

Increasing Population of Blue Swimming Crab (*Portunus pelagicus* Linnaeus, 1758) Through Stock Enhancement: A Case Study in Boonkong Bay, Sikao District, Trang Province, Thailand

Thongchai Nitiratsuwan^{1*}, Kansinee Panwanitdumrong¹ and Chansawang Ngamphongsai^{2,3}

ABSTRACT

Blue swimming crab (BSC) is an economically important species in Thailand. Due to the high market demand for BSC, this resource is rapidly declining. Stocking program is one of the strategies to help recover the decreasing population of this species. Seagrass bed is considered to be a suitable release site for the new stock. In this study, BSC distribution both before and after stocking was studied in Boonkong Bay, Sikao District, Trang Province, Thailand. Crab traps (1.5 inch mesh size) were used to collect BSC. Data were collected for four months and then analyzed to determine the distribution of BSC by interpolation function of geographic information system (GIS). The results showed that crab number was low (1 and 2 crabs/month) in September and October 2011. On July 9, 2013, thirty thousand young crabs (23 days after hatching) were released. In September 2013, the number of crabs increased (19 crabs/month), with an average size of 8.01-10.00 cm (medium size). In October 2013, the number of crabs decreased (11 crabs/month). The large size class (10.01-12.00 cm) was found extensively near the bay mouth. The results showed that there is potential for successful BSC stock enhancement in seagrass bed areas.

Keywords: Thailand, geographic information system, crab trap, release site, interpolation

INTRODUCTION

There are many protocols in stock enhancement, and a stocking program is one of them. A stocking program refers to the release of aquaculture stock to recover the declining natural population (Bell *et al.*,

2006). There are many attempts on stock enhancement worldwide, for example, in Japan, which have been conducting trials on stock enhancement since 1964. The assessments of over 40 projects found that only 4 were successful. One of the important success factors is releasing stock in a suitable

¹Faculty of Science and Fisheries Technology, Rajamangala University of Technology, Srivijaya, Sikao District, Trang 92150 Thailand

²Center of Excellence for Marine Biotechnology, Chulalongkorn University, Bangkok, Thailand

³National Center for Genetic Engineering and Biotechnology, National Science and Technology Development Agency, PathumThani, Thailand

*Corresponding author: nitiratsuwan@gmail.com

area. If the new stock to be released are in their larval stages, the site should be the nursing ground of the species (Hamasaki and Kitada, 2006). Apart from kuruma shrimp, there were stock enhancement projects of other 73 species which have been bred from hatcheries (Fushimi, 2001). In Denmark, there was a stock enhancement project of turbot *Psetta maxima* (Linné, 1758) which resulted in increased natural population (Støttrup *et al.*, 2002). In Thailand, stock enhancement projects have been operating due to the decline of BSC resource, from 36,305 tons in 2001 to 20,582 tons in 2011 (FAO, 2014).

Seagrass bed is the habitat of small size BSC where a higher density was found (Nitiratsuwan *et al.*, 2010; Tipamas, 2006). Seagrass bed is a nursing, feeding and hiding ground for larvae of aquatic organisms especially the aggressive species, like blue crab (*Callinectes sapidus*) (Lipcius *et al.*, 2005; Seitz *et al.*, 2005). These blue crabs had a better growth rate in these habitats than those in areas without seagrass (Perkins-Visser *et al.*, 1996). Kenyon *et al.* (1999) compared the abundance of fish and crustacean postlarvae on portable artificial seagrass units to the empty units, and found a higher number of BSC in the former than the empty units. Varin *et al.* (2004) also reported that the survival rate of BSC postlarvae was higher when artificial seagrass was used as a shelter compared to the use of other shelter materials.

Geostatistic method has been used to evaluate sea urchin (*Paracentrotus lividus*) distribution especially in small areas (Addis *et al.*, 2009). BSC distribution in Trang Province

was also studied using the geostatistic method and found that the small BSC densely inhabited seagrass areas (Nitiratsuwan *et al.*, 2010). This information could be used for BSC spatial management (Nitiratsuwan and Jantarachote, 2009).

The objective of this research was to study BSC stock increase from stock enhancement and distribution of BSC by density and size. All data were analyzed by GIS.

MATERIALS AND METHODS

Study area

Trang Province is situated in southern Thailand, on the Andaman coast. Boonkong Bay (BB) is next to Pak Meng Beach. There is a mangrove area in the south. The north is open to the Andaman Sea. BB is in the intertidal zone with water depth ranging between 2 meters at high tide and 1 meter at low tide. The lower area, near the mangrove, is muddy but the middle is muddy sand covered mostly with *Thalassia hemprichii*, followed by *Halophila ovalis*, *Enhalus acoroides* and *Cymodocea rotundata*. The area is 189,063 m². Systematic sampling points were set at 100 meters equidistant. There were 26 sampling points with interval distance of 100 m (Figure 1).

Collection and sampling methods

The crab trap is a suitable equipment for collecting BSC data (Archdale *et al.*, 2006; 2007). In this study, 26 crab traps (35x50x20 cm, stretched mesh size 1.5

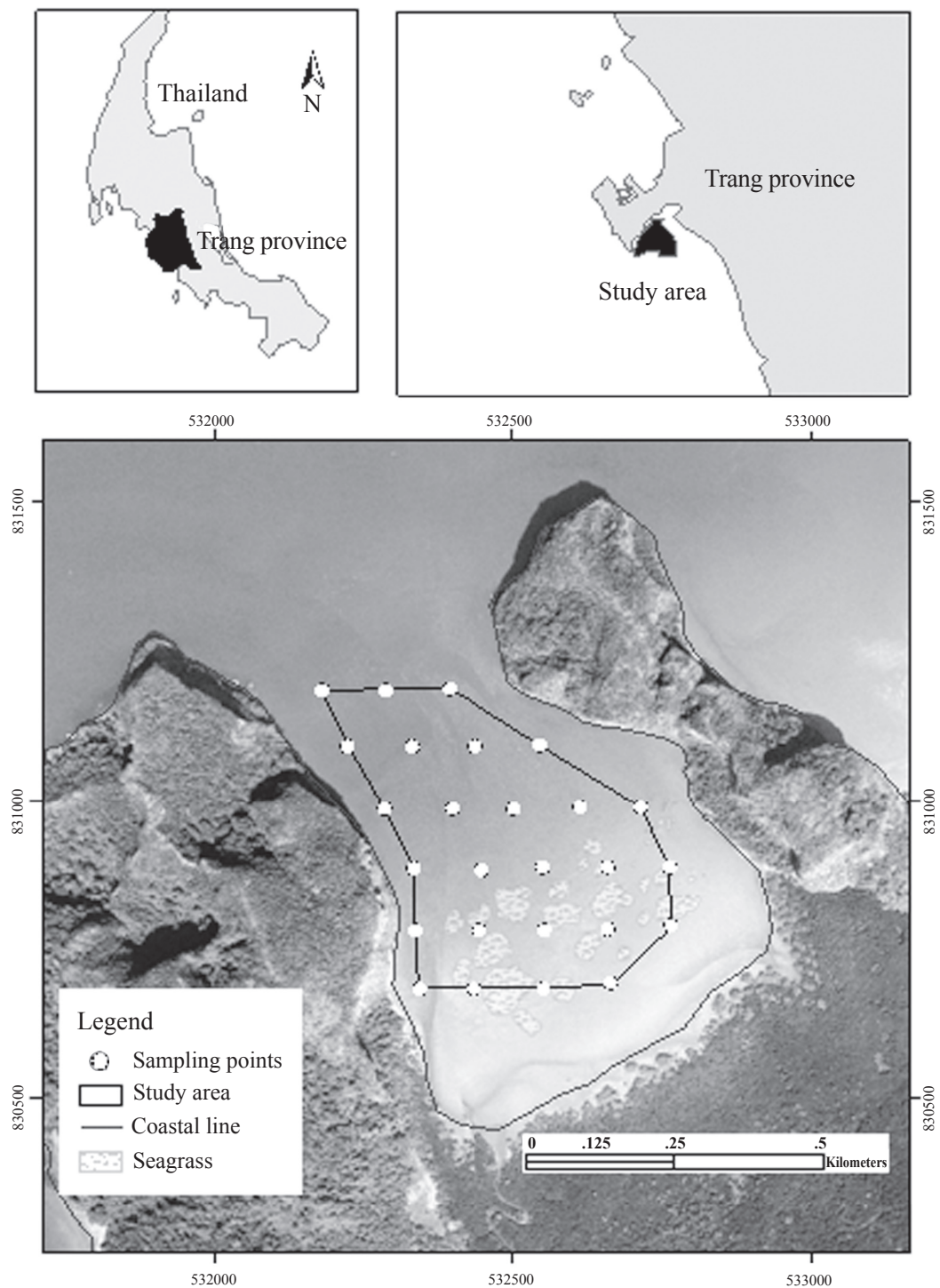


Figure 1. Aerial photograph of the study area with sampling points in Boonkong Bay, Sikao District, Trang Province, Thailand

inches), were placed in prepared sampling points. Trash fish was used as bait and put in the trap. Buoys were used to mark the sampling sites. The traps were collected 24 hours after placing the traps in the study area.

Data on crab numbers and carapace width (cm) collected in September and October 2011 (beforestock enhancement), and in September and October 2013 (afterstock enhancement) were compared.

Thirty thousand young crabs (age 22 days after hatching) were released onto the seagrass bed in July 2013.

Data analysis

Monthly histogram of BSC was classified by sex and carapace width. BSC carapace widths in September and October 2013 were compared using t-test. Distributions of BSC catch rate (crabs/trap/day) were analyzed, as follows: a) Summation of BSC numbers per trap, b) Interpolation of data from a) by IDW (Johnston *et al.*, 2003) using Arc GIS Version10, c) Spatial analysis of BSC catch rate (count of less than 0.5 crab/trap/day is assumed zero). The distribution of BSC by carapace width (average carapace width in each trap) was also analyzed by IDW.

RESULTS AND DISCUSSION

BSC Density

Before stocking, the number of BSC in Boonkong Bay in September and October 2011 was 1 and 2 crabs/month, respectively. After the new stock was released in July 2013,

the number of BSC (92 and 122 days after hatching) in September and October 2013 was 19 and 11 crabs/month, respectively (Figure 2). The carapace width of the crabs were 9.1 ± 1.2 and 11.2 ± 1.0 cm (t-test = 4.3, $p < 0.01$), respectively. The carapace widths were similar to those of the BSC in earthen ponds at 85, 115 and 145 days after hatching which were 6.0-8.0, 7.5-10.5 and 8.5-11.0 cm, respectively (Kedmuean *et al.*, 2004), and BSC (90 and 120 days after hatching) with carapace width of 4.5-8.5 and 7.5-10.0 cm, respectively (Thepphanich *et al.*, 2008).

Distribution of BSC by catch rate

In September 2013, after stock enhancement, distribution was scattered over 50% of the study area. High catch rate of BSC (2.1-3.0 crab/trap/day) was found in the middle of the study area, whereas the average catch rate (1.1-2.0 crab/trap/day) was found in the bay mouth and low catch rate (0.5-1.0 crab/trap/day) was found near the mangrove area.

In October 2013, BSC was distributed in a smaller area, by the bay mouth (Figure 3). The same results were found by Nitiratsuwan *et al.* (2009) whereas the small size BSC were found with higher density in the middle of the bay, and the larger size with lower catch rate were found in the bay mouth area.

BSC distribution by carapace width

In September after the new stock was released, the BSC was found in over 50% of the study area, with carapace widths of 8.1-10.0 cm. In October 2013, the BSC was also scattered over 50% of the area with carapace widths of 10.1-12.0 cm (Figure 4).

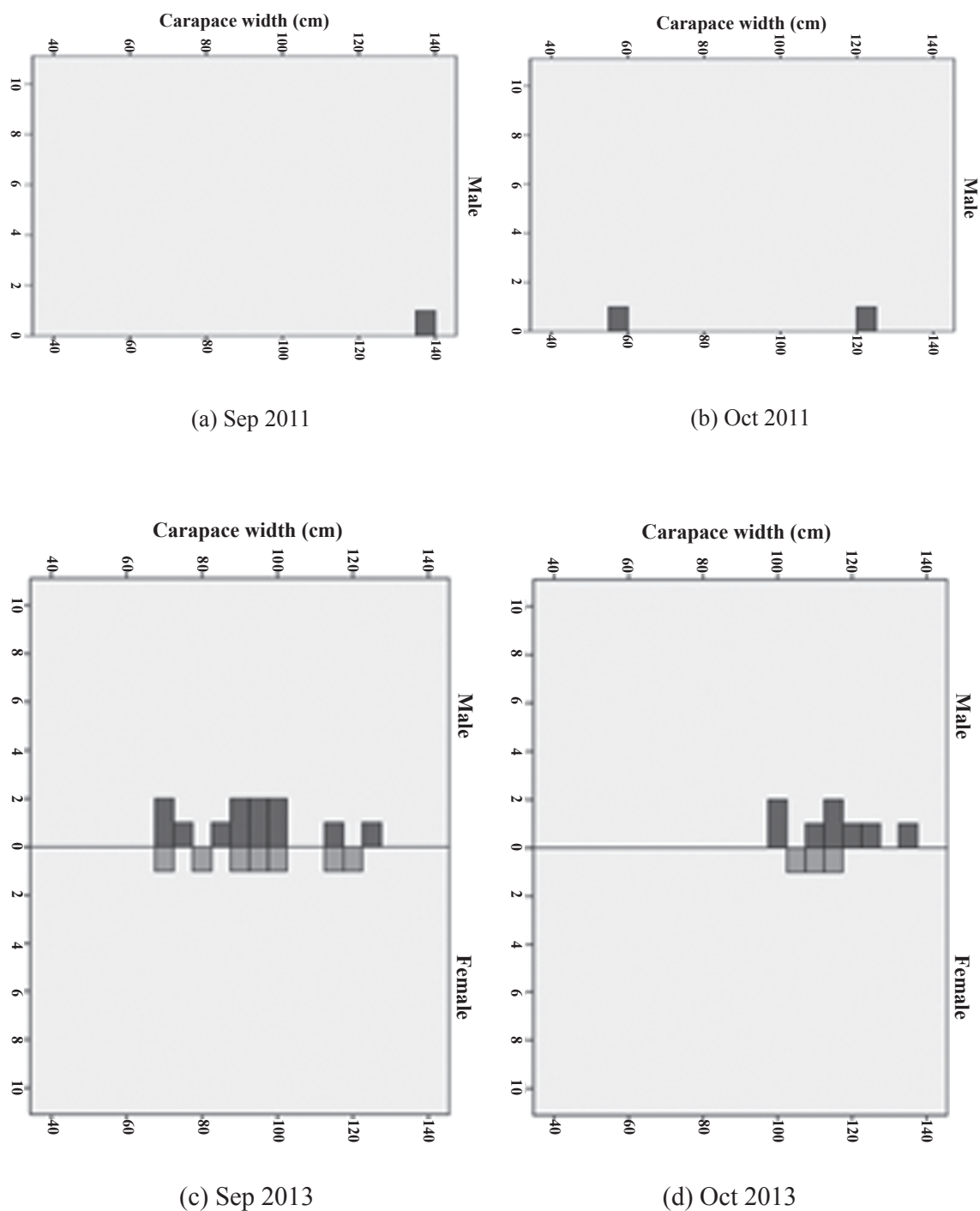
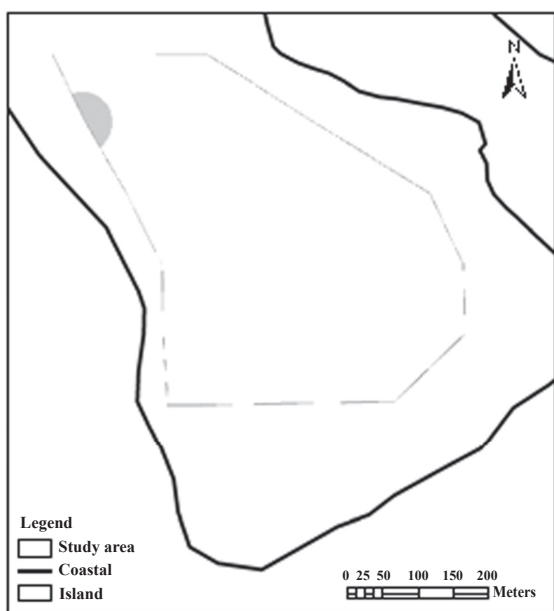
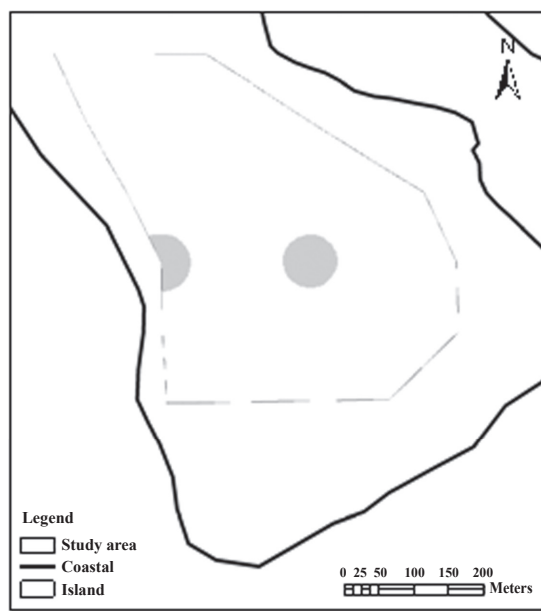


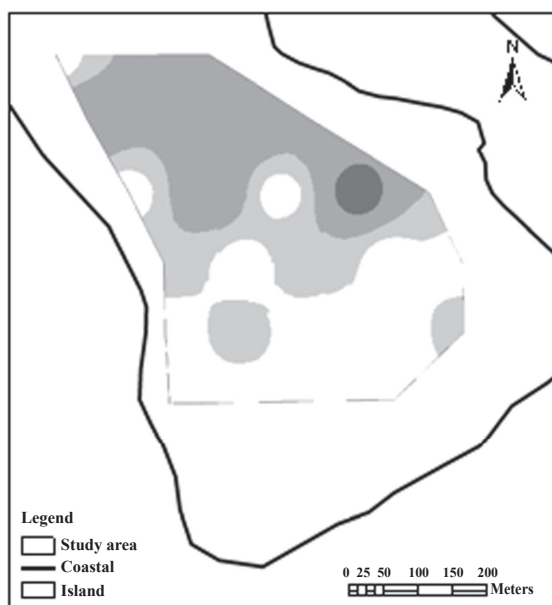
Figure 2. Histograms of blue swimming crab classed by size and sex before stock enhancement [(a) September and (b) October 2011], and after stock enhancement [(c) September and (d) October 2013].



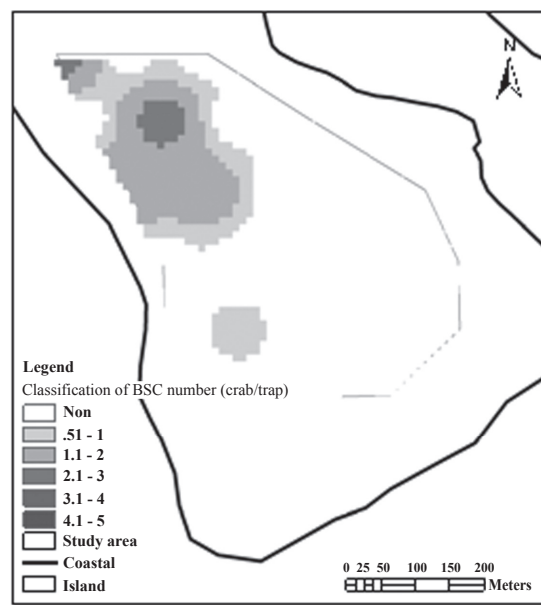
(a) September 2011



(b) October 2011

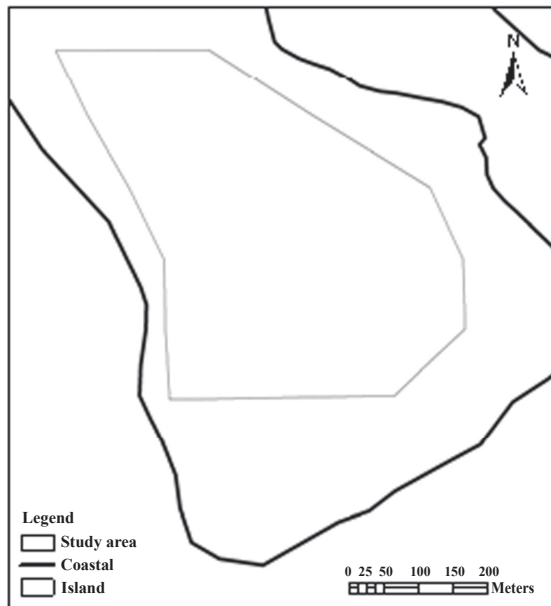


(c) September 2013

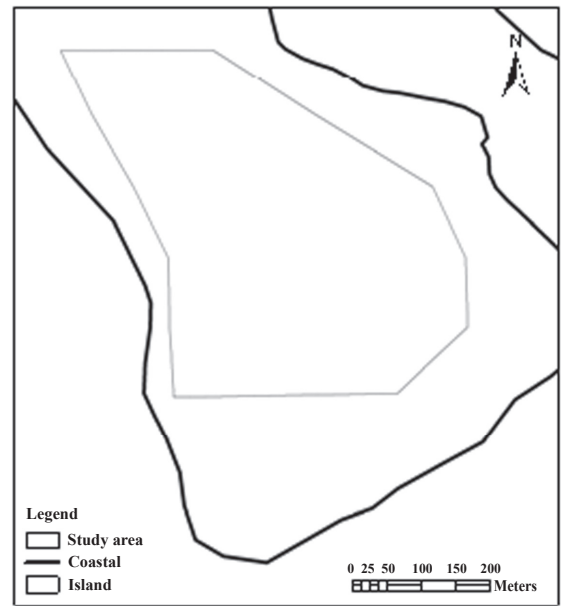


(d) October 2013

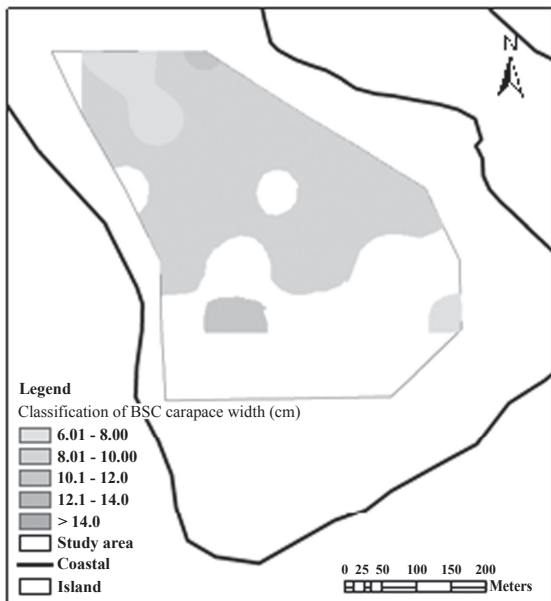
Figure 3. Distribution of blue swimming crab classified by catch rate (crab/trap/day) before enhancement [(a) September and (b) October 2011] and after enhancement [(c) September and (d) October 2013].



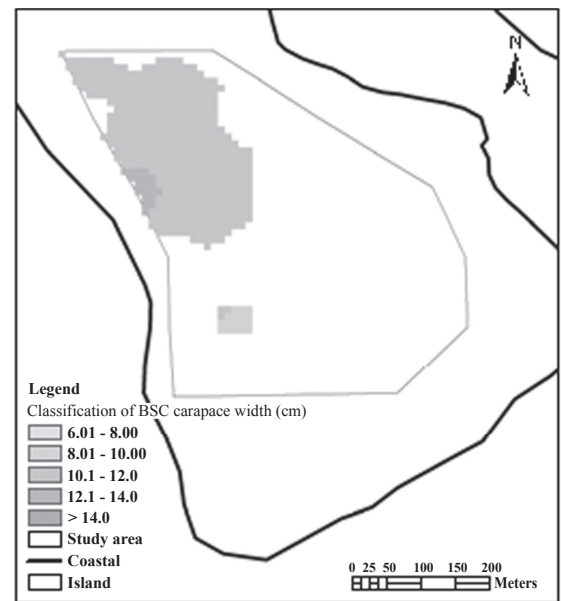
(a) September 2011



(b) October 2011



(c) September 2013



(d) October 2013

Figure 4. Distribution of blue swimming crab classified by carapace width (cm) before enhancement [(a) September and (b) October 2011] and after enhancement [(c) September and (d) October 2013].

The bigger BSC migrated to deeper waters. Rufino *et al.* (2005) reported lower densities of the swimming crab, *Liocarcinus depurator*, in the deeper zone. The same results were found by Jintana *et al.* (2004) in which BSC with carapace widths of 3.0-6.0 cm and 9.1-12.0 cm were found in depths of less than 10 m, and more than 10 m, respectively, whereas the BSC with carapace width of 6.1-9.0 were distributed in all the depths studied. BSC with carapace width of 8-10 cm were highly dense around the mouth of the bay, near the shore area. Then they migrated into the sea to continue to adult stage (Nitiratsuwan and Juntarashote, 2009; Nitiratsuwan *et al.*, 2010).

CONCLUSION

BSC stock enhancement in seagrass beds, especially at the young crab stage, increased the catch rate of BSC. For 92 days after hatching, there was a high catch rate of BSC at the center of the study area, average catch rate near the bay mouth, and a low catch rate near the mangrove areas. BSC at 122 days after hatching were distributed near the bay mouth. The carapace width of BSC at 92 days after hatching reached medium size (8.01-10.0 cm), while 122 days after hatching, BSC reached the large size (10.01-12.0 cm).

ACKNOWLEDGEMENT

We would like to thank the National Research Council of Thailand (NRCT) for the grant on Capability of Blue Swimming

Crab (*Portunus pelagicus* Linnaeus, 1758) Enhancement in Seagrass Beds for Fishery Communities. We are also thankful to our allies, Kobsak Kedmuean and Kowit Koeian, Department of Fisheries, Electricity Generating Authority of Thailand, all the fishermen and students working on the project, and last but not least, the sacrificed animals.

LITERATURE CITED

- Addis, P., Secci, M., Manunza, A., Corrias, S., Niffoi, A. and Cau, A. 2009. A geostatistical approach for the stock assessment of the edible sea urchin, *Paracentrotus lividus*, in four coastal zones of Southern and West Sardinia (SW Italy, Mediterranean Sea). **Fisheries Research**. 100: 215-221.
- Archdale, M.V., Añasco, C.P. and Hiromori, S. 2006. Comparative fishing trials for invasive swimming crabs *Charybdis japonica* and *Portunus pelagicus* using collapsible pots. **Fisheries Research**. 82: 50-55.
- Archdale, M.V., Añasco, C.P., Kawamura, Y. and Tomiki, S. 2007. Effect of two collapsible pot designs on escape rate and behavior of the invasive swimming crabs *Charybdis japonica* and *Portunus pelagicus*. **Fisheries Research**. 85: 202-209.
- Bell, J.D., Bartley, D.M., Lorenzen, K. and Loneragan, N.R. 2006. Restocking and stock enhancement of coastal fisheries: Potential, problems and progress. **Fisheries Research**. 80:1-8.

- Fushimi, H. 2001. Production of juvenile marine finfish for stock enhancement in Japan. **Aquaculture**. 200:33-53.
- Hamasaki, K. and Kitada, S. 2006. A review of kuruma prawn *Penaeus japonicus* stock enhancement in Japan. **Fisheries Research**. 80:80-90.
- Jindalikit, J., Panvichien, S. and Prapheut, P. 2004. **Distribution of *Portunus pelagicus* Linnaeus, 1758 in the Area of Chonburi Province by Research Vessel Pramong 2**, Department of Fisheries, Ministry of Agriculture and Cooperatives, Bangkok, Thailand, pp. 12-42. [in Thai]
- Johnston, K., Hoef, J.M.V., Krivoruchko, K. and Lucas, N. 2003. ArcGIS 9; Using ArcGIS **Geostatistical Analyst**. California: ESRI.
- Kedmuean, K., Koolkaew, K. and Jitmha, S. 2004. **Rearing of blue swimming crabs *Portunus pelagicus* (Linnaeus, 1758) in earthen ponds**. Technical Paper no.38/2004, Songkhla Fisheries Research and Development Center, Fisheries Research and Development Bureau, Department of Fisheries, Ministry of Agriculture and Cooperatives. 14 pp. [in Thai]
- Kenyon, R. A., Haywood, M. D. E., Heales, D. S., Loneragan, N. R., Pendrey, R. C. and Vance, D. J. 1999. Abundance of fish and crustacean postlarvae on portable artificial seagrass units: Daily sampling provides quantitative estimates of the settlement of new recruits. **Journal of Experimental Marine Biology and Ecology**. 232: 197 –216.
- Lipcius, R.N., Seitz, R.D., Seebo, M.S. and Colón-Carrión, D. 2005. Density, abundance and survival of the blue crab in seagrass and unstructured salt marsh nurseries of Chesapeake Bay. **Journal of Experimental Marine Biology and Ecology**. 319:69-80.
- Nitiratsuwan, T., Chiayvareesajja, S. and Somboonsuke, B. 2007. Socio-economic conditions of small-scale fishers in Trang Province and their blue swimming crab (*Portunus pelagicus*) fishing. **Kasetsart Journal (Social Science)**. 28: 309-320.[in Thai]
- Nitiratsuwan, T. and Juntarashote, K. 2009. Spatial management for blue swimming crab (*Portunus pelagicus* Linnaeus, 1758): a case study of Trang province. **Journal of Fisheries Technology Research**. 3: 97-102. [in Thai]
- Nitiratsuwan, T., Nitithamyong, C., Chiayvareesajja, S. and Somboonsuke, B. 2010. Distribution of blue swimming crab (*Portunus pelagicus* Linnaeus, 1758) in Trang Province. **The Songklanakarin Journal of Science and Technology** 32 (3):207-212.
- Perkins-Visser, E., Wolcott, T.G. and Wolcott, D.L. 1996. Nursery role of seagrass beds: enhanced growth of juvenile blue crabs (*Callinectes sapidus* Rathbun). **Journal of Experimental Marine Biology and Ecology**. 198:155-173
- Rufino, M.M., Maynoub, F., Abell'o, P., Sola, L.G. and Yule, A.B. 2005. The effect of methodological options on geostatistical modeling of animal distribution: A case study with *Liocarcinus depurator* (Crustacea: Brachyura) trawl survey data. **Fisheries Research**. 76: 252-265.

- Seitz, R.D., Lipcius, R.N. and Seebo, M.S. 2005. Food availability and growth of the blue crab in seagrass and unvegetated nurseries of Chesapeake Bay. **Journal of Experimental Marine Biology and Ecology**. 319: 57-68.
- Støttrup, J.G., Sparrevohn, C.R., Modin, J. and Lehmann, K. 2002. The use of releases of reared fish to enhance natural populations: A case study on turbot *Psetta maxima* (Linné, 1758). **Fisheries Research**. 59:161-180.
- Tanasomwang, V., Thongbor, P., Thongbor, C. and Thonglum, W. 2004. Rearing blue swimming crab (*Portunus pelagicus* Linnaeus, 1758) larvae in captive by providing different shelter. **Thai Fisheries Gazette**. 57, 505-514. [in Thai]
- Thepphanich, A., Noouseng, S., Wongwiwat, N. and Chumworathayi, S. 2008. **Culture of blue swimming crabs (*Portunus pelagicus* Linnaeus, 1758) with three different feeds in earthen ponds**. Technical Paper no. 44/2008, Fisheries Research and Development Bureau, Department of Fisheries, Ministry of Agriculture and Cooperatives. 30 pp. [in Thai]