

태국의 인공어초 현황과 전망

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Present Status and Prospect of Artificial Reef in Thailand

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ABSTRACT : Artificial reef in Thailand was trend to deploy and development artificial reef program to enhancing fisheries product and also use artificial reef for solve coastal problem. Artificial reef in Thailand was present in type of shallow water artificial reef by use concrete dice as dominant structure. To development artificial reef program for more benefit such as deep water artificial reef program that might provide more fisheries product for commercial fisheries and apply for use in many purposes especially for manage coastal environment in Thailand can be suggestion by cases of study . But all of that have to use more knowledge and concerning from government and organization that was responds in artificial reef program to decide the future of artificial reef program in Thailand

KEYWORD : artificial reef, Thailand artificial reef program, artificial reef development, status and prospect of artificial reef

1. Introduction

Artificial reef was use as a tool to enhancing marine productive and coastal management in many countries. The long history artificial reef developed country such as USA (the United State of America), Europe, Japan and South Korea. The most objective of artificial reef in most countries was provide for enhancing fisheries product.

In Southeast Asia, Thailand also be a country which develop artificial reef for rehabilitation marine resources. In the past Thailand was plentiful of nutrient and resources in sea area because of have many natural habitats such as coral reef that were present as food ground and habitat for marine life that have diversity richness of marine lives. Because of overfishing, rapid development of fisheries industry, harmed by human activity and lack of marine resources management and conservation that provide status of environment of

Thailand be in problem (Tokrina *et al.*, 1997). Since 1978 Thailand government used artificial reef program to solve problem of marine environment and resources. Development of artificial reef program can divide for 2 period (Ingsrisawang, 1999).

In the first period for artificial reef research and experiment during 1978-1986 artificial reef programs in Thailand were research and develop material by use many kind of materials that available in that area and low cost such as bamboo, rock, tire and were deployed without plan.

The second period since 1987 until the present artificial reef of Thailand were present as time for installation and enhancing resources. Artificial reef programs of Thailand were presented in concrete material that provided more than 90% of deployed artificial reef area in Thailand. While in another country have been developed artificial reef in many types, shape and material and deploy on purpose. Deployment method of Thailand artificial reef program still lack of technology and concerning in deploying method. In some artificial reef programs

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were presented scattering structure without plan and break during or after deployment. And assessment for artificial reef program in Thailand was concerning in organism assemblage and community especially economical fish but Thailand are lacking of physical monitoring in artificial reef program that might cause of most of Thailand artificial reef was provide in shallow area to increasing small scale fisheries product and high cost of technology.

To improve artificial reef development in Thailand for long term engagement program, this study presented status of artificial reef program during 1987–2005 and trend of artificial reef program development in the future of Thailand. First of all present position of artificial reefs and natural reefs that can effective or have impact by artificial reef construction, estimate and suggestion for useful technology and method from another case study that may apply with artificial reef program in Thailand for most benefit.

2. Data and Method

Thailand was located in tropical zone that has long coastal, was located from the east to the south that lies on Gulf of Thailand about 1874km. And about 740km of Andaman Sea that located on western coast of southern Thailand.

Artificial reefs in second period were deploying about 1646km² along coast of Gulf of Thailand and Andaman Sea by Department of Fisheries. And artificial reef that was deployed for 24 sites under responsible of Department of Marine and Coastal Resources during 2004–2006. This study will present Artificial reef areas by use AutoCAD 2006 program to create position and present artificial reef area on Thailand coastal line map from NOAA (16° 29.924 N 95° 52.313 E on the left top and 11° 58.418 N 100° 27.397 E at right bottom) and depth line use data from Electronic Navigational Chart N045 received from Cartographic Division, Hydrographic Department, Royal Thai Navy.

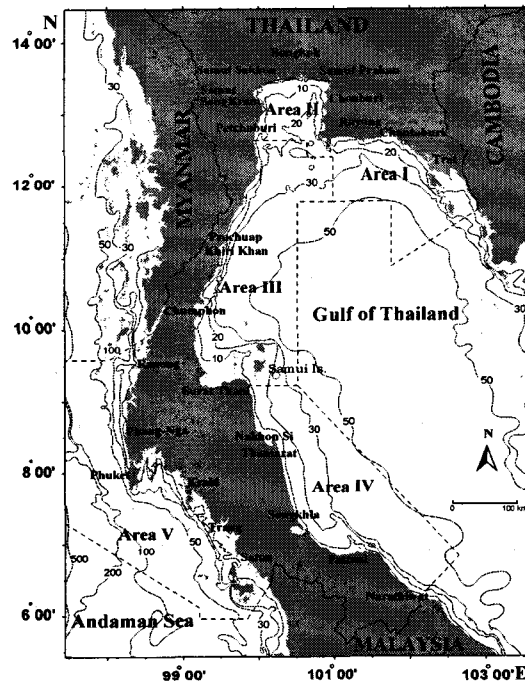


Fig. 1. Thailand coastal area divide by in respond of local fisheries centers.

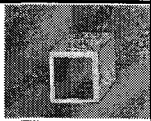
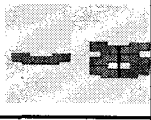





Area I Eastern Gulf : included Trat, Chantaburi, Rayong, **Area II** Inner Gulf included Chonburi, Chachoengsao, Bangkok, Samut Prakran, Samut Sakhon, Samut Songkhram and Phetchaburi, **Area III** Central Gulf : included Prachaub KiriKhan, Chumphon and Surat Thani, **Area IV** Southern Gulf : included Nakhon Si Thammarat, Songkhla, Pattani and Narathiwat, **Area V** Andaman Sea : included Satun, Trang, Krabi, Phuket, Phang Nga and Ranong.

Position of artificial reefs in Thailand were divided Thailand coastal area for 5 parts by undertaken area of 5 local Marine Fisheries Research and Development Center on the coastline map 14° 25' 37" N 97° 27' 56" E on the left top and 5° 25' 34" N 103° 35' 33" E at right bottom) (Fig. 1).

3. Result and Discussion

Since 1987 until 2005 Thailand artificial reef was used 9 types of material to deploy as artificial reef concrete patch, concrete ring, concrete dice (dimension size 1m, 1.5m, 2m), ship, concrete tube, trains (goods vans), fiberglass (Table 1.). Concrete patch and ring are a kind of material that use in first period and stop use in 1987 because of high sinking rate and easy to break. In this period concrete dice become deploy in many area and also have development to use trains and fiberglass in late of period.

Table 1. Deployed artificial reef modules in Thailand during 1987-2006

| Material | Shape | Size (H×W×L) (m) | Depth (m) | Problem |
|----------------|---|----------------------|-----------|---|
| Concrete patch |  | 0.8×1.0×1.0 | 4-6 | -Short duration -Easy to broken |
| Concrete tank |  | ∅=1.5, L=0.9 | 5-6 | -Short duration -Easy to broken |
| Concrete tube |  | ∅=0.4, 0.6, 0.9, 1.0 | 11 | -Easy to broken -High sinking rate |
| Concrete dice |  | 1.0×1.0×1.0 | 3-15 | -Easy to break by fishing gear |
| | | 1.5×1.5×1.5 | 5-30 | -Broken from attack by fishing gear |
| | | 2.0×2.0×2.0 | 8-11 | -Difficult to transport because of weight |
| Warship |  | 61.1 × 10.2 | 25-30 | -oil from ship might contaminate to sea water |
| Goods wagon |  | 2.18×6.65×2.23 | 8-29 | -Erosion of steel |
| Fiberglass |  | high 2-3 m | 9-20 | -High cost |

Concrete was presented as material for create fish habitat in Thailand while ship and fiberglass use for attract marine resources and they also provide for create new diving site. And the new artificial reef structure in Thailand, trains (goods vans) was constructed for increasing fisheries products and also for experiment of second used structure to use as artificial reef module that was trend to deploy more number in the future.

Table 2. is present concrete artificial reef deployed area in Thailand because of concrete was present as artificial reef material which most deployed more than 90% of Thailand sea area. Area I, the eastern Gulf of Thailand was found just type of concrete dice that covering about 237.79km² which total large was present in Trat province. And Area II most of artificial reef area was present in Phetchaburi about 110.4km² but in Samut Sakhon was provided just concrete dice which 2m that might because of in that area have high sediment that flowing from land. In Area III, artificial reef areas were covering for 333.1km² and Prachuab Khiri Khan was provide most artificial reef large area in Thailand about 179.74km². Area IV, is just a one area that was deployed concrete patch and concrete tube. In Area IV was present most artificial reef deployed area about 446.17km² and most of artificial reef program provide by use concrete dice size 1m and 2m deploy together and same as another area that was found high deployment by concrete dice which dimension 1.5m. Area V, Andaman Sea coastal area was present similarly of artificial reef area but Ranong is just a province that deploy concrete dice 1m and 2m deploy together in large area type.

Artificial reef deployed area during study period artificial reef in Thailand was provide in Thailand about 1646km² that concrete dice was present as dominant material by deployed about 1615km². In the early period artificial reef was provide in large area by use concrete dice 1.0m and 1.5m deploy together that present the most artificial reef area in study period and since 1999 artificial reef of Thailand were trend to provide in small area type scatter on coastal sea area by use just concrete dice which size 1.5m and in the present 1.5m is just a one size that continue deploy in Thailand.

Table 2. Deployed artificial reef areas of concrete material in Thailand since 1987-2005 by DOF (Department of Fisheries)

| Area | Province | Artificial reef area (km ²) | | | | | | | | | | | Total area (km ²) | Total partition area (km ²) |
|--|----------|---|-------|--------|-------|-------|----------|--------|------|------|------|---------|-------------------------------|---|
| | | Concrete dice dimension size (m) | | | | | Concrete | | | | | | | |
| | | 1 | 1.1.5 | 1.2 | 1.5 | 2 | dice | patch | ring | tube | | | | |
| Gulf of Thailand | I | Trat | | 0.36 | 50.46 | 8 | 40 | 98.82 | | | | | 98.82 | 237.79 |
| | | Chantaburi | | 56 | | 13 | | 69 | | | | | 69 | |
| | | Rayong | 13.75 | 48.72 | | 7.5 | | 69.97 | | | | | 69.97 | |
| | II | Chonburi | | 50 | | 4 | | 54 | | | | | 54 | 214.4 |
| | | Samut Sakhon | | | | | 50 | 50 | | | | | 50 | |
| | | Phetchaburi | 10 | 40 | | 60.4 | | 110.4 | | | | | 110.4 | |
| | III | Prachuab Khiri Khan | 20 | 106.75 | | 52.99 | | 179.74 | | | | | 179.74 | 333.11 |
| | | Chumphon | 19.13 | 49.84 | | 28.4 | | 97.37 | | | | | 97.37 | |
| | | Surat Thani | 3 | 50 | | 3 | | 56 | | | | | 56 | |
| | IV | Nakhon Si Thammarat | 1 | | 57.2 | 55.48 | | 113.68 | 8.1 | | | | 121.78 | 446.17 |
| | | Songkla | | 1 | 50.4 | 65.46 | | 116.86 | 8.1 | | | | 124.96 | |
| | | Pattani | 33.1 | | | 64.1 | | 97.2 | 8.1 | | | | 105.3 | |
| | | Narathiwat | | | 50.48 | 42.9 | | 93.38 | | | 0.75 | | 94.13 | |
| Andaman Sea | V | Satun | 16.25 | 51 | | 6 | | 73.25 | | 6 | | | 79.25 | 414.84 |
| | | Trang | 6.14 | 51.5 | | 6.5 | | 64.14 | | | | | 64.14 | |
| | | Krabi | 5.7 | 50.8 | | 7.5 | | 64 | | | | | 64 | |
| | | Phuket | 4.4 | 0.5 | | 51 | | 55.9 | | | | | 55.9 | |
| | | Phung Nga | 8 | 51 | | 37.2 | | 96.2 | | | | | 96.2 | |
| | | Ranong | | | 50.85 | 4.5 | | 55.35 | | | | | 55.35 | |
| Total deployed area (km ²) | | 140.5 | 607.5 | 259.4 | 517.9 | 90 | 1615.3 | 24.3 | 6 | 0.75 | | 1646.31 | | |

For development artificial reef in Thailand material is a first thing that most of artificial reef construction are concerning. Artificial reef should to have long duration, less impact to environment and structure should to suitable for purpose but Thailand artificial reef program was use concrete dice for dominant type for provide fish habitat and use in coastal management program. From the present artificial reef programs that were trend to use reuse material to provide and artificial reef structure that can cost the material and reuse waste that was research that this kind of structure may useful to create fish habitat and should to deploy in depth and area that will not effect to transport.

Deployment of artificial reef in first period was provide with out plan and scatter on sea bed, and in second period artificial reefs were deploying in 2 types (artificial reef clump and deploy in group or

reef set full in deployment area) on plan. Because of lacking of experiment and technology in construction artificial reef still found scattering on seabed by time or current and some was breaking during and after deployment. To solve this problem before deploy artificial reef should to study for characteristic of current and environment in deployment area and also develop technology to construction artificial reef. And the important thing that should to concern when construct artificial reef because of size and influence range might effect to natural reef in adjacent area that should to avoid overlay of artificial reef influenceable and prevent migration of fish that might effect to number of fish in area.

Researches and experiments are the most important to development in the future. Thailand have many researches in assemblage and community

of fish and organism but lacking of information in physical and characteristic of sea area. The knowledge in physical of sea area is very important and useful to develop structure and can estimate for effect that might effect to artificial reef structure.

For development artificial reef program in the future especially for increasing fisheries product is the one thing should to concern. Because of most of Thailand seabed is a muddy type and has average depth about 45m for develop artificial reef artificial reef in far from shore area that can provide big size of fish and high coast might be a good plan to enhancing marine resources. Most of Thailand seabed is a muddy type and has average depth about 45m for attract fish in deep water area the construction high structure in deep sea area might be suitable such as Rig to Reefs program in USA that was use oil platform or high rise artificial reef in Japan. This kind of artificial reef program use high structure to provide as artificial reef to be fish habitat and hard substrate to attract organism and marine lives and purpose to assemblage fish and another marine lives (Ito *et al.*, 2005). Or in another deep water artificial reef for enhancing marine resources such as deploy structure on deep water seabed to obstruct flowing current and push them to the surface for create food ground to attract and aggregate fishes such as in Japan and South Korea. And Thailand also be a nutrient richness country but for this kind of artificial reef program have to more research about current and effect after deployment.

Except increasing fisheries product artificial reef also use as a tool to coastal management in many countries such as Hong Kong that deploy artificial reef for biofilter in aquaculture area for improve water quality (Agriculture, Fisheries and Conservation Department). Or reef ball material that was deploy for prevent current and renourishment beach (Harris, 2003). Method to deploy or material will be different on purpose of artificial reef program while Thailand artificial reef still use same structure to provide for solve the problem. To development artificial reef Thailand also should develop material and construct on purpose.

Conclusion

Artificial reef in Thailand was development about 30 years. Development time of artificial reef program in Thailand can divide for 2 period. First period is time for researches and experiments in during 1978-1986. And second period was present since 1987 until the present time for installation and enhancing resources. This study period was concern status of artificial reef in Thailand during 1987-2005 for prospect artificial reef program in the future. With 9 types of artificial reef material artificial reef programs in Thailand were trend to deploy small area artificial reef type about 1km² per site in shallow water by use concrete dice as dominant structure. And since 2002, DOF (Department of Fisheries) was start to deployed unused material train (goods van) in the south of Thailand. That might be an initially period to use reuse structure and start deep water program in Thailand.

Because of lacking of knowledge and technology artificial reef in Thailand still was present in not various material that may not provide most benefit or can success on purpose and artificial reef was break or scattering from plan cause of construction method or from current.

In the future artificial reef program in Thailand such as deep water artificial reef program and artificial reef for use to solve marine coastal problem such coastal erosion and use for improve marine environment. To develop artificial reef in Thailand, information's of characteristic of seawater area in Thailand, ecosystem, marine resources etc in deep water area in also necessary to develop artificial reef in the future. And all of that have to use more knowledge and concerning from government and organization that was responds in artificial reef program to decide the future of artificial reef program in Thailand

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