RISE AND FALL OF THE MARKET CRAB INDUSTRY

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Abstract. The history and landing trends of the market crab fishery in California are discussed. Fishing has taken place in five areas with the San Francisco and Eureka-Crescent areas being the most important. In recent years the San Francisco area landings have declined and the Eureka-Crescent City area has provided the bulk of the landings.

Life history studies reveal that female crabs spawn between October and December and carry between 1-2 million eggs. The larvae pass through five zoeal and one megalops stage.

Sexual maturity in the market crab is reached at a size of about 4 inches at about 1 to 1-1/2 years of age. Legal size of 6-1/4 inches in width is generally reached in 11 to 13 molts at an age of 2.5 to 3.5 years.

Success of larval survival appears to be the reason for low or high crab abundance affecting the landings. Unfavorable oceanographic conditions for the larvae as well as pollution may be causing the continued decline in the San Francisco area.

Research efforts have been directed to learning more of the fluctuations in abundance of various segments of the resource. We have conducted trawling, trapping and tagging of crabs in both central and northern California. Water quality studies in relation to crab and larval survival are planned.

Current season (1972-73) landings are expected to equal or exceed slightly last year's record low of 320,000 pounds in the San Francisco area and landings are not expected to reach 2.5 million pounds in the Eureka-Crescent City area. An encouraging sign is the strong showing of the 1972 year class in northern California. However, these crabs probably will not contribute to the fishery until the 1974-75 season.

INTRODUCTION

The market crab (Cancer magister) is harvested from California to Alaska. In California it is fished from Avila to the Oregon border. The fishery off San Francisco has existed

for over 100 years. Prior to the 1944-45 season, the fishery was centered around San Francisco. The fishery expanded in the Eureka-Crescent City area as World War II ended. Introduction of the crab trap, which replaced the hoop net in the early 1940's, also influenced the landings. Since the 1945-46 season, the average season Statewide production has been 10.5 million pounds, a four-fold increase over the pre-1945 average. Most of the increase was due to the fishery expanding in the northern part of the State.

Fishery

A small fishery developed in the Morro Bay-Avila area in 1947. It reached a peak of 434,000 pounds in the 1950-51 season, continued good through the 1950's but declined sharply in the 1961-62 season. The fishery has never recovered, and landings have totaled only a few thousand pounds by season ever since.

The small fishery around Monterey reached peaks of 498,200 and 558,312 pounds in the 1927-28 season and 1938-39 seasons respectively. It continued on a small scale through the 1950's, and in 1961-62 followed the same downward pattern as Morro Bay. Like Morro Bay, the Monterey area has never recovered and landings recently have amounted to only a few hundred or thousand pounds per season.

San Francisco production was relatively stable from 1945-46 to 1955-56 with landings averaging 4.2 million pounds and ranging from 3.2 to 5.3 million pounds. In the 1956-57 season, the fishery reached its peak of 8.9 million pounds. For four seasons after that the fishery continued to produce better than average landings, but in the 1960-61 season the landings declined to 2.3 million pounds. A more severe decline followed in the 1961-62 season with landings of just 710,000 pounds. The resource remains in a depressed state and landings have not exceeded 1.4 million pounds since the 1961-62 season. Last season's landings (1971-72 season) were the lowest on record--320,000 pounds.

The Eureka-Crescent City including the Fort Bragg fishery increased substantially after 1945. Landings in this fishery appear to be cyclic and follow very closely the landing patterns of Oregon and Washington. A low of 1.5 million pounds was reached in the 1954-55 season and lows of 900,000 and 800,000 pounds were reached in the 1962-63 and 1963-64 seasons respectively. Peak record landings of 12.3 million pounds were reached in the 1958-59 season and also the 1968-69 and 1969-70 seasons with landings of 12.8 and 14.1 million pounds respectively. Recently the fishery has experienced another decline and landings for the 1970-71 and 1971-72 seasons were 7.8 and 2.5 million pounds respectively. This appears to be part of the cyclic low pattern which appears about every eight years. The current season (1972-73) is expected to be another low landing season because of poor catches at the start of the season.

Regulations

The crab fishery is regulated by seasons to allow harvesting when the crabs are in prime condition. The central California season--from the southern boundary of Mendocino County south--opens the second Tuesday in November to June 30. The northern California season--including Mendocino County north to the Oregon border--opens December 1 and closes July 15.

No female crabs may be harvested and male crabs must measure a minimum 6-1/4 inches measured by the shortest distance through the body from one edge of the shell to the other edge of the shell directly in front of the spines.

Each crab trap is required to have two 4-inch openings to allow undersize male and female crabs to escape.

Biological Knowledge

The market crab has a definite preference for sandy bottoms. Occasionally it will be found in mud, but rarely in rocky areas. While the species occurs to depths of 750 feet, it is not abundant over 300 feet.

The resource off California consists of five subpopulations. One each in the area around Avila-Morro Bay, Monterey, San Francisco, Fort Bragg, and Eureka-Crescent City. Tagging experiments have demonstrated little or no intermixing between the subpopulations. Also, ocean tagging has shown that no particular migration patterns are evident. Instead, movement appears to be random, particularly coastal movement. At times an inshore or offshore movement migration has been observed. Movements up to 125 miles have been noted, but movement generally is restricted to less than 10 miles.

Mating takes place generally in the spring between a hard shelled male and a soft shell or freshly molted female. The females generally spawn between October and December and carry the eggs under the abdominal flap until they hatch. This occurs between November and February. The number of eggs per female ranges from about 1-2 million.

The newly hatched larvae pass through five zoeal and one megalops stage before attaining the regular crab form and settling to the bottom as juveniles. Generally, 4 to 5 months is required to complete the larval stages. During this interval, the larvae are part of the zooplankton found in the upper water layers.

Metamorphosis from the last larval stage to the regular crab form or juvenile stage occurs from April to June. Approximately 1 year later, the crab has attained a width of 3.5 to 5.5 inches. Sexual maturity is reached at a size of about 4 inches or about 1 to 1-1/2 years of age, starting at the time of larval release. Prior to reaching maturity, growth is the same for both sexes. Once maturity is reached, growth of the females becomes slower.

Growth is accomplished only by molting, resulting in a saltatory type growth pattern. Prior to reaching maturity, molting occurs frequently. About 8 to 11 molts are completed during the first year after metamorphosis from the larval stage, and about 9 to 10 are required to reach maturity. Molting frequency diminishes to about once a year after maturity is reached, and approximately 11 to 13 molts are required to reach the legal size of 6-1/4 inches in width. Legal size is generally reached 2.5 to 3.5 years after metamorphosis. Maximum age and size appear to be 6 years and 9 inches respectively.

Status of Population

Total population estimates have never been made. The only indications of its status is obtained from commercial landings and from pre-season cruises. Fishing pressure is great and the resource appears to be near full exploitation. Fishing mortality on the legal male crabs is high, running at least 75 percent each season. Most of this is from commercial fishing; however, limited sport use does occur both in northern and central California. Although we do not have good estimates of the sport catch, it is insignificant in relation to the total catch.

The general status of the subpopulations is known but the total size is not. Central California populations are at low levels of abundance. Monterey and Morro Bay have always had relatively small populations and are considered limited potential fisheries. San Francisco, which used to be the major area of production in the State, has experienced a decline to low levels of harvest for the past 11 seasons. Now it contributes a small portion of the Statewide landings.

Conditions in northern California have been much better. Although low landing seasons have been encountered, some record or near record seasons have been experienced prior to and after the low seasons. The Eureka-Crescent City area supports the major population in California. The landings have been larger than all the others combined.

Reasons for Fluctuations in the Fishery

The most critical stage in the crab's life as far as mortality is concerned appears to be the larval stage. Since the larval life is so long, this stage may be subjected to all sorts of unfavorable environmental conditions, such as different temperatures and salinities, currents affecting distribution, lack of food, numerous predators, pollution, etc. Poor

survival results in poor year classes and subsequent reduced populations and landings. The fact that the San Francisco fishery has not recovered to its former levels of abundance suggests that something other than natural oceanographic conditions is causing the continued decline.

Although we do not have the proof, it appears that pollution may be the limiting factor. Areas of greatest larval and juvenile crab concentration appear to be inshore near mouths of rivers and bays and in certain bays. San Francisco Bay--particularly San Pablo Bay--appears to be an important nursery area for young crabs. The females release the larvae out in the ocean off San Francisco and the larvae apparently are carried into the bay by the currents. Various larval stages are carried into the bay and after metamorphizing to the first juvenile stage (regular crab form) spend about the next year in the bay. After that time we suspect that most of them migrate to the ocean and contribute a good share overall to the resource.

Our Research Efforts

In an effort to learn more of the fluctuations of abundance of the resource, we have been conducting trawling and trapping cruises in the ocean off San Francisco and Eureka to determine the strength of the incoming year classes and also the older components of the resurcce. Studies of bay crabs have also been conducted to determine abundance, growth and the role of bays as crab nursery areas. During 1971 and 1972, approximately 4,000 crabs were tagged in San Pablo Bay. Tag recoveries have been poor, but some of those crabs recovered moved from 25 to 38 miles out to the ocean.

We feel that poor water quality is affecting survival of the crabs and hope to have the assistance of our water quality people in conducting tests at our Granite Canyon Laboratory when the water quality section is completed. The crabs and larvae will be subjected to various types of pollution.

Outlook of the Fishery

We do not anticipate much of a change in landings in the San Francisco area for the current 1972-73 season. Landings should equal or slightly exceed the record low of 320,000 pounds for last season. However, judging by a fairly strong showing of sub-legal (1970 and 1971 year class) crabs during our last year's September-October cruise, we feel that landings should show some improvement in the 1973-74 season. This is provided the crabs do not experience high mortality. However, the road to full recovery appears a longer way off. We have not been able to locate the 1972 year class crabs in quantity in San Francisco Bay or the ocean.

The landings at Eureka and Crescent City are down this season (1972-73) and it appears that they will not reach the 2.5 million pounds harvested last season. Cruise data indicates a scarcity of sub-legal crabs and it appears that the 1973-74 season's catch will remain at low levels also. An encouraging sign is the strong showing of the 1972 year class from the cruise survey and Humboldt Bay surveys. However, these are still about 2-3 years off from attaining legal size and probably will not contribute to the fishery until the 1974-75 season.