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Increasing Area of Green Mussel Culture in Ao Sriracha, Chon-Buri Province

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ABSTRACT

Nowadays, in Ao Sriracha, Chon-Buri province, fishermen install sea floating rafts of green mussel in extensive area. The RADARSAT imaged data in the years 2001 to 2004 showed that floating rafts of green mussel increased 3 times from 0.5 km^2 to 1.5 km^2. Increasing area of green mussel culture enlarged in the northern and the middle parts of Ao Sriracha, but in the southern part, the floating rafts were intensive. POM 2 D (Princeton Ocean Model 2 dimensions) based on momentum balance, mass balance under conditions of well mixed seawater and no effects of wind was simulated. Assuming that seawater current in Ao Sriracha was only affected by tide, seawater height at the southern part was transferred to be boundary condition in the model. Results of the model showed that averaged velocity of seawater flowing pass the area of green mussel culture from north to south was about 0.2-0.3 m/sec in June and from south to north was about 0.3-0.4 m/sec in September. Patterns of averaged circulation related to increasing area of floating rafts for supporting spat of green mussel from the northern part. For suitable management of the culture area, the floating rafts should be arranged to leave wide space between them which was large enough for good circulation of seawater and dispersion of green mussel spats. If there was good distribution of spats, the area of southern part could be extended for floating rafts to raise marine farms and marine products. At the same time, it would be the ways to keep good environments for sustainable marine cultures.

Key words: green mussel, RADARSAT, POM, seawater circulation, Ao Sriracha

INTRODUCTION

Chon-Buri Province has a large area of green mussel culture, most of which is near shore. There are 2 types of culture namely bamboo poles and floating rafts. Since green mussel (*Perna viridis*) has promoted by high growth rate, good taste and good price, fishermen are increasingly interested in the culture of green mussel by using the floating rafts. Numbers of spat suspended in seawater for settling and fixed with materials after breeding are limited. Because there are a lot of floating rafts distributed in Ao Sriracha, the spats are not enough for settling on materials. Consequently fishermen buy small shells from other places to be cultured, but it is costly and increases the capital expenditure.

Ao Sriracha, Chon-Buri Province is a small semi-open gulf. Its coast in the eastern part composes of mud flat, sandy beach and rocky shore. The western part is the upper gulf of Thailand. The northern part is Laem Samuk and

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the southern part is Laem Chabang industrial estate. The site covers 680000-710000 E and 1440000-1470000 N about 900 km^2 as shown in Figure 1. Averaged depth is about 15-20 m and maximum depth is about 29 m in southern part.

The research was studied on water circulation by using POM 2 D (Prince Ocean Model 2 dimension). This model would be computed the averaged velocity of seawater in 14.75 days of the whole year 2004. The magnitude and direction of seawater circulation were considered. The satellite image data, RADARSAT, in the years 2001-2004 would be interpreted to estimate area of green mussel farms in Ao Sriracha. This research would be useful for planning and management of the area of green mussel culture in Ao Sriracha, Chon-Buri Province. The impacts of increasing area of green mussel on the environment would be decreased. At the same time the fishermen could increase marine products and sustainable fishing.

MATERIALS AND MATHODS

Studies on patterns of seawater circulation around Ao Sriracha were investigated by using tidal simulation model of POM 2 D. This simulation model based on momentum balance and mass balance accordingly equation (1) and (2) respectively. Assuming that velocity of seawater in Ao Sriracha was depended only on tide. Water column was well mixed and no effects by wind. Area of consideration in simulation model was about 900 km^2. Boundary of model was only seawater height. Topography of site was observed by map of the upper gulf of Thailand (001).

$$\frac{D\overline{V}}{Dt} + (\overline{V}\cdot\nabla)\overline{V} + 2\overline{\Omega}\times\overline{V} = \frac{1}{\rho}\nabla\overline{P} + \overline{F} \qquad (1)$$

$$\nabla\cdot\rho\overline{V} = \frac{D\rho}{Dt} \qquad (2)$$

$\overline{V}$ = velocity $\quad$ $\overline{F}$ = external force

t = time $\quad$ Ω = angular rotation of earth

ρ = density $\quad$ $\overline{P}$ = pressure

The simulation model used to compute the averaged velocity throughout 14.75 days of the whole year 2004. Each year in the eastern part of the Gulf of Thailand, spats of green mussel would settle on the materials of the floating rafts 2 times especially in May-July and November-February. Residue current mean that both direction and magnitude of the current would point to the probability of spat distribution area.

Satellite image data of RADARSAT from Geo-Information and Space Technology Development Agency (Public Organization) in 26

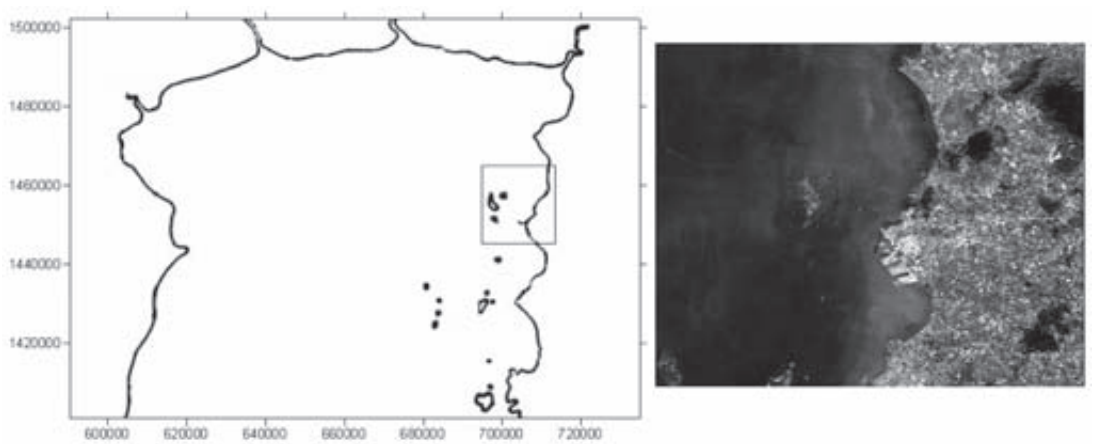

Figure 1 The site of study(From : GISTDA 2004).

Table 1 Parameters used to find the tidal current in POM 2 D.

Description	Unit	Symbol	Value
Outer limits of horizontal grid index		im,jm	26,34
External mode time step	sec	dte	3
Internal mode time step	sec	dti	45
Grid spacing	m	dx,dy	930
Coefficient of Smagorinsky diffusivity		horcon	0.2
Von Karman's constant		κ	0.4
Horizontal kinematic viscosity	m^2s^{-1}	aam	50
Default density	kg/m^3	rhoref	1025

August 2001 and 2 March 2004 were interpreted and mapped by ERMAPPER 5 software. The area of marine culture farms were estimated by application software. The comparative of increased area of marine culture in 2001-2004 and trend of the distribution of floating rafts in Ao Sriracha, Chon-Buri Province during 2001-2004 were investigated.

RESULTS

Seawater circulation was mainly affected by tide. During flood tide, seawater migrated from south to north parallel to the coast at maximum velocity of 0.7 m/sec. On the other hand, during ebb tide, seawater flowed from north to south parallel to the coast at maximum velocity of 0.8 m/sec. Figure 2 shows the simulated patterns of flow during ebb tide and flood tide, respectively.

Averaged velocities for 14.75 days were computed 24 times in the whole year. Magnitude of velocities was different each time. Magnitude of averaged velocities had the cycle as the harmonic function. The circulation patterns of averaged velocities computed in May and November were shown in Figure 3. The circulation patterns of the averaged velocities looked like the pattern of seawater flow during ebb tide and flood tide, respectively. The averaged velocities computed in area of floating rafts were about 0.2-0.3 m/sec in May and about 0.3-0.4 m/sec in November.

The pattern of seawater movement in May as shown in Figure 3 agreed with the distribution of spats. Extensive spat sources could come from Chachoengsao and Samutprakan

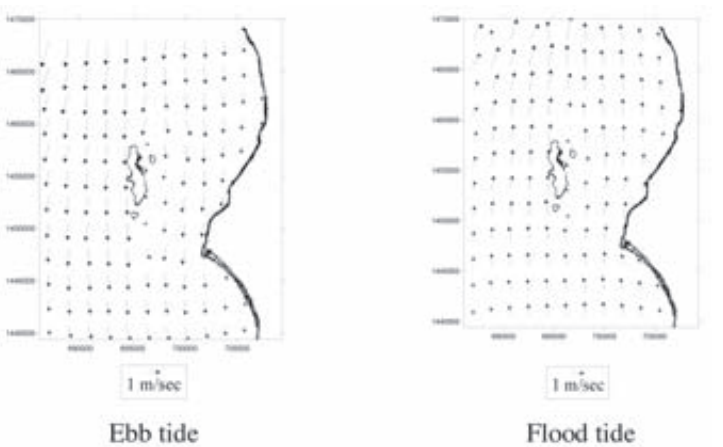

Figure 2 Tidal current patterns during ebb tide and flood tide.

Provinces in the northern part of this area where there were a lot of marine farms and large area of green mussel culture. Behavioral of response green mussel when the water quality or the weather was changed would be to induce breeding.

The suspended spats of green mussel in seawater needed to hold the material within 7 days after breeding otherwise they would die. The spats distributed from the north paralleled to the coast.

The satellite image data of RADARSAT were processed by ERMAPPER 5 and application software, they showed that area of floating rafts of green mussel culture were significantly expended during 2001-2004 as shown in Figure 4. The comparison of area of sea farming in 2001 with 2004 was shown in Figure 5.

Figure 4 shows the number of area of floating rafts which increased 3 times from 2001-2004. The extension area of floating rafts was perpendicular to the direction of averaged velocities of seawater. The purposes of the extension area were to increase area for holding spats at the time of increasing the quantity of shell.

DISCUSSION

Green mussel is one of commercial marine animals. In each year, it made a lot of

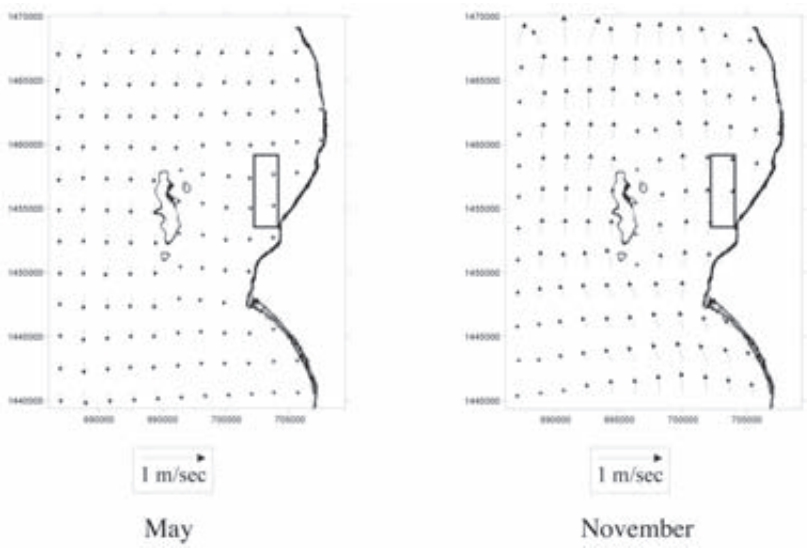

Figure 3 Area of green mussel farms and the residue current patterns in May and November.

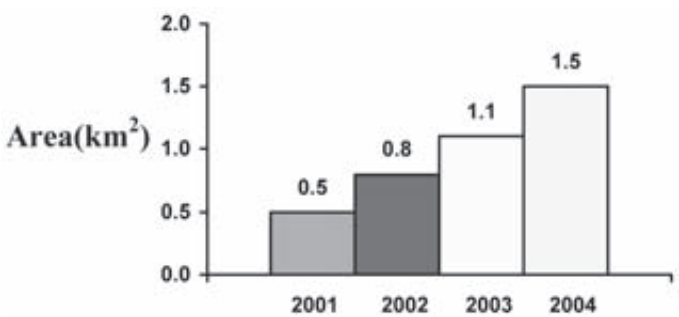

Figure 4 Area of green mussel farms during 2001-2004.

income to fishermen. In the upper gulf of Thailand, there are many green mussel culture farms along the coast as in Samutprakan, Chachoengsao, Chonburi, Samutsongkram and Petcha-Buri Provinces. Green mussels were found in the coastal zone, having slow seawater movement all the time. It is filter feeder and is descended by sexuality. The eggs bred would be suspended in seawater for a short period until the size is suitable for holding the materials.

The report of Department of Fisheries (1993) found that in Ao Sriracha the spat would hold with the material during May to July and November to February every year. Green mussel spat will hold the material in one or two times a year, and they will stay their life at that place not move to anywhere until they die. The materials for holding of spat in Ao Sriracha were the floating rafts with plastic net and bamboo poles. The report of Chuchit and Yoosamran (2006) found that this area had plankton bloom many times a year. This plankton would be the important food for the shell.

Distribution of spat source would come from the northern part of Ao Sriracha in area of Chachoengsao and Samutprakan Provinces. This area had a lot of the green mussel farms which would produce abundant spat source. The rapid change of seawater temperature and left shell day for long time, would be the reasons for stimulating breed. Fishermen in this area sold the small size of shell to other places as another way for doing business.

Extension of the floating rafts perpendicular to the flow direction was a good idea for increasing spat settlement. At the same time, the material blocked the spats and slowed down the flow of seawater. Seawater could not conveniently propagate to the southern part of Ao Sriracha. As shown in Figure 5, the northern part and the middle part of floating rafts were increasing. On the other hand, sea farms in the

Figure 5 Area of green mussel farms in 2001 and 2004(From: GISTDA 2005).

southern part were extended slowly. The trend of the increasing area of sea farms would be extended in the northern part and in the middle part due to accessible to dispersion of spat from the north.

The increasing floating rafts in the north seemed to trap more spats preventing them from reaching farms in the south of farm area. Therefore, some farms had to buy small green mussel for fattening the shell from the other places such as Chachoengsao and Samutprakan Provinces. That meant the way of increasing cost.

The management of the area of floating rafts for suitable environment were important and necessary. One way of management was to increase the interval area between the floating rafts to be wide enough for convenient seawater flow and to enlarge the area of marine culture perpendicularly far from the coast. And after the good movement of seawater, the southern part of Ao Sriracha could be useful for expansion of sea farms for increasing the quantity of products. The suitable marine culture and the capacity of environment would be compromised for reducing marine pollution, keeping the good nature and the sustainable fishing.

CONCLUSION

The area of floating rafts increased 3 times from 2001-2004 (0.5 km^2 to 1.5 km^2). The increasing area of floating rafts was in the northern part and the middle part of the Ao Sriracha. The southern part was lowly increasing. The extension area of culture was enlarged far from the coast to deeper. An averaged velocities of seawater flow pass the area of culture in May 2004 was about 0.2-0.3 m/sec from north to south.

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