Current Status of *Eriocheir sinensis* Larviculture in China

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World Distribution
Chinese Mitten Crab
*Eriocheir sinensis*

- Carapace 8-10 cm;
- BW 100-200 g

- Only being cultured in China
- Only favored by Chinese people
Crabs identified with laser tag
Competition for the largest size and best quality
Geographical Distribution in China

- Liaohe River population
- Yangtze River population
  - Fastest growth
  - Biggest body size
  - Most valuable
- Ou River population
Natural Resources in China

- Megalopa yield
  - Overfishing
- Dam construction
  - Adult fishery
Megalopa Production

Megalopa yield (Kg)

637,758 kg in 2005
Aquaculture Production

1993-2003 Production increase

Since 2004 Quality enhancement

500,000 mt, 2.2 billion USD increase in 2007

Annual yield (*10^3 mt)

93 94 95 96 97 98 99 00 01 02 03 04 05 06 07
Aquaculture Operation

Broodstock management (3-4 months)

- Broodstock selection (wild or farmed)

  - Mating (13-15°C)

  - Berried female maintenance over winter

  - Ambient temp.

  - Fertilized eggs incubation

  - 15-20°C

Larval rearing (20-30 days)

- Z1

  - 21-24°C

  - Z5

  - Meagalopa temperature ↓

  - Salinity ↓

Growout (1 or 2 years)

- Juvenile crab

  - Yellow crab

  - Green crab

  - Market

- Market
Larval Rearing Techniques

- Indoor Intensive Larviculture
- Outdoor Semi-Extensive Larviculture
- Outdoor “Ecological” Larviculture
**E. sinensis Larviculture Models**

<table>
<thead>
<tr>
<th></th>
<th>Indoor Intensive Larviculture</th>
<th>Outdoor Semi-intensive Larviculture</th>
<th>Outdoor “Ecological” Larviculture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ponds</strong></td>
<td>concrete</td>
<td>earthen</td>
<td>earthen</td>
</tr>
<tr>
<td><strong>Size (m²)</strong></td>
<td>12-30</td>
<td>400-700</td>
<td>10,000-15,000</td>
</tr>
<tr>
<td><strong>Stocking density of Z1 (ind/ m³)</strong></td>
<td>200,000-500,000</td>
<td>20,000-30,000</td>
<td>&lt; 10,000</td>
</tr>
<tr>
<td><strong>Diets for Z1-Z5</strong></td>
<td>Microalgae, egg yolk, Artemia nauplii, frozen rotifer and copepod</td>
<td>Microalgae, soybean milk, Artemia nauplii</td>
<td>Microalgae, rotifer</td>
</tr>
<tr>
<td><strong>Diet for Z5-M</strong></td>
<td>Artemia nauplii, frozen adult Artemia and copepod</td>
<td>Artemia nauplii, frozen adult Artemia and copepod</td>
<td>Live rotifer, frozen adult Artemia and copepod</td>
</tr>
<tr>
<td><strong>Antibiotics</strong></td>
<td>Yes (occasionally)</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
### E. sinensis Larviculture Models

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</tr>
</thead>
<tbody>
<tr>
<td><strong>Probiotics</strong></td>
<td>Only in Z1-Z2</td>
<td>Yes</td>
<td>Yes (occasional)</td>
</tr>
<tr>
<td><strong>Megalopa yield (g/ m³)</strong></td>
<td>150-500</td>
<td>15-30</td>
<td>1-7.5</td>
</tr>
<tr>
<td><strong>Survival to megalop (%)</strong></td>
<td>10-15</td>
<td>5-10</td>
<td>2-4</td>
</tr>
<tr>
<td><strong>Cost (RMB/ kg megalop)</strong></td>
<td>600-1200</td>
<td>500-1000</td>
<td>300-500</td>
</tr>
<tr>
<td><strong>Duration of larviculture</strong></td>
<td>22-24 days</td>
<td>28-30 days</td>
<td>28-30 days</td>
</tr>
<tr>
<td><strong>Water temperature (°C)</strong></td>
<td>18-24</td>
<td>10-23</td>
<td>10-23</td>
</tr>
</tbody>
</table>
Outdoor Extensive Larviculture

Algae and rotifer culture ponds

Fertilizer ponds
Scientific Research on Mitten Crab Hatchery Techniques

(Shanghai Ocean University, China / Gent University, Belgium)
Our publications


Effect of Dietary PL on GSI/HSI During Ovary Maturation (after 3 months feeding)

- Significant lipid mobilization from hepatopancreas to ovary
- Higher dietary PL significantly improve ovary maturation
## Effect of PL on Reproductive Performance

<table>
<thead>
<tr>
<th></th>
<th>Diet 1 (0% PL)</th>
<th>Diet 2 (1.2% PL)</th>
<th>Diet 3 (2.4% PL)</th>
<th>Diet 4 (3.6% PL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spawning rate (%)</td>
<td>81</td>
<td>81</td>
<td>92</td>
<td>95</td>
</tr>
<tr>
<td>No. of eggs / female (*10^4)</td>
<td>30.8 b</td>
<td>33.9 b</td>
<td>39.4 ab</td>
<td>41.1 a</td>
</tr>
<tr>
<td>Fecundity (No. of eggs / g female)</td>
<td>2957 c</td>
<td>3312 bc</td>
<td>3825 ab</td>
<td>4106 a</td>
</tr>
<tr>
<td>Egg diameter (μm)</td>
<td>351</td>
<td>343</td>
<td>345</td>
<td>342</td>
</tr>
<tr>
<td>Hatching rate (%)</td>
<td>54</td>
<td>55</td>
<td>51</td>
<td>50</td>
</tr>
</tbody>
</table>

- Egg production and fecundity increase significantly with increasing dietary PL
Effect of dietary HUFA on the HUFA Content in Tissues

- Significant correlation between dietary HUFA content and HUFA content in hepatopancreas, ovary and eggs

- Relatively higher HUFA content in ovary and eggs, indicates certain HUFA requirement during ovary maturation
Effect of Dietary n-3 HUFA on Larval Growth and Survival

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Larval stage index (LSI)</th>
<th>dry BW (μg)</th>
<th>Survival (%)</th>
<th>Cumulative stress index (CSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICES 0/-</td>
<td>5.83 (^{bc})</td>
<td>957 (^{b})</td>
<td>20.0 (^{a})</td>
<td>69 (^{b})</td>
</tr>
<tr>
<td>ICES 30/0.6</td>
<td>5.92 (^{ab})</td>
<td>1203 (^{a})</td>
<td>22.0 (^{a})</td>
<td>62 (^{ab})</td>
</tr>
<tr>
<td>ICES 50/0.6</td>
<td>5.99 (^{a})</td>
<td>1203 (^{a})</td>
<td>18.2 (^{a})</td>
<td>57 (^{a})</td>
</tr>
<tr>
<td>Control</td>
<td>5.74 (^{c})</td>
<td>973 (^{b})</td>
<td>24.7 (^{a})</td>
<td>85 (^{c})</td>
</tr>
</tbody>
</table>

- n-3 HUFA significantly improved LSI, BW and CSI, but did not affect survival
- Total HUFA level of 17 to 18 mg g\(^{-1}\) dw in rotifers and *Artemia* is optimum for larvae growth and survival
Cumulative Mortality of Megalopa

(transferred from 20 to 60 g L\(^{-1}\))

Osmotic tolerance of megalopa significantly improved with increasing dietary n-3 HUFA levels
## Effect of Dietary DHA/EPA ratio on Larval Growth and Survival

<table>
<thead>
<tr>
<th>Treatment</th>
<th>LSI</th>
<th>Dry BW (ug)</th>
<th>Survival (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Rotifers / Artemia)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.6 / 0.6</td>
<td>5.93&lt;sup&gt;a&lt;/sup&gt;</td>
<td>487&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>52.3&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>0.6 / 4</td>
<td>5.99&lt;sup&gt;a&lt;/sup&gt;</td>
<td>563&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>61.9&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2 / 0.6</td>
<td>5.93&lt;sup&gt;a&lt;/sup&gt;</td>
<td>533&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>67.5&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2 / 4</td>
<td>5.94&lt;sup&gt;a&lt;/sup&gt;</td>
<td>553&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>65.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>4 / 0.6</td>
<td>5.94&lt;sup&gt;a&lt;/sup&gt;</td>
<td>577&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>65.2&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>613&lt;sup&gt;a&lt;/sup&gt;</td>
<td>66.5&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Control</td>
<td>5.80&lt;sup&gt;b&lt;/sup&gt;</td>
<td>423&lt;sup&gt;c&lt;/sup&gt;</td>
<td>50.0&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

- Larvae continuously receiving diets with lower DHA/EPA ratio had significantly lower LSI, survival and BW.
- DHA/EPA ratio of 1.2 and 0.3 in rotifers and *Artemia* are optimal for larvae growth and survival.
Osmotic tolerance of Z5 significantly improved with increasing dietary DHA/EPA ratio.
Feeding Strategy of Zoeal Larvae

- Rotifers are ideal food for early larval stages (Z1/ Z2), Artemia should be introduced from Z3/ Z4 onwards

- Optimal rotifer feeding density for Z1 and Z2: 15 and 20 rotifers/ mL with initial Z1 stocking density of 200 ind./ mL

- Optimal Artemia density for Z3, Z4 and Z5: 3, 5 and 8/ mL with initial Z3 stocking density of 150 ind./ mL
Future Perspectives

- Nutritional enhancement of broodstock through formulated dry diets
- Formulated dry diets for zoeal larvae
- Indoor intensive hatchery technique improvement
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