

## 7. SHEEP CRAB

### Overview of the Fishery

The sheep crab, *Loxorhynchus grandis*, commonly known as the spider crab, is trapped mainly in the Santa Barbara Channel and off the northern Channel Islands. The bulk of landings occur in Santa Barbara and Ventura Counties, although most crabs are marketed in San Pedro (Los Angeles County) and the greater Los Angeles area. Crab traps are set primarily in shallow, sandy-bottom areas (30-70 ft) in spring and summer, and moved to deeper waters (120-240 ft) in fall and winter.

Before the late 1970s, sheep crabs were occasionally taken as bycatch in commercial gill and trammel net fisheries, and were infrequently taken by recreational divers. They were a nuisance to net fishermen as they often became tangled in gear. Santa Barbara fishermen and processors developed an experimental market for sheep crab, which grew rapidly because of high demand for the claws.

Two types of fisheries exist for sheep crab: one for claws alone, and one for whole crabs. Gill net and trammel net fishermen supplied the claw market, usually killing the crab in the claw-removal process. With development of the claw fishery, sheep crab became a valuable product for gill net fishermen. Only male crabs are used in the claw fishery, as adult female and small adult male claws do not reach market size.

For the whole crab fishery, both males and females are taken, with crab and lobster trap fishermen supplying the bulk of live crabs. Modified rock crab or lobster traps with enlarged funnels are used to trap sheep crab.

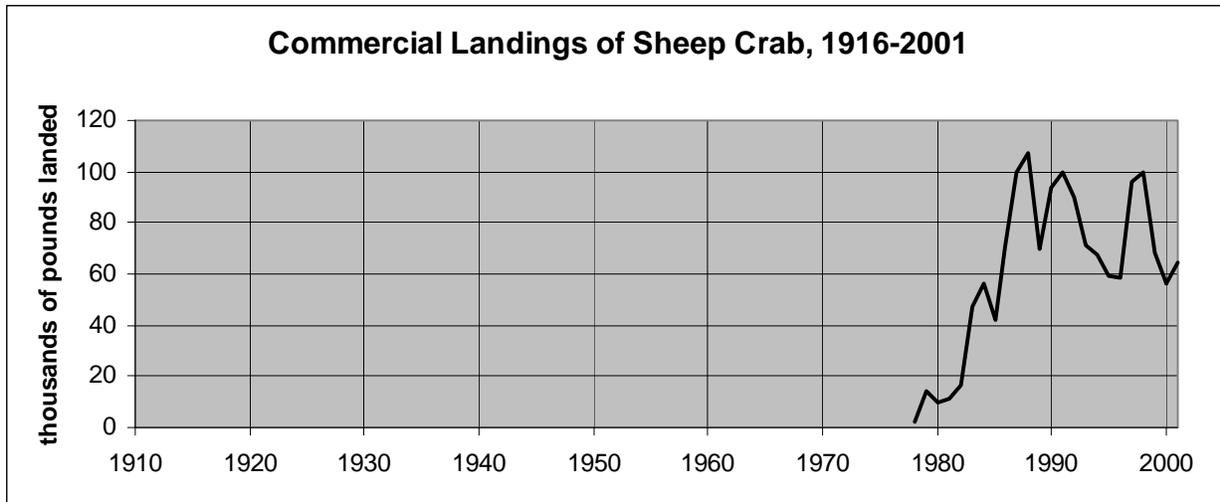


Figure 7.1. Annual commercial landings (pounds) of sheep crab from 1916 to 2001. Data sources are California Department of Fish and Game (DFG) Catch Bulletins (1916-1983) and the DFG commercial landing receipt database (1984-2001).

Fishery landings peaked in 1988 with landings of 108,000 lb of whole crabs (Figure 7.1 and Table 7.1), and 96,000 lb of claws (Table 7.2). From 1986 through 1990, the crab claw market category contained claws from both sheep crab and rock crab, with sheep crab claws more prevalent than rock crab claws. The retail value of

the combined catch was about \$1.9 million, with claws being sold for \$5.75 per lb and whole crabs going for \$3.00 per lb live and \$4.25 per lb cooked. The 1988 claw landings represented approximately 362,000 lb of whole crabs. When the claw fishery was at its peak, the sheep crab fishery was the only fishery in the United States with sizeable landings of both claws and whole crabs.

In 1990, the Marine Resources Protection Act (California ballot initiative Proposition 132) established a three year phase-out of gill and trammel nets within three miles of the mainland shore south of Point Arguello (Santa Barbara County) and in areas around the Channel Islands. Subsequently, landings of sheep crab claws plummeted. Since the phase-out of gill and trammel nets in 1994, crab claw landings have averaged 4,000 lb per year, while the annual landings of whole crabs has not changed substantially.

While claws commanded a higher price per lb than whole crab before the phase-out of gill and trammel nets, the price of claws fell along with landings after the phase-out in 1994. In 1999 the retail value of fishery landings was approximately \$310,000, with whole, live crabs being sold for up to \$4.00 per lb and claws up to \$3.00 per lb.

Any future increase in claw landings seems unlikely given that the fishery was developed to provide some value to a bycatch species. Also, when it became illegal to take rock crab claws in 1991, landings of sheep crab claws did not increase to compensate for the loss of rock crab claws in the market, probably because the law banning take of rock crab claws was implemented at the same time as the ban on using gill and trammel nets in shallow waters. Thus, the ban on the primary gear used to take sheep crab claws incidentally seems to have stemmed any possible increase in claw landings.

Fishing effort for whole crabs and landings of whole crabs remains relatively low since fishermen generally must establish their own live markets and must be able to hold the live crabs for up to a week or more. In addition, because of the heavy, thick shell of the crab, processing the body meat is uneconomical at present. Landings of whole crabs may increase if new marketing efforts expand the live markets or if processing becomes economically feasible. Increased landings seem possible given the continued interest in the California fishery and the recent development of an experimental sheep crab fishery off Baja California, Mexico.

### **Status of Biological Knowledge**

“Sheep crab” is the common name of one species within a family of crabs (Majidae), collectively known as spider crabs. Consequently, the sheep crab, which is the largest member of the California majid crabs, is often called “spider crab”. They range from Cordell Bank (off Marin County) south to Cape Thurloe, Baja California, in depths of 20 to 410 ft. It is not known whether the sheep crab resource consists of more than one population. Sheep crabs are apparently most abundant off southern California.

Longevity of this crab is currently unknown, but many adults appear to be at least four years old. In contrast to most other commercially-important crustaceans, sheep crabs are believed to cease “molting”, or shedding their shells, upon reaching maturity. After the final molt, crabs do not increase in size nor do they regenerate limbs.

Because of this characteristic, sheep crabs may require a different management regime than other crabs.

Maturation is currently defined only by the relative size of external body parts. At maturity, the width of the abdomen in females and the length of the claw in males increase markedly when compared to carapace length. Females become mature between 4.2 and 6.8 in. carapace length. Adult males range in size from 4.2 to 9.6 in. carapace length. However, juvenile male crabs can reach a length of 6.8 in., so size alone cannot determine maturity. The presence of a gap in the serration on the claw of adult male crabs also distinguishes them from juvenile males. It is uncertain how maturity, as determined by the relative size of external body parts, relates to physiological and behavioral maturity.

The number of egg-bearing females peaks in late spring and remains high throughout the summer, although they can be found throughout the year. Adult females are able to mate when soft- or hard-shelled. Sperm storage allows for multiple broods to be laid even in the absence of males. Egg numbers probably increase with the size of brooding female crabs. Small broods may contain 125,000 eggs, whereas large broods can contain up to 500,000 eggs.

Laboratory observations suggest that sheep crabs feed on a variety of prey. They readily eat dead fish, crushed mussels, and kelp. Cannibalism of newly-molted animals occurs in the laboratory when crabs are not well fed. No observations are available on foraging behavior in the wild, nor have gut contents been analyzed.

Predatory interactions have not been observed in the field, but it is likely that small crabs are preyed upon by cabezon, California sheephead, octopus, sharks and rays. Small sheep crabs disguise themselves by decorating their carapace with algae, sponges, or other encrusting materials. Large crabs probably have few predators.

Two parasitic infections could potentially impact the number of individuals reaching later life stages: an undescribed species of nemertean worm, also known as the ribbon worm, and the rhizocephalan barnacle. The ribbon worm consumes developing embryos in eggs, while the barnacle eliminates reproductive output and also inhibits growth of the crab. Preliminary observations indicate that certain areas contain a high prevalence of individuals parasitized by these barnacles, and that crabs become infected as juveniles.

Male crabs winter in deep water. Both sexes migrate onshore in early spring, and piles of adult females have been observed in shallow water in spring and summer. Large adult males have been seen on the perimeter of these aggregations, which are apparently related to mating. Within these aggregations, the majority of females bear eggs, and the males often exhibit competitive behavior for mates. Male and female crabs have been observed hooked together, back-to-back, by the male's hindmost limbs. Similar aggregate mating behavior has been reported for other spider crabs.

### **Status of the Population**

The abundance of sheep crabs is unknown. Abundant populations have been reported off Los Angeles (Los Angeles County) and San Diego (San Diego County). Although this crab has been harvested as bycatch for many years, there is no evidence of declining populations in the Santa Barbara Channel where most of the crab fishing takes place. However, there are reports of a decrease in overall crab size. This decline

could be due to the immense fishing pressure for large males at the height of the fishery. Because this species stops molting at maturity, removal of large crabs may leave only small animals to contribute to the gene pool. If the terminal molt is genetically regulated, this could result in a population of smaller crabs. However, this is presently a hypothesis. The true state of populations and size distributions remains unknown.

### **Management Considerations**

Additional biological information, including a better understanding of physiological and behavioral reproduction, is needed to develop sound management policies. Nevertheless, limited management recommendations can be made based on certain biological characteristics of the sheep crab:

- Sheep crab stop molting upon reaching adulthood. Thus, the claws will not regenerate once removed from adult crabs.
- The cessation of molting and other characteristics have implications for management of the live, whole body fishery. For example, size limits would likely need to include both an upper and lower limit. This would leave the largest and smallest crabs to mate and maintain recruitment. The lower limit would need to protect large juvenile males which overlap in size with the smaller adults.
- Protection of seasonal spawning aggregations may need to be incorporated into a management plan for this species.
- After sheep crab stop molting, the shell and limbs of the crabs become abraded over time. The level of abrasion (called “abrasion stage”) can be used to distinguish between juveniles and adults. Use of abrasion stages may also provide a good tool for management. However, duration of the various abrasion stages and their association with gonadal development and reproductive success needs to be determined before considering this management strategy.

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### **Further Reading**

- Anonymous. 1983. Guide to underutilized species of California. National Marine Fisheries Service Admin. Rept. T-83-01. 29p.
- Culver, Carolynn S. 1991. Growth of the spider crab, *Loxorhynchus grandis*. M.A. Thesis, Univ. of Calif. Santa Barbara, California. 101 p.
- Pleschner, DB 1985. Fish of the Month: Spider Crab. Pacific Fishing Magazine. 8(6): 33-39.

**Table 7.1. Commercial landings (pounds) of sheep crab, 1916-2001**

Year	Pounds								
1916	-----	1933	-----	1950	-----	1967	-----	1984	56,328
1917	-----	1934	-----	1951	-----	1968	-----	1985	41,760
1918	-----	1935	-----	1952	-----	1969	-----	1986	70,465
1919	-----	1936	-----	1953	-----	1970	1,032	1987	99,546
1920	-----	1937	-----	1954	-----	1971	-----	1988	107,569
1921	-----	1938	-----	1955	-----	1972	-----	1989	70,057
1922	-----	1939	-----	1956	-----	1973	-----	1990	93,444
1923	-----	1940	-----	1957	-----	1974	52	1991	99,500
1924	-----	1941	-----	1958	-----	1975	-----	1992	89,871
1925	-----	1942	-----	1959	-----	1976	-----	1993	71,173
1926	-----	1943	-----	1960	-----	1977	-----	1994	67,290
1927	-----	1944	-----	1961	-----	1978	1,919	1995	59,427
1928	-----	1945	-----	1962	-----	1979	14,402	1996	58,852
1929	-----	1946	-----	1963	-----	1980	9,869	1997	95,801
1930	-----	1947	-----	1964	-----	1981	10,914	1998	99,797
1931	-----	1948	-----	1965	-----	1982	16,495	1999	68,602
1932	-----	1949	-----	1966	-----	1983	47,108	2000	55,995
								2001	64,564

----- No landings were reported.

1. Data sources: DFG Catch Bulletins (1916-1983) and commercial landing receipt database (1984-2001).

2. Sheep crab landings are reported as spider crab by DFG.

**Table 7.2. Commercial landings (pounds) of crab claws, 1986-2001**

Year	Pounds	Year	Pounds	Year	Pounds
1986	46,167	1991	28,805	1996	6,490
1987	82,931	1992	27,368	1997	4,958
1988	96,471	1993	19,482	1998	5,447
1989	76,090	1994	4,423	1999	3,347
1990	64,556	1995	3,812	2000	3,258
				2001	2,750

1. Data source: DFG commercial landing receipt database.

2. In 1986, a new market category (reporting category) was created for crab claws. Between 1986 and 1990, this category contained claws from both sheep crab (spider crab) and rock crab, with sheep crab claws more prevalent than rock crab claws. On January 1, 1991, it became illegal to take rock crab claws and the category became exclusively sheep crab claws.

3. Landings reported as weight of the claws and are not an estimate of whole weight of the crab.