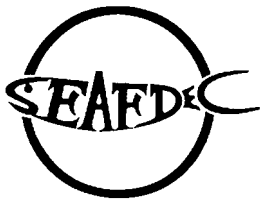
Annex 17



THE FOURTH REGIONAL WORKSHOP ON SHARED STOCKS:
RESEARCH AND MANAGEMENT
IN THE SOUTH CHINA SEA

Kuala Terengganu, Malaysia 24th - 26th January 2000

OPTIMIZING THE APPLICATIONS OF MARINE GEOGRAPHICAL INFORMATION SYSTEM (MARINE GIS), IN FISHERY RESEARCH AND RESOURCE MANAGEMENT IN SOUTHEAST ASIAN REGION

By:

ROSIDI BIN ALI[1], RAJA BIDIN BIN RAJA HASSAN[1], KU KASSIM BIN KU YAACOB[1], TENGKU ROZAINA BT. TENGKU MUHAMAD[1], SHUNJI FUJIWARA[1], KUNIMUNE SHIOMI[1] AND KINOSHI ITOH[2]

Optimizing The Applications of Marine Explorer, A Marine Geographical Information System (GIS), In Fishery Research and Resource Management In Southeast Asian Region

By

Rosidi bin Ali[1], Raja Bidin bin Raja Hassan[1], Ku Kassim bin Ku Yaacob[1], Tengku Rozaina bt. Tengku Muhamad[1], Shunji Fujiwara[1], Kunimune Shiomi[1] and Kinoshi Itoh[2]

ABSTRACT

This paper describes a project that has just been initiated by MFRDMD, to promote the application of Marine Explorer, a marine Geographical Information System (GIS), in fisheries research and resources management in the Southeast Asian region. Features and functions of Marine Explorer are briefly described. Two case studies are reviewed. Steps to materialize the application of the GIS in fishery research and resources management for this region are also listed and discussed.

Key word: Geographical Information System, Acoustic survey, Marine Explorer, Fisheries Research and Management

Introduction

Geographical Information System (GIS) is a powerful tool capable of organizing, analyzing and displaying spatial explicit data, with a better speed and accuracy compared to the conventional approaches. It comprises of a collection of integrated of computer hardware and software which together is used for inputting, storing, manipulating, analyzing and presenting a variety of geographical data, to assist in formulation of firm and precise decisions, immediately. Therefore, GIS has been widely applied in many areas such as in agriculture and land use planning, forestry and wildlife management, archeology and geology (Aronoff, 1995). However in the fisheries sciences especially the marine sector, applications of GIS have presently been very limited (Isaak and Hubbert, 1997; Meadan and Chi, 1996). Some reasons for GIS has been slowed to materialize have been listed by Meadan and Chi (1996), among which are lack of recognition of spatial aspects in fisheries management, the cooperation problems which need to overcome in data collection and lack of suitable data base in many areas of fisheries resources.

---

1) Marine Fishery Resources Development and Management Department, Fisheries Garden, Chendering, 21080 Kuala Terengganu, MALAYSIA.

2) Environmental Simulation Laboratory Inc., Kawagoe, Saitama, Japan.

However, continuous over exploitation and declining fish stocks indicating the needs for spatial and integrated strategies in fisheries management is imperative. GIS which is able to answer questions such as what is at....?, how big/long is...?, where is....?, what has change since...? what spatial patterns exist...? and what if...?, undoubtedly to be the most efficient of all available tools. Therefore, its application in marine fisheries has to be promoted.

The Features and Functions Of Marine Explorer

Marine Explorer is a new GIS that has been developed by the Environmental Simulation Laboratory, Inc., Japan, purposely for the utilization and analysis of oceanographic and fishery data (Itoh, 1999). This GIS has first been released in 1996 with instruction in Japanese language. However in early 1999, the version 3.0 with English language instruction has been released. This new version of Marine Explorer was demonstrated in the First International Symposium in Fishery Science at Seattle in March 1999, and has been noted as the best GIS to be promoted for marine fisheries application.

The Marine Explorer has designed to perform seven types of function: data base, horizontal distribution, vertical distribution, overlay map, creation of map, spatial analysis and 3D Viewer. However, for the Version 3.0, only data base, horizontal distribution and overlay map have been fully developed. The developments of the other four functions are in progress.

Marine Explorer accepts data from various applications such as Lotus, Excel and Access. The data need to be arranged in vector format, prior conversion and registration by Marine Explorer. Six types of distribution could be mapped i.e. symbol, contour, trace, image, vector and observation station. Various types of distribution could be overlaid to observe the correlation.

Case study 1 : Spatial Analysis Of The Acoustic Survey Data For Marine Fish Resources Within the Malaysian Economic Zones (EEZ)

The background of the study

Details of the study were described by Rosidi et al (1999[1]). The aim of this analysis was to understand the spatial distribution of fish in EEZ's of Malaysia. In 1998,

Department of Fisheries, Malaysia had carried out acoustic surveys covering almost all EEZ waters of Malaysia. The surveys off west coast of Peninsular Malaysia, east coast of Peninsular Malaysia and East Malaysia were conducted on March 24 to 30, May 24 to June 6 and July 8 to August 5 respectively. A training vessel belongs to the Department of Fisheries Malaysia, K.L. CERMIN, was used in the survey. The scientific echo-sounder, FQ-70M, was applied for the survey. Samplings of the oceanographic parameters were also conducted simultaneously with these acoustic surveys.

The Department of Fisheries, Malaysia had hired a consultant company from Japan, Sasa Labo. Co., to supervise and assist the local researchers in processing and analyzing the data.

Materials And Methods

The analysis was done in a ten days workshop from September 26 to October 7, 1998 at MFRDMD, as part of the contract between the Department of Fisheries Malaysia and Sasa Labo. Co. The hardware and software used in the analysis were provided the National Research Institute of Far Sea Fisheries, Japan, and the Environmental Simulation Laboratory, Japan.

Electrical based maps and bathymetry of the study areas were created in Marine Explorer. The estimated fish densities data compiled from Sasakura (1998), were transferred to the vector format, to enable them to be input into the Marine Explorer. Ranks of the densities were evaluated with basic statistics in order to standardize the symbols for all the areas. Based on this, the data were grouped into five classes of symbols at levels 20%, 40%, 60% and 80%. The distributions of fish densities were map using the Marine Explorer.

The same data of estimated fish densities were used to develop contour maps. Since the contour function in Marine Explorer has yet to be developed at that time, Surfer software was applied to estimate the contour values. The original density (point) data were transfer into the Surfer to get the contour value by pixel (5' x 5' basis). The data in the vector format were presented in continuos symbols so that the area based contour maps could be developed. The five levels of classes (similar to the once used in Marine Explorer) of different colors were chosen.

The maps of fish densities developed in Marine Explorer were the overlaid into the contour maps developed in Surfer to produce the final maps.

Results and Discussions

Map of the distribution and the contour of fish densities off west coast and east coast of Peninsular Malaysia is as shown in Figure 1. In the west coast of Peninsular Malaysia, it appears that the fish density is independent of water depth. The depth of water in this area is uniform and shallower than 50 m. High fish density area was observed in the northern part the areas, especially in the coastal waters. The fish density was relative low in the central part of the area. Raja Mohammad Noordin (personal comm.) reported that a convergence zone occurred in the offshore waters of the northern areas (off Penang) during the survey. Water from the north flowed southward but was prevented from flowing further by a strong underwater current, which flowed in a northward direction. The southern waters tapered off and flowed near shore in a northerly direction in north of Penang towards Kedah waters and then into waters between Perlis and Pulau Langkawi. The area of convergence indicated the down-welling of water and this would produce upwelling in adjacent areas. These phenomena would induce richness of water in areas and capable of aggregating higher density of fish.

In the east coast of Peninsular Malaysia (Figure 1), high fish density was concentrated in the deeper waters, offshore of the northern part. The survey was conducted in March, just after NE monsoon. Rosidi et al (1997) found out that during pre NE monsoon, pelagic fish concentrated at the upper part of the Gulf of Thailand. Mansor and Abdullah (1995) and Anon (1987) suggested that during post NE monsoon, these pelagic fish would move out to the offshore waters of the South China Sea.

In the East Malaysia high fish densities were observed in the coastal waters and in the continental shelf zone off Sarawak (Figure 2). Hadil Rajali (personal comm.) suggested that the appearance of coastal waters and the occurrence of upwelling seems to have close relationship to the distribution of fish in the areas.

Case Study 2 : The Affect Of Northeast Monsoon On The Distribution Of Fish Abundance Off East Coast Of Peninsular Malaysia

The Background of the study

Details of the study were described by Rosidi et al (1999[2]). The aim of the study is to observe the change in fish distribution due to Northeast monsoon. Analysis was based on three acoustic surveys were currently carried off east coast of Peninsular Malaysia. The first and the second surveys were carried out by M.V. SEAFDEC, a training vessel belong to the Training Department, SEAFDEC (Rosidi et al 1998). The former was conducted in September 1995, during the pre Northeast monsoon whilst the later was conducted in April to May 1996, during the post Northeast monsoon. The third surveys was carried out by K.L. CERMIN, a training vessel belong to the Fisheries Training Institute, Department of Fisheries, Malaysia, in May to June 1998, which was during off season of Northeast monsoon (Sasakura, 1999). The scientific echo-sounder used in the first two surveys were FQ-70 and in the third survey FQ-70M was used. Both equipment is similar in specification and is comparable. All the three surveys were aimed to estimate fish biomass in the area.

Materials and Methods

The average values of the back scattering area (SA) from the three acoustic surveys that had been carried out currently off east coast of Peninsular Malaysia were compiled (Note: SA values are index of fish availability). Only the SA values happened to be surveyed on the same transacts or stations for the three surveys were selected and used in the analysis. A total of 66 data of SA values were selected i.e. 22 data for each survey. All SA values were linked and analyzed for percentile rank using basic function in Excel to standardize the range at 0%, 20%, 40%, 60%, 80% and 100%. Based on these, five ranges of distributions were endorsed in Marine Explorer (i.e. 0% to 20%, 20% to 40%, 40% to 60%, 60% to 80%, 80% to 100%).

The SA data were arranged into the vector format, to enable them to be treated and analyzed by the Marine Explorer. The distributions of SA values for the three surveys were then mapped individually using the Marine Explorer and the maps were compared.

Results and Discussion

Distributions of SA value s off east coast of Peninsular Malaysia for the three surveys are shown in Fig. 3, Fig. 4 and Fig. 5 respectively. High concentrations of SA values were observed at the northern part of the study area in the first survey (Fig. 4) and in the third survey (Fig. 5). However, in the second survey (Fig. 4), the SA values were relatively low and scattered.

The SA values are index to indicate the availability of fish resource, and therefore the fish abundance within the survey area. Findings from this analysis, therefore indicated that the most potential fish ground off east coast of Peninsular Malaysia is probably in northern part of the waters.

The findings of this analysis also indicated that the fish abundance was concentrated during off season (starting in May) to pre season of Northeast monsoon. However after the monsoon, the fish were dispersed and move out to the offshore waters of the South China. The same conclusions were derived by Department of Fisheries Malaysia (1987) and Mansor and Abdullah (1985).

Programs Of SEAFDEC/MFRDMD To Promote And Optimize The Application Of Marine GIS In The Southeast Asian Region

The general objective of MFRDMD, the forth department of SEAFDEC, which has been established in 1992, is to provide assistance to the member countries of SEAFDEC for development and management of marine fisheries resources in waters of Southeast Asia. Since then, this department has played her role actively to achieve the above objective, such as coordinating and conducting researches, training, seminars, workshop and dissemination of information. In parallel with the above activities, the department has always looked forward for the possibilities to venture into new scopes or disciplines and also to be equipped by the most advanced and sophisticated tools. As the center for sustainable development and management of marine fisheries for the Southeast Asian region, MFRDMD has realized the necessity to promote and optimize the application of marine GIS in the region. In line with these, the department has taken the initiative to

introduce and promote the application of Marine Explorer, a marine GIS, in this region. Some of the activities that have been considered by the department are:

1. To be fully equipped and familiarized with GIS facilities.
2. To analysis on the correlation of marine fish distribution to the marine environment in the EEZ of the member countries.
3. To participate in the regional and international activities concerning the application of GIS in marine fisheries.
4. To introduce and train researchers from the member countries on the application of Marine Explorer.

A unit of marine GIS facilities comprises hardware (computer and printer) and software (Marine Explorer) has been established at MFRDMD in 1999. The activity at present is mainly to familiarize the application of the marine GIS. Two series of training had been conducted in 1999, coordinated by Environmental Simulation Laboratory Inc, Japan. Another training is planned to be in February 2000. At the same time, data of the resource surveys, oceanographic and biological studies within EEZ of the member countries will be compiled for further analysis. In 1999, MFRDMD participated in two international functions to present works on the application of Marine Explorer (Rosidi et al 1999[1], 1999[2]). Application of Marine Explorer has also been introduced into the regional training course on acoustic held at MFRDMD. Another activity that would to be considered is to establish regional team to work on Marine Explorer. GIS does not necessary to stand alone as a discipline. It is a tool to be fully applied in fisheries research and management. Those involve in this field should be exposed to this technology.

Acknowledgements

We wish to thank the Chief of MFRDMD, Mr. Ismail Taufid bin Md. Yusoff and the Deputy Chief of MFRDMD, Mr. Hitoshi Fujita for their support to establish GIS facilities at MFRDMD, which enable us then to perform this project. We also wish to thank the organizing committee of the 4th Regional Workshop On Shared Stock for giving us the opportunity to present our tiny work.

References

1. Aronoff, S. 1995. Geographic information systems, a management perspective, WDL Publication, Ottawa, Canada.
2. Department of Fisheries Malaysia. 1987. Deep sea fisheries resource survey within the Malaysian Exclusive Economic Zone, 2.
3. Isaak, D.J. and W.A Hubert. 1997. Integrating new technologies into fisheries sciences, the application of geographic information systems, Fisheries, 22 (1), 6 - 10.
4. Itoh K. 1999. Marine Explorer for fisheries science, presented in the First International symposium on GIS in Fishery Sciences, Seattle, USA.
5. Mansor M.I and S. Abdullah. 1995. Growth and mortality of Indian mackeral *(Rastrelliger kanagurta)* and slender scad *(Decapterus russelli)* off the east coast of Peninsular Malaysia, Sci. Mar. 59, 533 - 554.
6. Meadan G.J. and T.D. Chi. 1996. Geographical information systems, application to marine fisheries, FAO Fisheries technical paper, 356.
7. Rosidi A., A.C. Gambang, H. Rajali, R.B.R. Hassan, S. Basir, K. Shiomi and S. Fujiwara. 1998. Application of the acoustic method in biomass estimation of multispecies fish in the South China, J. Korean Soc. Fish, Res., 1(1), 157 - 167.
8. Rosidi A., R.B.R. Hassan, T.R.T. Mohamad, M. Ibrahim, N. Seman and T. Nishida. 1999[1]. Introduction and application of the Marine Geographical Information System (Marine GIS) in understanding the spatial distribution of marine fish resources in Southeast Asian region, a case study in the Exclusive Economic Zones of Malaysia. Presented in First International Symposium in Fisheries Science, Seattle, USA.
9. Rosidi A., R.B.R. Hassan, S. Fujiwara and K. Shiomi. 1999[2]. Presented in 3rd JSPS International Seminar on Fisheries Sciences In Tropical Area, Bali, Indonesia.
10. Sasakura, T. 1999. Final report of the national acoustic survey within waters of Malaysian EEZ, 1997/1998.

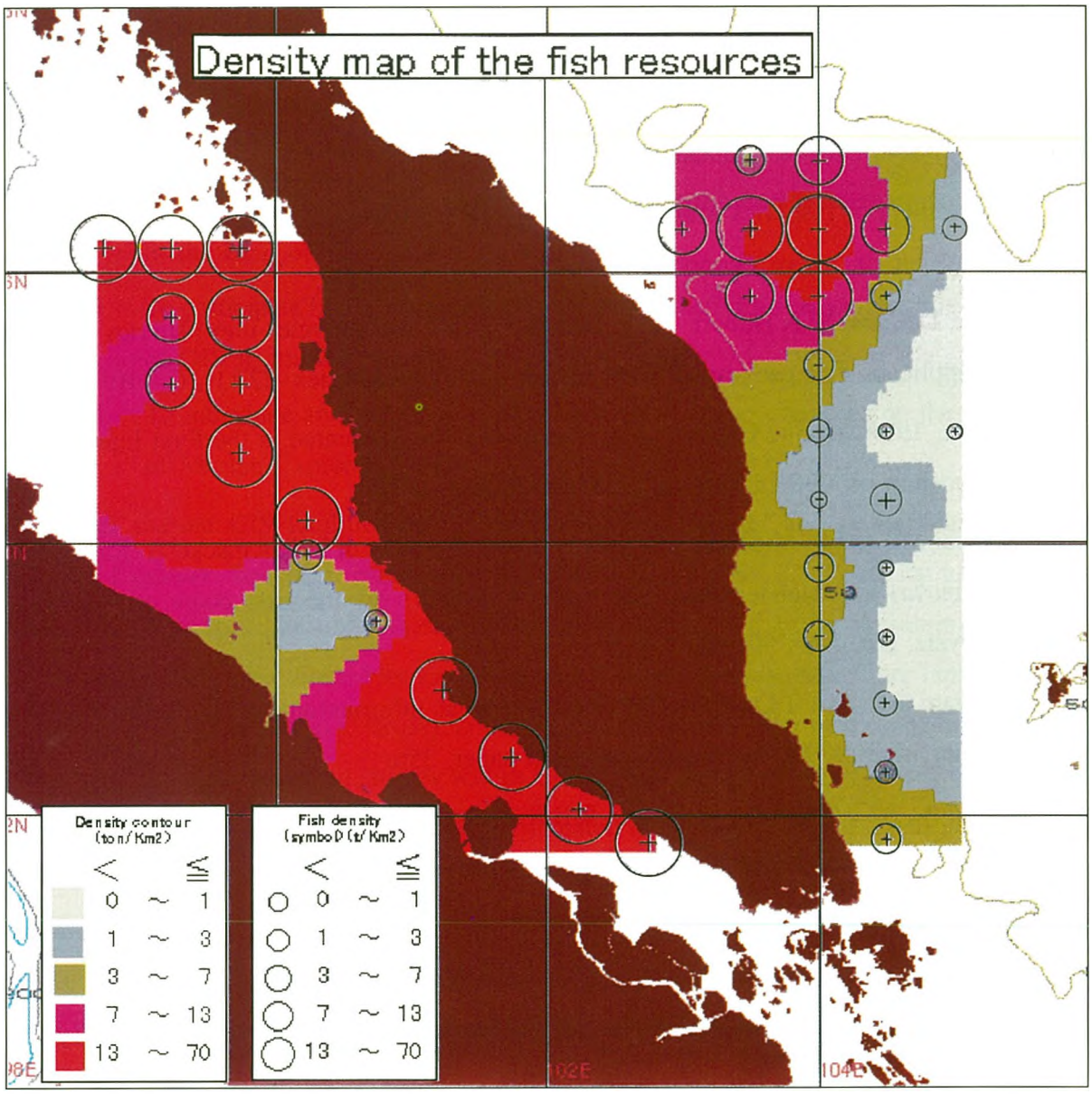


Figure 1: Distribution (by symbol and contour) of fish densities off west and east coast of Peninsular Malaysia

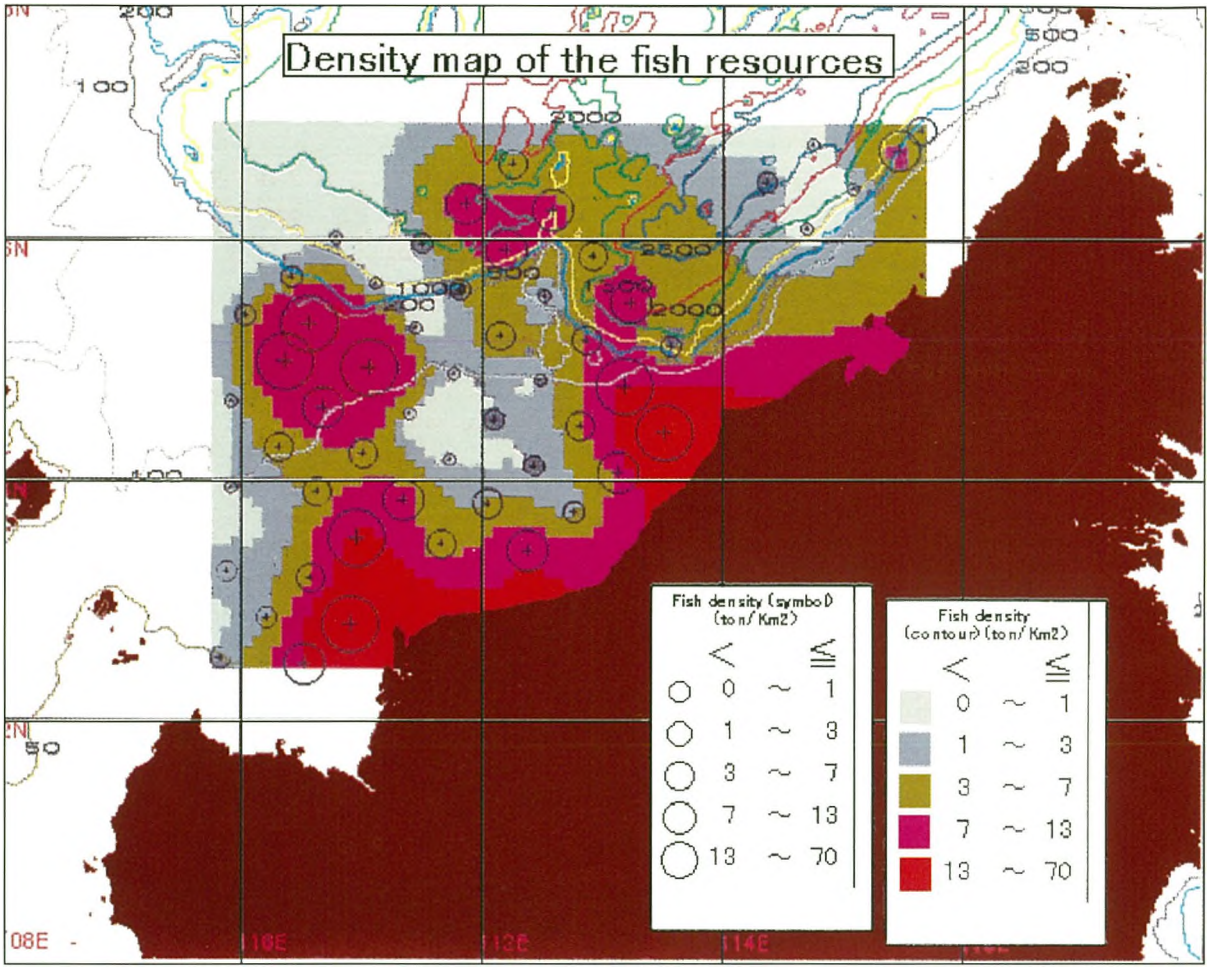


Figure 2: Distribution (by symbol and contour) of fish densities of East Malaysia (Sarawak and Sabah)

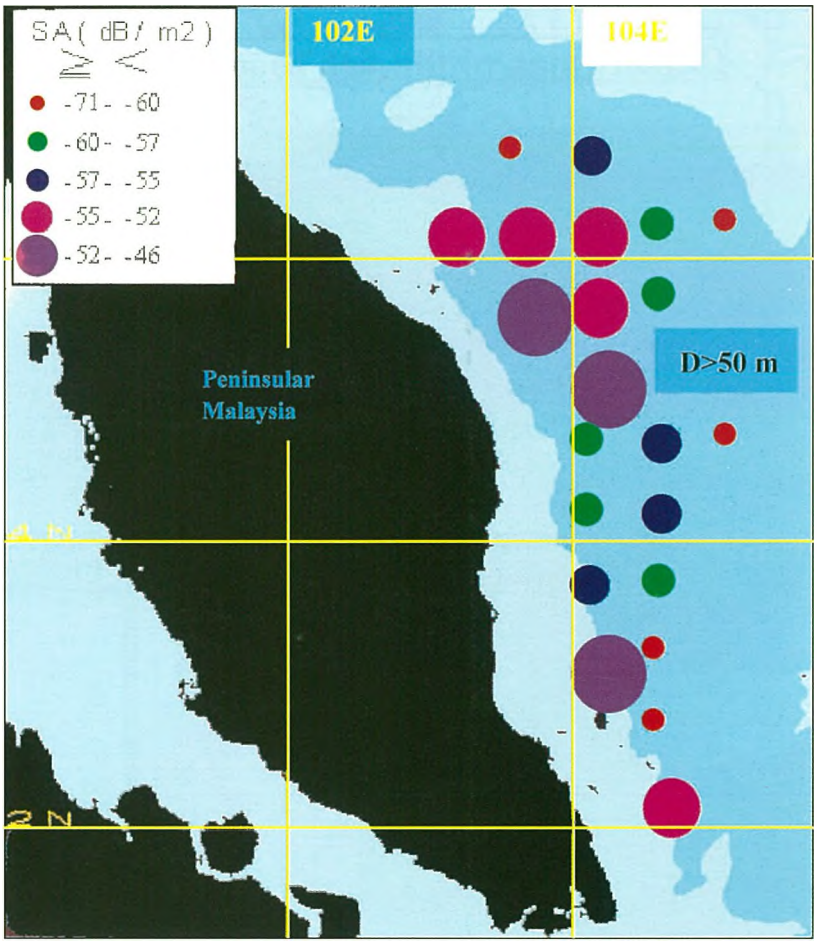


Fig. 3: Distribution of the average SA values (dB/m^2) off east coast of Peninsular Malaysia based on the acoustic survey by M.V. SEAFDEC carried out during the pre Northeast monsoon in September,1995.

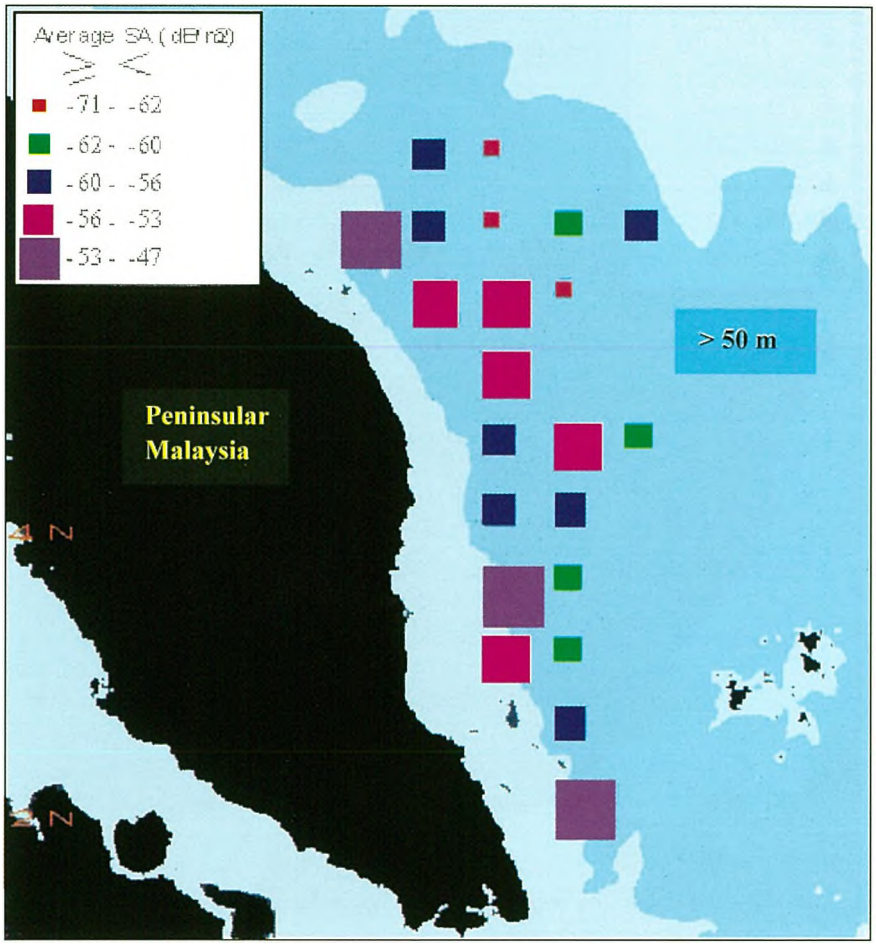


Figure 4: Distribution Of Average SA (dB/m^2) Off East Coast Of Peninsular Malaysia By Acoustic Survey Carried Onboard M.V. SEAFDEC During The Post Northeast Monsoon (NE) In April to May, 1996.

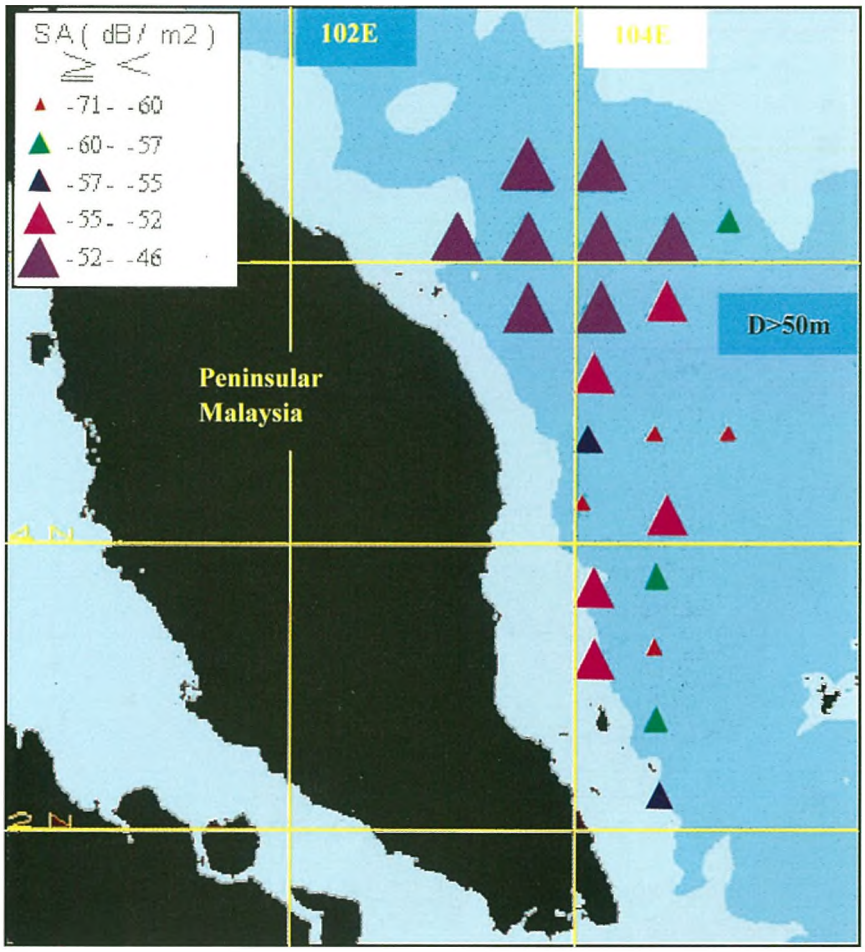


Fig. 5: Distribution of the average SA values (dB/m^2) off east coast of Peninsular Malaysia based on the acoustic survey by K.L. CERMIN carried out during off monsoon season in May to June, 1998.