15 to 30 meters) of water. During late March and early April, female lobster moved into shallow water. Adult males began a general movement inshore in May. A similar pattern was documented in San Diego Bay where trapped lobster were almost exclusively male in May, but transitioned to mostly female during the summer months. The transition began at the mouth of the bay, progressing farther into the bay as the summer progressed. Commercial and recreational fishermen have observed that lobster are caught in shallow water when the fishing season starts and in deeper water after the onset of winter storms. Correspondingly, many commercial fishermen move their traps farther offshore as the season progresses.

Lobster are omnivorous and consume algae, as well as a wide variety of benthic invertebrates in addition to fish. They are thought to act as a keystone species preying

on mussels along rocky shores and on sea urchins within kelp forests. Lobster will also feed on dead and decaying matter and have been known to be cannibalistic. Lobster are eaten by a wide variety of animals including California sheephead, cabezon, kelp bass, octopuses, California moray eels, horn sharks, leopard sharks, rockfishes, giant sea bass, and, of course, humans.

Status of the Population

In 2010 and 2011, the Department performed a stock assessment of the spiny lobster population in southern California. This assessment relied on SCB-wide Department datasets, modeled results, and published life history parameters (e.g., growth rates). Based on this assessment, the spiny lobster population off southern California appears to be stable and the fisheries targeting this species can be considered sustainable at present. Support for this conclusion follows from conditions outlined previously and include consistently large harvest levels, harvest rates, and sizes of animals caught by both the commercial and recreational fisheries.

The sub-legal population appears large and robust. The number of short lobster released as a percentage of the total SCB-wide catch has remained consistent over the decade, regardless of the overall size of the seasonal harvest. This sub-legal population is also probably responsible for the majority of seasonal spawning.

Management Considerations

The Department is currently in the process of developing a Fishery Management Plan for spiny lobster (Spiny Lobster FMP) as required by the Marine Life Management Act. The Spiny Lobster FMP will ensure a sustainable lobster resource, and healthy commercial and recreational fisheries. The Spiny Lobster FMP effort is timely because of the recent implementation of marine protected areas along the south coast of California that impact both the recreational and commercial lobster fisheries. The Spiny Lobster FMP is a multi-year project, and the draft plan is scheduled to be delivered to the California Fish and Game Commission for adoption in early 2015. The Spiny Lobster FMP will contain a management strategy evaluation procedure that will allow the Department to monitor and evaluate the health of the fishery as future data becomes available. In addition to developing the Spiny Lobster FMP, continuing existing public education and Department enforcement efforts are essential because an illegal market has always existed for shorts, which are very important to the health of the population.

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Further Reading

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California spiny lobster commercial landings by season (October-March), 1935-36 to 2010-11.					
Season	Pounds	Season	Pounds	Season	Pounds
1935-36	327,300	1961-62	455,400	1987-88	469,061
1936-37	430,900	1962-63	496,900	1988-89	667,817
1937-38	409,900	1963-64	597,000	1989-90	731,110
1938-39	271,800	1964-65	435,600	1990-91	792,260
1939-40	356,700	1965-66	492,000	1991-92	590,979
1940-41	303,500	1966-67	496,800	1992-93	579,701
1941-42	334,100	1967-68	424,200	1993-94	514,036
1942-43	182,700	1968-69	286,146	1994-95	523,132
1943-44	399,000	1969-70	294,058	1995-96	583,838
1944-45	486,300	1970-71	207,624	1996-97	711,861
1945-46	443,900	1971-72	289,520	1997-98	951,518
1946-47	980,600	1972-73	342,482	1998-99	674,878
1947-48	558,400	1973-74	237,011	1999-00	506,865
1948-49	535,200	1974-75	152,196	2000-01	702,207
1949-50	1,069,400	1975-76	251,036	2001-02	681,670
1950-51	820,400	1976-77	266,272	2002-03	717,832
1951-52	880,900	1977-78	269,016	2003-04	681,647
1952-53	777,900	1978-79	572,167	2004-05	919,809
1953-54	809,500	1979-80	423,961	2005-06	698,478
1954-55	931,700	1980-81	461,667	2006-07	881,025
1955-56	789,700	1981-82	463,321	2007-08	674,049
1956-57	624,200	1982-83	477,718	2008-09	728,186
1957-58	626,300	1983-84	495,802	2009-10	752,673

California spiny lobster commercial landings by season (October-March), 1935-36 to 2010-11.					
Season	Pounds	Season	Pounds	Season	Pounds
1958-59	608,500	1984-85	422,257	2010-11	695,361
1959-60	474,200	1985-86	432,550		
1960-61	360,000	1986-87	493,229		

Data Source: Department catch bulletins (1936-1989) and CFIS (1990-2011).