TUMSAT-OACIS Repository - Tokyo University of Marine Science and Technology (東京海洋大学)

Invasion risk assessment of Chinese mitten crab in Japan

学位名	博士(海洋科学)
学位授与機関	東京海洋大学
学位授与年度	2018
学位授与番号	12614博甲第496号
URL	http://id.nii.ac.jp/1342/00001596/

Summary of doctoral dissertation

専　攻 Major	Applied Marine Biosciences	氏　名 Name	ZHANG ZHIXIN
論文題目 Title	Invasion risk assessment of Chinese mitten crab in Japan （チュウゴクモクズガニの日本への侵入リスクに関する研究）		

The Chinese mitten crab *Eriocheir sinensis* H. Milne Edwards, 1853 is an important aquaculture species in its native range, especially in China. This species, however, becomes an annoying invasive alien species outside native distribution. This crab has successfully invaded several European and North American countries and caused substantial ecological and economic damages. This species is extremely difficult and cost-intensive to eradicate once established. Although *E. sinensis* has also been regarded as an invasive species in Japan, its invasion risk in Japan remains unclear. Besides, its possible impacts on native Japanese species remain unstudied. In my study, I developed a matrix population model for *E. sinensis* to better understand its population dynamics. In addition, I examined its competitive and predatory impacts on native Japanese mitten crab *E. japonica* under laboratory conditions.

E. sinensis is a catadromous species, which grows in summer and migrates to estuary for reproduction during winter. Based on previous published life history information, I developed a periodic matrix population model for this species. Elasticity analysis suggested that larval mortality rate and water temperature during larval stage are the most important parameters. As a result, larval stage should be most critical in the population growth of *E. sinensis*. Simulation results indicated that capturing larvae in summer and small sized crabs in winter is the most efficient control strategy. New methods should be developed to catch larvae and small sized crabs.

Invasive *E. sinensis* and native *E. japonica* share a number of similar characteristics. If Chinese mitten crab invaded Japanese ecosystems, two species may compete for limited resources, such as shelter. Shelter is important for crustaceans especially during the moult period. I studied the competition between males of two species under laboratory conditions. A resident-intruder model was adopted and crab behavior was recorded by a drive recorder. Results showed that competition between the two species was size dependent: *E. japonica* always successfully defended shelter when competing with smaller or slightly larger *E. sinensis*; *E. sinensis* only won the shelter when having a size advantage. Two species exhibited different behavioral patterns: *E. japonica* frequently displayed positive behavior including approach, weak contact by walking legs, and chela contact, while *E. sinensis* exhibited more frequent retreat behavior. The results also showed that fight duration between the two species was influenced by fighting bout and relative size difference. Fight duration of the first bout was longest and fight duration reached maximum when two species have similar fighting ability. These results suggest that the widely distributed native *E. japonica* is competitively superior and this may act as a form of biotic resistance impeding the establishment of invasive *E. sinensis* in Japan.

Both *E. japonica* and *E. sinensis* are omnivorous and opportunistic species; therefore, it is possible that large crabs may predate on smaller crabs. I tested the intra- (also known as cannibalism) and inter-specific predation by adult *E. japonica* and *E. sinensis* on juvenile *E. japonica* under laboratory conditions. Cannibalism results showed that *E. japonica* is a cannibalistic species and cannibalism only happen when size difference between predator and prey becomes large. Male crabs are more cannibalistic than females; alternative food and shelter would significantly reduce cannibalism rate. Male *E. japonica* predated on conspecifics following a type II functional response. Intra- and inter-specific predation comparison results showed that both adult *E. japonica* and *E. sinensis* predated intensively on juvenile *E. japonica*.

My studies represent the initial attempt to evaluate the invasion risk of *E. sinensis* in Japan. In addition to

competitive and predatory impacts, *E. sinensis* may negatively influence native *E. japonica* populations in other ways, such as pathogen transmission and hybridization. Further studies are required.