

# Chinese Mitten Crabs in North America

by Andrew N. Cohen

The Chinese mitten crab (*Eriocheir sinensis*) was accidentally introduced to northern Europe in the early part of this century. To prevent introductions of mitten crabs in North America, the importation of live mitten crabs was banned in the late 1980s. Nevertheless, mitten crabs established breeding populations in San Francisco Bay, California, by 1994 (Cohen & Carlton 1995). The mitten crab is now one of the few **catadromous organisms** in North America.

## Biology of Mitten Crabs

Chinese mitten crabs are native to the estuaries and rivers of the Korean and Chinese coasts from the Yellow Sea to south of Shanghai. They dig burrows in mud banks, and in coastal areas are often found in rice paddies. Some migrate far upstream; some have been found in the Changjiang (Yangtze) River over 800 miles from the sea. In late autumn and winter adult crabs

migrate to coastal waters where they mate, spawn and die. Each female produces from 250,000 to 1 million eggs, which hatch in late spring or early summer. The larvae develop through six planktonic stages, with the early stages requiring saltier water and the later stages tolerant of less salty water. After the final larval molt the juvenile crab settles to the bottom and begins its migration upstream (Panning 1939; Ingle 1986; Anger 1991).

## Mitten Crabs in Europe

A mitten crab was collected in the Aller River, Germany, in 1912, and is generally presumed to have been introduced in ballast water (Panning 1939). Mitten crabs spread through the Netherlands and Belgium to northern France by 1930 (Hoestland 1948), eventually reaching the west coast of France and, via the Garonne River and the Canal du Midi, the Mediterranean coast

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zooids, each a few millimeters in length, are embedded in a common tunic which in some species may spread out in a sheet to cover considerable space.

When W.E. Ritter (Founder of Scripps Institution of Oceanography) described the sea squirts of southern California harbors in 1909, the predominant solitary sea squirts were *Pyura haustor* and *Ascidia ceratodes*, species that are rare today. Through the years these two dominant species have been largely replaced by others that are better able to maintain space and reproduce in the ever-changing southern California harbors. By 1915 *Styela plicata* appeared in San Diego (Ritter and Forsyth, 1917) but 30 years later still had not become abundant (Van Name, 1945). *Styela clava* probably arrived in Newport Harbor during the 1920s, although it was not recorded until 1933 when it was already abundant (Abbott and Johnson, 1972). By 1949 *Ciona intestinalis* and *S. clava* dominated Newport Harbor (MacGinitie and

MacGinitie, 1949). Although huge populations of *C. intestinalis* are much rarer now than in the past, they still occur seasonally in Los Angeles and San Diego marinas. However, *S. plicata* and *S. clava* now dominate many harbors.

Additional nonindigenous species continue to appear: *Styela canopus* (formerly *S. partita*) in San Diego in 1972; *Microcosmus squamiger* in Alamitos Bay in 1986, now extremely numerous from San Diego to Ventura and Santa Catalina Island; *Ciona savignyi* in Long Beach in 1985, now abundant (seasonally) from San Diego to Santa Barbara and San Francisco Bay; *Symplegma oecania* in San Pedro in 1991, recorded in San Diego in 1994; and *Molgula manhattensis*, recorded in San Francisco Bay in the 1960s (Carlton, 1979), found in Long Beach-Newport Harbors in 1984 and now also in Marina del Rey and Ventura Bays. The newest invader is *Polyandrocarpa zorrissentis*, first observed in 1994 in San Diego and Oceanside. It will be interesting to see if it continues to spread north-

ward. It is known to be an aggressive invader; Brunetti (1978-79) first observed it in Venice Lagoon, Italy, and it has now been found in Japan (Koyama, pers. comm.).

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Summary of recent introductions observed by the authors and not reported by Fay and Johnson (1971) or Fay and Vallee (1979)

Species	Location	Year first observed
<i>Styela canopus</i>	San Diego Harbor	1972
<i>Molgula manhattensis</i>	Long Beach-Newport Harbor	1984
<i>Ciona savignyi</i>	Long Beach	1985
<i>Microcosmus squamiger</i>	Alamitos Bay	1986
<i>Symplegma oecania</i>	San Pedro	1991
<i>Ascidia interrupta</i>	San Diego Bay, Marina del Rey	1983
<i>Polyandrocarpa zorrissentis</i>	San Diego, Oceanside	1994
<i>Ascidia</i> sp.	San Diego Bay, Los Angeles	1995

*Mitten Crabs* continued from page 20 by 1959 (Hoestland 1959; Petit 1960). They became phenomenally abundant in Germany in the mid-1930s, with masses of crabs migrating up the main rivers, piling up against dams, climbing spillways and swarming over the banks onto shore, sometimes wandering onto city streets and entering houses. Government authorities operated barrel and pit traps that caught tens of millions of crabs each year in order to prevent damage to banks and levees (the crabs may dig burrows two feet deep) and to reduce interference with trap and net fisheries (Panning 1939). A similar "plague of mitten crabs" was reported from the Netherlands in 1981 (Ingle 1986).

Hundreds of adult mitten crabs have been collected along the shores of the Baltic Sea, but since the Baltic's salt content is too low for successful spawning, these crabs are generally thought to be individuals transported by ship from the North Sea (Haahtela 1963; Rasmussen 1987). Occasional mitten crabs, including a few ovigerous females, have been collected in England since 1976, though it is unclear whether breeding populations have been established there (Ingle, 1986).

#### Mitten Crabs in North America

A mitten crab was collected in the Great Lakes in 1965, and nine or ten additional adult crabs were collected between 1973 and 1994, all but one of which were taken from western Lake Erie (Nepszy & Leach 1973; J. Leach, pers. comm.). As in the Baltic, the Great Lakes do not support spawning, so each individual is believed to have arrived as a larva or juvenile in ballast water from Europe. A single adult mitten crab was collected from the Mississippi River delta in Louisiana in 1987, with none reported since then (Howarth 1989; D. Felder, pers. comm.).

In November 1994 a mitten crab was caught in a shrimp net at the southern end of San Francisco Bay and identified by Robert Van Syoc of the California Academy of Sciences. Shrimp trawlers report that they have occasionally caught such crabs, many of them carrying eggs, in the South Bay since 1992 and in San Pablo Bay (a northern embayment of San Francisco Bay) since the summer of 1994. Of 75 crabs collected from San

Francisco Bay, 24 were female, 19 of which were carrying eggs. Several ovigerous females collected in the winter of 1994-95 were maintained in aquaria by the Marine Science Institute of Redwood City, California, and hatched active zoeae by the first week of February. The number of crabs present, their persistence over several years, their broad distribution within the Bay, the range of size classes, and the presence of females carrying eggs and hatching larvae all indicate that mitten crabs are well established in San Francisco Bay (Cohen & Carlton 1995).

Mitten crabs could have arrived in the Bay either in ballast water from Asia or Europe, or they might have been intentionally introduced in the watershed as a food resource. In 1978 Dustin Chivers of the California Academy of Sciences noted that live mitten crabs could be imported into California from firms in Hong Kong and Macao. In 1986 the California Department of Fish and Game found live



An adult mitten crab; they can grow up to three inches across the shell, and their claws are sometimes covered with hair.

mitten crabs, bound with twine, offered for sale in Asian food markets in San Francisco and Los Angeles at prices of \$12.50 to \$14.50 per pound. Although importation of live mitten crabs was banned by California in 1987 and by the United States in 1989, the high price they command has encouraged continuing efforts to import them. On 11 occasions since 1989, U.S. Fish and Wildlife Service inspectors intercepted batches of as many as 28 mitten crabs hand-carried by travellers from Asia disembarking at the San Francisco Airport (H. Roche, pers. comm.), and crabs have been intercepted at Los Angeles and Seattle as well (M. Osborne and M. Williams, pers. comm.; Cohen & Carlton 1995). In 1994 a businessman lobbied the California leg-

islature for permission to import and raise mitten crabs in California (T. Gosliner, pers. comm. 1994).

The ban on importing live mitten crabs was enacted due to concern over potential damage from their burrows to levees and rice fields in the Central Valley, and because the crab is a second intermediate host of a human parasite, the oriental lung fluke *Paragonimus westermanii*. Armand Kuris and Mark Torchin of the University of California, Santa Barbara, found no parasites of any kind in 25 mitten crabs from San Francisco Bay (A. Kuris, pers. comm. 1995). Establishment of the fluke in the United States is possible, however, because snails that are suitable first intermediate hosts are present in California and adjacent states (T. Gosliner, pers. comm.), which could lead to infections of humans and other mammals. The potential effects of large numbers of river crabs on an ecosystem where none previously existed are unknown.

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