CURRENT TRENDS IN HATCHERY TECHNIQUES AND STOCK ENHANCEMENT FOR CHINESE MITTEN CRAB *ERIOCHEIR SINENSIS*

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Chinese mitten crab (*Eriocheir sinensis*) is a native crustacean of high economic value in China. In recent years, Chinese mitten crab culture has developed very quickly, such that its aquaculture now occurs all over China except in Tibet Province. The total production was about 368,000 t in 2003, more than 40 times the production in 1991 (China Fisheries yearbook, 2004). This increase mainly resulted from breakthroughs and improvements in hatchery techniques after 20 years of development to produce artificial seed (i.e., megalopa stage) in very large quantities. Larval rearing (5 Zoea and a postlarval Megalopa stage, i.e., Z1-Z5, M) is done in brackish water in coastal areas for subsequent transfer to inland freshwater systems for juvenile growth to market size. Based on recent statistics from the China Fisheries Bureau, the quantity of mitten crab megalops artificially produced in China has exceeded 200,000-600,000 kg per year, with production increasing each year (277,000 kg in 2001, 346,000 kg in 2002, 521,893 kg in 2003). Nearly all of the megalopa production occurs in the Yangtze River delta. For example, in 2003, total megalopa production in Jiangsu Province was 360,586 kg, while in Zhejing Province it was 37,445 kg. Using a range of hatchery techniques, juvenile mitten crabs are stocked into a variety of highly managed and natural habitats for growth to adult size for harvest.

There are two models of hatchery technique for Chinese mitten crab in China. In the first, intensive larviculture occurs in indoor concrete ponds (most 5 m x 5 m x 2 m) with temperature control (starting at 18 ºC for Zoea I (Z1) and increasing 1 ºC before every stage larvae molt to 24 ºC by the molt to meglopa), aeration and supply of live food (alage, rotifers, *Artemia* nauplii), and other foods like frozen rotifers and copepods, and egg yolk. The ZI density can be 0.2-0.5 million$\cdot m^{-3}$, and megalopa production is usually 150-500 g$\cdot m^{-3}$. From Z1 to Z3, a little pond water is changed; after Z3, the pond water is changed more and quickly; and in megelopa stage water is changed twice per day. The salinity for good rearing larvae is 20-25 ppt, although megelopa can be reared successfully in 10-30 ppt. Salinity reduction (“desaltting”) typically begins 3 days after the molt to meglopa, and at meglopa day 6-7, the salinity is reduced to <5 ppt. At this stage the meglops can be sold.

The second hatchery technique is outdoor extensive larviculture in earthen ponds with no temperature control. This technique also has two variations. One in Zejiang Province uses small (400-700 m^2) aerated ponds. The density of Z1 in ponds is 20,000-30,000 m^{-2}, and meglopa production is 15-30 g$\cdot m^{-2}$ (150-300 kg$\cdot ha^{-1}$). Z1 and Z2 are mainly fed with soybean milk and *Spirulina* powder, while Z3-megalopa are

mainly fed with *Artemia* nauplii, frozen adult *Artemia* and copepods. During larviculture, the temperature ranges from 10-23 ºC, the duration is from about April 20 to May 20.

A second variation on outdoor culture is in big ponds (about 1-1.5 ha) without aeration in Jiangsu Province. The density is <0.1 millon m^{-2}, but the meglopa yield is not stable and varies from 1-7.5 $g \cdot m^{-2}$ (10-75 $kg \cdot ha^{-1}$). The larvae in all stages are mainly fed with rotifers, which are also reared in nearby earthen ponds. The ratio of pond area for rotifer culture to crab larval is 1:1. In later stages, especially Z5 to meglopa, and only in some cases, rotifers may be supplemented with the frozen copepod or adult *Artemia*.

The key to sucessful hatchery techniques is to obtain good broodstock. Broodstock nutrition is crucial during gonadal development in fall (beginning in late Sept to early Oct). Good diets consist of formulated feeds or natural food such as razor clams.

Stock enhancement of the mitten crab focuses on releases of seed crabs cultured in net enclosures in lakes. The seed crab stage occurs after juveniles molt 7-8 times during May to November in earthen ponds, and the seed crab size is about 2-3 cm carapace width), called ‘coin sized’ crab (140-280 per kg). It is important to control precocious maturation of crabs; otherwise they do not grow and they die the next April.

Habitat characteristics are important for net enclosure culture, including abundant water plants (80% of water area), good water quality, slow water flow, and suitable depth (1-2 m). Combined culture may occur in large fenced areas in ponds and lakes. The benefits are that water quality is better; the crabs can move in a larger space; food is abundant; and culture density is comparatively low. Also, larger and better quality crabs are produced, survival can be 40-50%, costs are lower, and economic benefits are higher. Production of adult crabs is usually l50-450 $kg \cdot ha^{-1} \cdot$ However, because the mitten crab is omnivorous, culture in net enclosures usually destroys the lake vegetation. Consequently, net enclosure culture is now organized to protect water plants by combining or alternating mitten crab culture with culture of shrimp and fish. Also, some water grass (e.g., *Vallisneria spiralis*, *Elodea* sp. *Hydrilla verticillata*) are often planted before stocking mitten crab.

Freshwater marshes are suitable for crab growth - the cost is very low and the sizes of adult crabs are larger and their quality is good. However, the harvest rate is very low, and the production is only 50-200 $kg \cdot ha^{-1}$. Release of the Chinese mitten crab into rice fields is a newly developed polyculture system in the Liao area of north China. Small amounts of fertilizer are required, insect pests can be killed and weeds may be removed. As a result, rice production increases. In addition, reconstructed rice fields are suitable for adult crab production. As a rule, the rice fields can achieve higher production than prior to mitten crab stocking, and the production of adult crabs is about 300-450 $kg \cdot ha^{-1}$, and even as high as 750 $kg \cdot ha^{-1}$.