Selectivity of traps for blue swimming crab in Trang province

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Abstract: The blue swimming crab (Portunus pelagicus) is an important commercial species in Trang province, Thailand. This study aims to investigate the selectivity of the three types of traps for this species and analyse the probability of capture with respect to inner carapace width (ICW). Blue swimming crabs were randomly sampled on a monthly basis (October 2010 to July 2011) from the catches of small-scale fishers in three fishing villages: Ban Chang Lang, Ban Nam Rab and Ban Haad Sum Ran. The total numbers of crab from those three villages were 1,208, 1,357 and 1,555 respectively. The ICW ranged between 4.75-13.25 cm, 5.25-14.00 cm and 5.25-14.00 cm respectively. The size at first capture (ICWc) and selection range were 7.74 (7.04-8.42) cm in the fixed box trap, 9.31 (8.69-9.93) cm in the collapsible vertical trap and 9.41 (8.65-10.17) cm in the collapsible box trap. The selection factor (SF) of the three types of trap were 1.80, 1.86 and 3.14 respectively. This study shows that the ICWc from the fixed box traps is smaller than the crab size at 50% maturity (ICWm50%= 7.80 cm) and that the crab stock is therefore at risk from the use of the fixed box trap. Moreover, the catch composition among the three gear types also shows variation with respect to the fishing ground and seasonal shift related to climate change.

Keywords: blue swimming crab, Portunus pelagicus, crab traps

INTRODUCTION

The blue swimming crab (Portunus pelagicus Linnaeus, 1758) is an important commercial resource for small-scale fisheries throughout the Indo-West Pacific from Africa to India, South-east Asia and Australia [1-3]. In Thailand, they are a major source of livelihood for small-scale fishers in many parts of the Andaman Sea and Gulf of Thailand [4]. The production of blue swimming crab in Thailand during 2005 was approximately 3,000 metric tons [5]. However, in 2008 exports fell rapidly
due to low production, as measured in terms of the quantity of fishing gear. Moreover, the size of the blue swimming crabs was also smaller than in the previous years [6-7].

Traps are a major type of gear for catching blue swimming crab apart from bottom gillnets. Since traps were introduced from Japan in 1981, there has been intensive fishing by small-scale fishers, who set 100-300 traps per boat [8]. In Trang province, southern Thailand, there are three types of traps, namely fixed box trap, collapsible vertical trap and collapsible box trap. Boutson et al. [8] reported that 32-42% of blue swimming crabs in Thailand are immature based on onboard monitoring. Nitiratsuwana et al. [9], and Jindalikit [10] reported that 64.2% of the total landings on the Trang coast are small-sized.

Gear selectivity is one of the most important pieces of information needed to develop measures for the sustainable management of the blue swimming crab fishery. The aim of this study is to investigate the selectivity of three types of crab trap in terms of inner carapace width (ICW) and selection factor (SF) by analysing the probability of capture.

METHODS

Study Area

This study was conducted in Trang province in southern Thailand along 119 km of coast between longitude 99° 10’-99° 35’ E and latitude 7° 5’-7° 27’ N (Figure 1). That area supports a large part of the landing (around 30%) of blue swimming crab from the Andaman Sea and covers an area of 650 km² including the intertidal zone down to 5-15 m in depth.

![Figure 1. Map of fishing villages and sampling sites in Trang province, Thailand](image-url)
Sample Collection

Blue swimming crabs were collected on a monthly basis during October 2010 - July 2011 from small-scale fishers in three fishing villages: Ban Chang Lang in Sikao district, Ban Nam Rab in Kantang district and Ban Haad Sum Ran in Haad Sum Ran district. Each village used different types of trap. A traditional fixed box trap (30x45x20 cm) covered with a red polyethylene net with mesh size (m) of 4.3 cm (Figure 2a) was used in Ban Chang Lang, where fishers set an average of 100 traps per day per boat. The second type of trap was a collapsible vertical trap with a diameter of 50 cm covered with a green polyethylene net with mesh size of 5.0 cm (Figure 2b). It was used in Ban Nam Rab, where fishers set an average of 180 traps per day per boat. The third type of trap was the common collapsible box trap (35x50x20 cm) covered with a green polyethylene net with mesh size of 3.0 cm (Figure 2c). It was used in Ban Haad Sum Ran, where fishers set an average of 700 traps per day per boat.

A sample of 120 crabs was drawn from the total landing at each sampling site per month. Each crab was sexed, weighed and the inner carapace width (ICW) measured.

![Sample Collection](image)

**Figure 2.** Three types of trap used to capture blue swimming crabs on the coast of Trang

Data Analysis

Selection curves were generated by the probability of capture method \([8, 11]\) using the ‘solver’ tool in Microsoft Excel. The size at first capture (ICW\(_c\)) and the selection range (ICW\(_{25}\% - \text{ICW}_{75}\%\)) were estimated using mesh size (m). Selection factor (SF) and optimum mesh size (m\(_o\)) in each gear type were estimated by comparing the size at 50% maturity (ICW\(_{m50}\%\)) of female crabs.\([9]\):

\[
SF = \frac{\text{ICW}_{m50}\%}{m}
\]
RESULTS AND DISCUSSION

The total number of blue swimming crabs during October 2010 - July 2011 caught by each gear type was as follows: 1,208 (males 651, females 557) by fixed box trap; 1,357 (males 662, females 695) by collapsible vertical trap; and 1,555 (males 810, females 745) by collapsible box trap. The ICW ranged between 4.75-13.25 cm for fixed box trap, 5.25-14.00 cm for collapsible vertical trap, and 5.25-14.00 cm for collapsible box trap (Figure 3). The size at first capture (ICW_{50%}) and selection range (ICW_{25%} - ICW_{75%}) were 7.74 (7.04-8.42) cm, 9.31 (8.69-9.93) cm and 9.41 (8.65-10.17) cm for the fixed box trap, the collapsible vertical trap and the collapsible box trap respectively. The selection factor (SF) of the three types were 1.80, 1.86 and 3.14 respectively (Table 1 and Figure 4).

The optimum mesh size (m_o) in each gear type (fixed box trap, collapsible vertical trap and collapsible box trap) were 4.40, 4.20 and 2.50 cm respectively.

\[ m_o = \frac{ICW_{50\%}}{SF} \]

**Figure 3.** Size distributions of blue swimming crabs from three trap types
Table 1. Selectivity parameters of three trap types

<table>
<thead>
<tr>
<th>Gear types</th>
<th>Sex</th>
<th>Mesh size of gear (cm)</th>
<th>ICW&lt;sub&gt;25%&lt;/sub&gt; (cm)</th>
<th>ICW&lt;sub&gt;50%&lt;/sub&gt; (cm)</th>
<th>ICW&lt;sub&gt;75%&lt;/sub&gt; (cm)</th>
<th>SF</th>
<th>M&lt;sub&gt;o&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed box trap</td>
<td>Male</td>
<td>6.49</td>
<td>7.39</td>
<td>8.28</td>
<td>1.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>6.76</td>
<td>7.49</td>
<td>8.21</td>
<td>1.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Combined</td>
<td>4.3</td>
<td>7.04</td>
<td>7.74</td>
<td>8.42</td>
<td>1.80</td>
<td>4.40</td>
</tr>
<tr>
<td>Collapsible vertical trap</td>
<td>Male</td>
<td>8.60</td>
<td>9.22</td>
<td>9.83</td>
<td>1.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>8.56</td>
<td>9.28</td>
<td>9.99</td>
<td>1.86</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Combined</td>
<td>5.0</td>
<td>8.69</td>
<td>9.31</td>
<td>9.93</td>
<td>1.86</td>
<td>4.20</td>
</tr>
<tr>
<td>Collapsible box trap</td>
<td>Male</td>
<td>8.72</td>
<td>9.43</td>
<td>10.14</td>
<td>3.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>8.60</td>
<td>9.38</td>
<td>10.16</td>
<td>3.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Combined</td>
<td>3.0</td>
<td>8.65</td>
<td>9.41</td>
<td>10.17</td>
<td>3.14</td>
<td>2.50</td>
</tr>
</tbody>
</table>

Note: Size at 50% maturity of female blue swimming crabs in Trang province is 7.80 cm

Figure 4. Selectivity curves for blue swimming crabs from three trap types

Traps are known to be selective with respect to species and size of catch, which is related to passive behaviours and the attraction of appropriate bait. The ICW<sub>50%</sub> of the catch in collapsible vertical traps and collapsible box traps (Table 1) was higher than the size at 50% maturity reported by Nitiratsuwan et al. [9]. The ICW<sub>50%</sub> from fixed box traps, on the other hand, was smaller than the maturity size. The variation of ICW<sub>50%</sub> among trap types was also due to the differences among fishing grounds, which were clearly separated because of movements of blue swimming crabs between near-shore and off-shore areas [8].

It is shown in this study that for the fixed box trap, the size at first capture (ICW<sub>c</sub>) was less than the size at maturity (ICW<sub>m50%</sub>) for female broodstock. If ICW<sub>m50%</sub> was considered, the fishermen should change the fixed box trap mesh size. By applying the concept of optimum mesh size (M<sub>o</sub>), the mesh size of the fixed box trap should be enlarged to 4.50 cm to reduce the impact on immature stock. Optimum mesh size can reduce the destruction of young populations without reducing the catch efficiency for crabs of marketable size [8]. Selection performance is a critical point in the construction of many gear types. For example, mesh size modification in Japan and increase in the number of trap funnel entrances have improved trap fisheries according to studies on selectivity and catch efficiency.
[12, 13]. Bigger mesh sizes on traps have been shown to be more efficient for larger blue swimming crabs while reducing by-catch [14]. These concepts can also be applied to the future management of crab trap fisheries in the coastal waters of Trang.

CONCLUSIONS

Traps are an effective small-scale fishing gear for catching blue swimming crabs in Trang. Catch composition varies among the three gear types and fishing grounds. The management measure recommended from this study is based on the minimum size at maturity of the blue swimming crab. However, before any change in the legal mesh size of fixed box traps is implemented, further information on crab biology, socio-economic factors and the fishing grounds is required to properly assess the status of blue swimming crab stocks along the coast of Trang. Moreover, the catch composition among the three gear types also shows variation with respect to the fishing ground.

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