

**REFERENCE COPY**

Do Not Remove from the Library

U. S. Fish and Wildlife Service

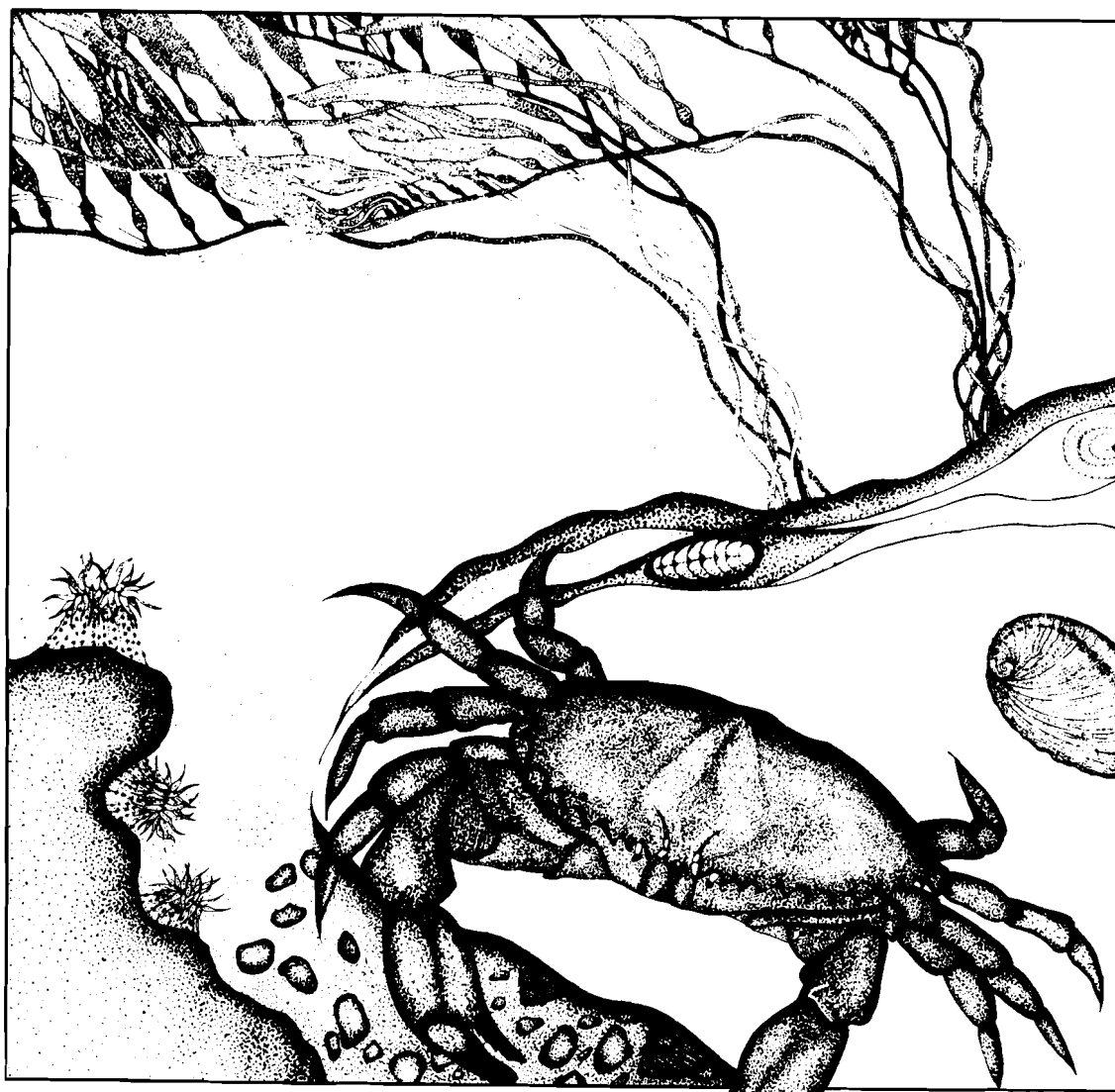
Biological Report 82(11.117)  
December 1989

National Wetlands Research Center  
700 Cajun Dome Boulevard  
Lafayette, Louisiana 70506

TR EL-82-4

**Species Profiles: Life Histories and  
Environmental Requirements of Coastal Fishes  
and Invertebrates (Pacific Southwest)**

# **BROWN ROCK CRAB, RED ROCK CRAB, AND YELLOW CRAB**



Fish and Wildlife Service

U.S. Department of the Interior

Coastal Ecology Group  
Waterways Experiment Station

U.S. Army Corps of Engineers

Biological Report 82(11.117)  
TR EL-82-4  
December 1989

Species Profiles: Life Histories and Environmental Requirements  
of Coastal Fishes and Invertebrates (Pacific Southwest)

**BROWN ROCK CRAB, RED ROCK CRAB, AND YELLOW CRAB**

by

Jay C. Carroll  
TENERA Environmental  
Avila Beach, CA 93424

and

Richard N. Winn  
South Carolina Wildlife and Marine Resources Department  
Charleston, SC 29412

Project Officer  
David Moran  
U.S. Fish and Wildlife Service  
National Wetlands Research Center  
1010 Gause Boulevard  
Slidell, LA 70458

Performed for  
U.S. Army Corps of Engineers  
Waterways Experiment Station  
Coastal Ecology Group  
Vicksburg, MS 39180

and

U.S. Department of the Interior  
Fish and Wildlife Service  
Research and Development  
National Wetlands Research Center  
Washington, DC 20240

This series may be referenced as follows:

U.S. Fish and Wildlife Service. 1983-19\_\_\_. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates. U.S. Fish Wildl. Serv. Biol. Rep. 82(11). U.S. Army Corps of Engineers, TR EL-82-4.

This profile may be cited as follows:

Carroll, J.C., and R.N. Winn. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)--brown rock crab, red rock crab, and yellow crab. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.117). U.S. Army Corps of Engineers, TR EL-82-4. 16 pp.

## PREFACE

This species profile is one of a series on coastal aquatic organisms, principally fish, of sport, commercial, or ecological importance. The profiles are designed to provide coastal managers, engineers, and biologists with a brief comprehensive sketch of the biological characteristics and environmental requirements of the species and to describe how populations of the species may be expected to react to environmental changes caused by coastal development. Each profile has sections on taxonomy, life history, ecological role, environmental requirements, and economic importance, if applicable. A three-ring binder is used for this series so that new profiles can be added as they are prepared. This project is jointly planned and financed by the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

Suggestions or questions regarding this report should be directed to one of the following addresses.

Information Transfer Specialist  
U.S. Fish and Wildlife Service  
National Wetlands Research Center  
NASA-Slidell Computer Complex  
1010 Gause Boulevard  
Slidell, LA 70458

or

U.S. Army Engineer Waterways Experiment Station  
Attention: WESER-C  
Post Office Box 631  
Vicksburg, MS 39180

## CONVERSION TABLE

### Metric to U.S. Customary

<i>Multiply</i>	<i>By</i>	<i>To Obtain</i>
millimeters (mm)	0.03937	inches
centimeters (cm)	0.3937	inches
meters (m)	3.281	feet
meters	0.5468	fathoms
kilometers (km)	0.6214	statute miles
kilometers	0.5396	nautical miles
square meters (m <sup>2</sup> )	10.76	square feet
square kilometers (km <sup>2</sup> )	0.3861	square miles
hectares (ha)	2.471	acres
liters (l)	0.2642	gallons
cubic meters (m <sup>3</sup> )	35.31	cubic feet
cubic meters	0.0008110	acre-feet
milligrams (mg)	0.00003527	ounces
grams (g)	0.03527	ounces
kilograms (kg)	2.205	pounds
metric tons (t)	2205.0	pounds
metric tons	1.102	short tons
kilocalories (kcal)	3.968	British thermal units
Celsius degrees (° C)	1.8 (° C) + 32	Fahrenheit degrees

### U.S. Customary to Metric

inches	25.40	millimeters
inches	2.54	centimeters
feet (ft)	0.3048	meters
fathoms	1.829	meters
statute miles (mi)	1.609	kilometers
nautical miles (nmi)	1.852	kilometers
square feet (ft <sup>2</sup> )	0.0929	square meters
square miles (mi <sup>2</sup> )	2.590	square kilometers
acres	0.4047	hectares
gallons (gal)	3.785	liters
cubic feet (ft <sup>3</sup> )	0.02831	cubic meters
acre-feet	1233.0	cubic meters
ounces (oz)	28350.0	milligrams
ounces	28.35	grams
pounds (lb)	0.4536	kilograms
pounds	0.00045	metric tons
short tons (ton)	0.9072	metric tons
British thermal units (Btu)	0.2520	kilocalories
Fahrenheit degrees (° F)	0.5556 (° F - 32)	Celsius degrees

## CONTENTS

	<u>Page</u>
PREFACE .....	iii
CONVERSION TABLE .....	iv
FIGURES .....	vi
ACKNOWLEDGMENTS .....	vii
NOMENCLATURE/TAXONOMY/RANGE .....	1
MORPHOLOGY/IDENTIFICATION AIDS .....	3
REASON FOR INCLUSION IN SERIES .....	4
LIFE HISTORY .....	4
Mating .....	4
Eggs and Fecundity .....	4
Larvae .....	5
Juveniles .....	5
Adults .....	6
Movements .....	7
GROWTH CHARACTERISTICS .....	7
ECOLOGICAL ROLE .....	8
THE FISHERY .....	9
Commercial Harvest .....	9
Recreational Harvest .....	9
Factors Affecting Commercial Landings .....	10
ENVIRONMENTAL REQUIREMENTS .....	11
LITERATURE CITED .....	13

## FIGURES

<u>Number</u>		<u>Page</u>
1	Rock crabs .....	1
2	Distribution of rock crabs in the Pacific Southwest .....	2
3	Larval stages of yellow crab .....	5
4	Relative abundance of brown rock crab, red rock crab, and yellow crab in four areas of the Pacific Southwest .....	6
5	Annual rock crab landings in California, 1964-86 .....	9
6	Annual rock crab catches from three fishery origin blocks in California, 1970-85 .....	11

## **ACKNOWLEDGMENTS**

We gratefully acknowledge the reviews of this manuscript by Paul Reilly and David Parker of the California Department of Fish and Game, Jeffrey Shields of the University of California at Santa Barbara, and Christopher Toole of the California Sea Grant Marine Advisory Program.

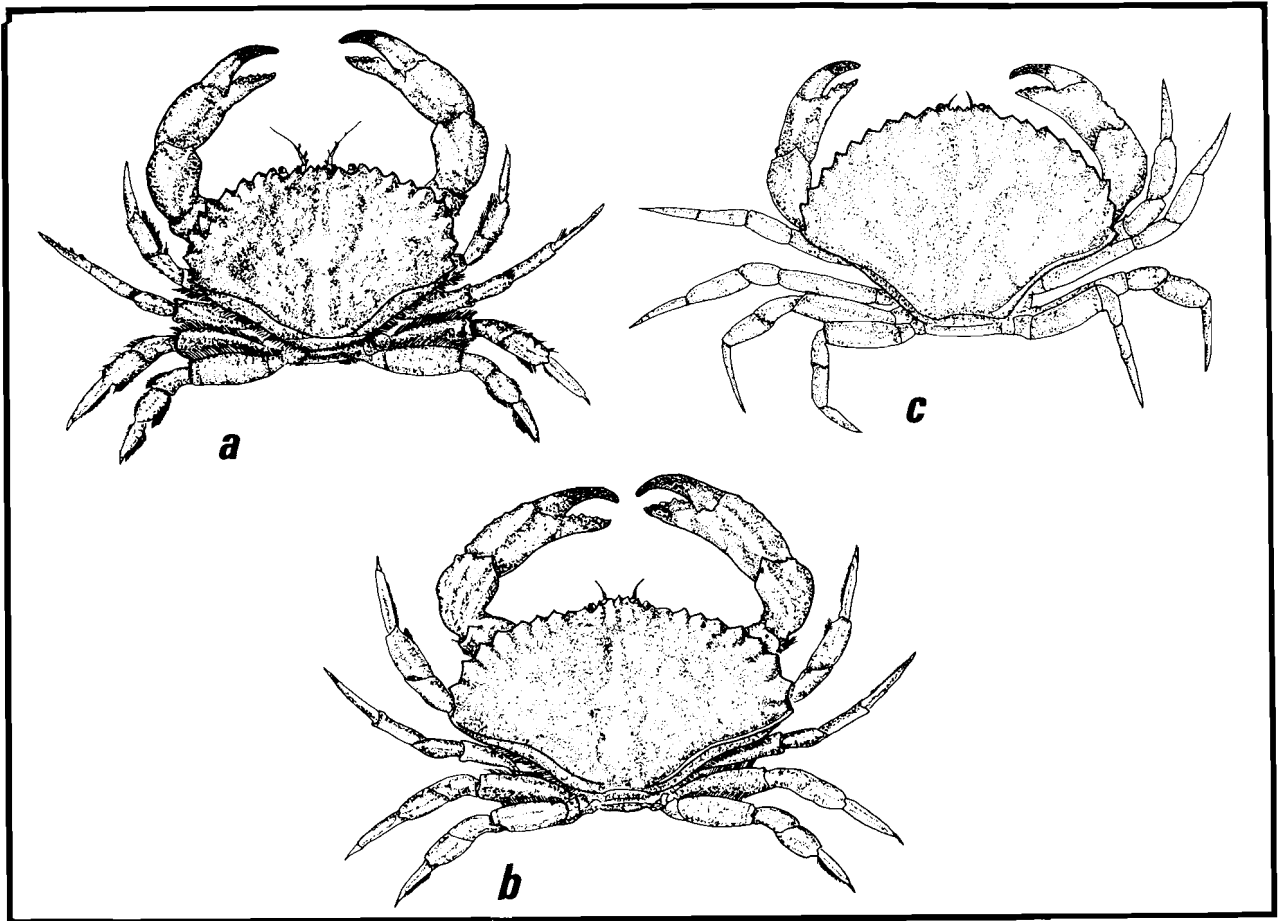


Figure 1. Rock crabs: a) brown rock crab (after Rathbun 1930); b) red rock crab (after Rathbun 1930); c) yellow crab (after Johnson and Snook 1955).

### BROWN ROCK CRAB , RED ROCK CRAB , AND YELLOW CRAB

#### NOMENCLATURE/TAXONOMY/RANGE

Scientific name.....*Cancer antennarius* Stimpson 1856  
 Preferred common name.....Brown rock crab (Figure 1a)  
 Other common names.....Rock crab, brown crab, red rock crab, spot-bellied crab

Scientific name.....*Cancer productus* Randall 1839  
 Preferred common name.....Red rock crab (Figure 1b)  
 Other common names.....Rock crab, red crab

Scientific name.....*Cancer anthonyi* Rathbun 1897  
 Preferred common name.....Yellow crab (Figure 1c)  
 Other common names.....Rock crab, gold crab

Class.....Crustacea  
 Order.....Decapoda  
 Infraorder.....Brachyura  
 Family.....Canceridae

Geographical ranges (Figure 2): rock crabs are distributed in coastal waters of the west coast of North America (Nations 1975). *Cancer antennarius* ranges from Sequim, Washington (Jensen and Armstrong 1987), to Baja California, Mexico, including Islas de Todos Santos (Schmidt 1921; Garth and Abbott 1980). Its habitat extends from the low intertidal zone to depths greater than 100 m, and includes substrates of

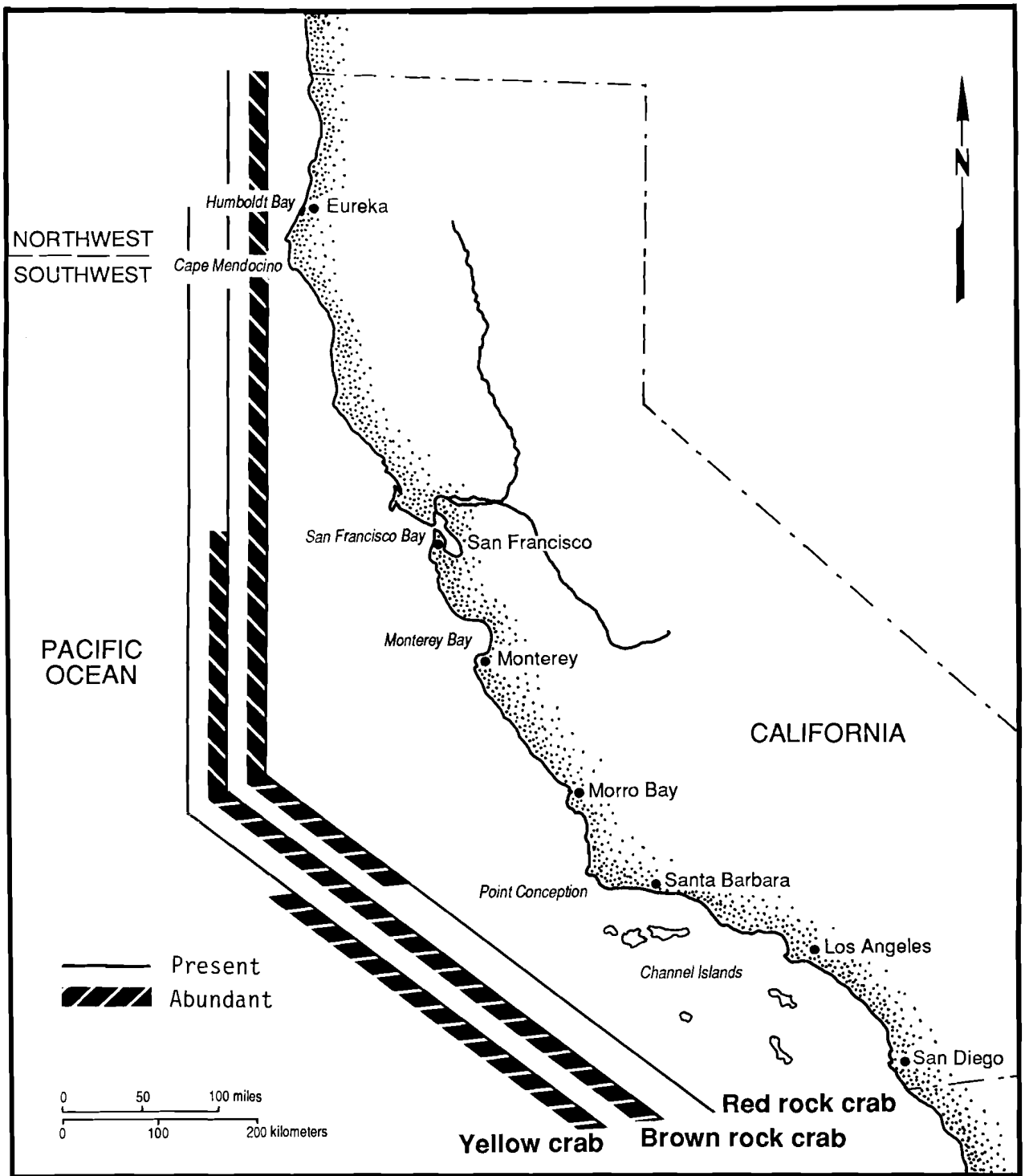


Figure 2. Distribution of brown rock crab, red rock crab, and yellow crab in the Pacific Southwest.

rocky shores, subtidal reefs, and coarse to silty sands (Winn 1985).

*Cancer productus* occurs from Kodiak Island, Alaska, to San Diego, California (Schmidt 1921). San Diego is the margin of the southern range limit though the species has been reported at Bahia Magdalena, Baja California, Mexico (Garth and Abbott 1980). The habitat of the red rock crab extends from the low intertidal zone, including bays and estuaries, to a depth of at least 91 m, and includes gravel and rocky substrates, subtidal reefs, coarse sands, and muds (Schmidt 1921).

*Cancer anthonyi* ranges from Humboldt Bay, California (Willis 1968) to Magdalena Bay, Baja California, Mexico (Schmidt 1921). Its habitat extends from the low intertidal zone, including bays and estuaries, to a subtidal depth of 140 m; it inhabits mostly silty sand to mud substrates and the sand-rock substrate ecotone of rocky reefs (Garth and Abbott 1980; Winn 1985).

## MORPHOLOGY/IDENTIFICATION AIDS

Taxonomic keys to the species of *Cancer* in California were provided by Carlton and Kuris (1975). The following morphological descriptions are adapted from Rathbun (1930). All *Cancer* species are recognized by their broad, oval, uneven but not highly sculptured carapace which has numerous anterolateral teeth. Males are distinguished by a slender abdomen and mature females by a broad abdomen that is often hirsute on the margin. Lawton and Elner (1985), who studied the morphological relationships of 10 northern temperate *Cancer* species, considered the brown rock crab, red rock crab, and yellow crab closely related primarily on the basis of similarities in claw shape.

The brown rock crab is mottled dark brown dorsally (rarely uniformly orange or gray), and has red spotting over a white background ventrally. There are nine anterolateral teeth, and the carapace is widest at the eighth tooth. Characteristic long and stout paired antennae (from which the species name is derived) arise between the retractable stalked eyes. Legs are generally rough along the edges and may be hairy, especially in

females and juveniles. The claws are black tipped with a single tooth or spine on the wrist.

Adult red rock crabs are mottled brick-red dorsally, and dirty white or yellowish white ventrally, but there are no red spots such as those on the brown rock crab. The carapace is widest at the eighth of 10 anterolateral teeth; the teeth become larger and more acute posteriorly. Red rock crabs are distinguished from other *Cancer* species by the characteristic frontal margin of the carapace between the eyes which is markedly produced as five equally-spaced teeth beyond the orbital angles (to which the species name refers). The red rock crab has a greater carapace width:carapace length ratio compared to that of brown rock crab and yellow crab. The claws are rough above and black tipped. Color of juveniles is often extremely variable ranging from pure white to a variety of color patterns including bands of brown and white, stripes of red and white, and brown stripes (Garth and Abbott 1980). The produced frontal margin is also distinct in juvenile crabs.

Adult yellow crabs are light brown to pale yellow dorsally and uniformly light yellow ventrally, without red spotting beneath. The carapace is widest at the ninth of 10 anterolateral teeth. The tips of the claws are partly or almost entirely darkened and the walking legs are generally without hair. Coloration of juveniles tends to be darker than that of adults, ranging from brown to gray. Yellow crabs are allied to the brown rock crabs, but have broader and less projecting anterolateral teeth, and less hairy legs.

Two other large *Cancer* species, the Dungeness crab (*C. magister*), and the slender crab (*C. gracilis*) also occur in the coastal areas of California. In both species the tips of the claws lack dark coloration. The Dungeness crab is widest at the 10th or last anterolateral tooth and is light brown-yellow dorsally. Additionally, it is the only species of *Cancer* in which the tip of the last abdominal segment is rounded rather than pointed (P. Reilly, California Department of Fish and Game [CDFG], Menlo Park; pers. comm.). The slender crab has a light olive coloration, slender walking legs, and only nine low anterolateral teeth.

A small species of *Cancer* in the Pacific southwest region, the hairy cancer crab (*C. jordani*), may be confused with the juvenile brown rock crab. The hairy

cancer crab, however, has 10 sharp anterolateral teeth, alternately large and small, and lacks red spotting ventrally.

## REASON FOR INCLUSION IN THE SERIES

The three rock crab species treated here contribute to a commercial fishery that has grown unevenly but steadily from 1963 to 1986. Rock crabs had been fished previously at a low level of effort since at least 1930 (Heimann and Carlisle 1970). Commercial fishery landings statistics of CDFG showed that annual landings in the mid-1980's approached 2 million lb with an ex-vessel value exceeding \$1.6 million. Declines in the stocks of other commercially important nearshore species have stimulated interest in further use of rock crab species; continued growth of the fishery is expected (D. Parker, CDFG, Long Beach; pers. comm.). The three species also support a small recreational fishery.

Rock crabs occupy a variety of coastal habitats and are an ecologically important component of the nearshore environment. As juveniles, they are important prey of numerous invertebrates and many commercially and recreationally important fishes (Van Blaricom 1982; Roberts et al. 1984). Adult rock crabs are a major food of the threatened southern sea otter (*Enhydra lutris*) along the central California coast (Benech 1986).

## LIFE HISTORY

### *Mating*

Details on seasonal and regional variability in mating for each of the three species are lacking, although a generalized description of reproduction known from other *Cancer* species may be reasonably applied (see Warner 1977). The female mates in the soft-shell condition, after molting. Soft-shell female rock crabs are most common in spring and fall, though they may be found throughout the year (Reilly 1987; CDFG, unpubl. data). A pheromone released in the urine of females before they molt attracts males and stimulates mating behavior. Yellow crabs and brown rock crabs are stimulated to pre-copulatory position and activity by pheromone concentrations as low as  $10^{-8}$  moles/l and  $10^{-10}$  moles/l, respectively (Kittredge et al. 1971). The

male carries the female, before her ecdysis, through insemination, and until initial hardening of her shell occurs. Mating involves insertion of the male gonopod into the spermatheca of the female and deposition of a spermatophore. Spermatophores contain sperm that is potentially viable for a year or longer, for multiple spawnings. Mated females (in the "plugged" condition) may be identified by the presence of the hardened spermatophore deposited in the spermatheca by the male, which presumably blocks further mating and prevents loss of sperm. Plugged yellow crabs have been most commonly found from spring to early summer in southern California (CDFG, unpubl. data). The plug is ejected during the first oviposition; multiple ovipositions may occur but no record of them has been published.

### *Eggs and Fecundity*

The eggs are fertilized internally as they are extruded, about 11 weeks after the mating, and are carried by the female during development. They appear as a bright orange mass ("sponge") attached to setae on the endopodites of the pleopods, beneath the abdominal flap. Egg-bearing ("berried" or "ovigerous") female brown rock crabs are most common in central California in winter (Carroll 1982), although ovigerous yellow crabs and brown rock crabs are present throughout the year in nearshore waters (Toole 1985; Winn 1985; Reilly 1987). Ovigerous brown rock crabs have been observed buried in sand at the base of rocks in shallow water, and are found more commonly in water less than 18 m deep in southern California (Reilly 1987). The color of the eggs progressively darkens from orange to dark brown as embryos absorb the yolk during development. A single egg mass in brown rock crabs may contain from 0.41 million to 2.79 million eggs, red rock crabs from 0.56 million to at least 1.01 million eggs, and yellow crabs from 0.68 to 3.85 million eggs (A. Hines, Smithsonian Environmental Research Center, Edgewater, MD; pers. comm.). Clutch size in the yellow crab averages over 2.6 million eggs (J. Shields, University of California, Santa Barbara; pers. comm.).

In brown rock crabs and yellow crabs, 7-8 weeks are required for development and hatching of eggs at ambient temperatures of 10-18 °C (Anderson and Ford 1976; Carroll 1982). Yellow crab eggs hatched in about 43 days at 17 °C (J. Shields, pers. comm.).



























