Annex 13

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

Kuala Terengganu, Malaysia 24th - 26th January 2000

REVIEW ON STATUS AND BIOMASS OF PELAGIC FISHERY RESOURCES IN THE SOUTH CHINA SEA AREA

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Review on Status and Biomass of Pelagic Fishery Resources in the South China Sea Area

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Abstract

A series of acoustic survey had been conducted by MFRDMD by using MV SEAFDEC in collaboration with TD and other SEAFDEC Member Countries for the last 4 years. Since then four areas have been covered namely the Gulf of Thailand and East Coast of Peninsular Malaysia, Sarawak-Brunei and Sabah, Western Philippines and Vietnam waters. A similar study using KL CERMIN was also conducted in the EEZ of Malaysian waters in 1998. Both vessels were equipped with the scientific echo sounder FQ70, which is very reliable to collect back scattering values (sv) data that is useful for stock determination. Biological information for dominant species is provided through sampling program or fishing operations. Estimation of pelagic biomass was made based on biological parameters of representative species in each survey area. This paper will present the status and estimation of pelagic biomass based on collaborative study and national surveys conducted by Member Countries.

Keywords, Scientific echo-sounder, back scattering layers, species composition, biomass estimation.

1. Introduction

The ocean resources especially fisheries resources are the common treasure of human that should be kept and utilized in proper manner to secure as protein supply for future generations. Fisheries resources could be estimated with various tools, one of which by proper acoustic survey. SEAFDEC has conducted a series of acoustic survey by deploying MV SEAFDEC in South China Sea area. South China Sea is one of the major fishing grounds in the world where many country depend, on fisheries for export, livelihood and other economic benefits. However, fishing activities in certain areas are limited due to climatic conditions. During southwest and northeast monsoon seasons, only few large-scale fishermen operate in offshore area while the artisanal fishermen concentrate along the coastal waters. Anyway, it might be necessary to assess the potential of the fish resources before they are being exploited.

Fish stock assessment is a growing necessity in many countries in Southeast Asian countries. Previously in many countries, stock assessment is only based on landed catch data or swept area method survey. However, there is a potential to adopt a new method in determining fish stocks i.e. hydro-acoustic. As in other tropical regions, South China Sea area has a similar fish biological characteristic such as the distribution and abundance of multi-species and all year round spawning. The inherent characteristics of fisheries hinder the collection of reliable landing statistics throughout the area. A suitable fish stock assessment methods is not readily available in this region. SEAFDEC has been making efforts to develop appropriate methods using hydro-acoustics (Rosidi *et al.*, 1998). Application of scientific hydro-acoustic equipments in assessing fish population seems to be a more appropriate means among others to meet overall goal of the rapid fish resources assessment, although the method does not give a complete answer for the tropical multi-species condition. But, it is an

effective way to assess new fishing grounds where statistics are not sufficient and to provide baseline information for the fishery management.

This paper will present the status and estimation of pelagic resources in the South China Sea based on acoustic study conducted by SEAFDEC and other national research institute of Member Countries.

2. Materials and Methods

2.1 Survey area and period

Table 1 indicates the survey areas and periods for SEAFDEC acoustic survey since 1995. The first survey covers area of the Gulf of Thailand and East Coast of Peninsular Malaysia. The second one surveyed in Sarawak, Brunei and Sabah. While the third and fourth cruises, devoted to the western part of Philippines and Vietnamese waters respectively. A similar survey in the EEZ of Malaysia was also carried out in 1998. The survey was conducted in three consecutive periods from March to August 1998. Survey was repeated for the West Coast of Peninsular Malaysia after a critical advice by the project consultant. The second survey had spent more time as the vessel speed was reduced from 10 knot to less than 8 knot. However both cruises had covered the same number of stations but started from different location. The first cruise had begun from Langkawi to Johore while the second cruise started from Johore to Langkawi.

The acoustic survey in the East Coast was kick off from Genting while for Sarawak and Sabah waters was departed from Kuching. Map 1 and 2 shows the cruise tracks in the West and East Coast of Peninsular Malaysia and Sabah & Sarawak waters respectively.

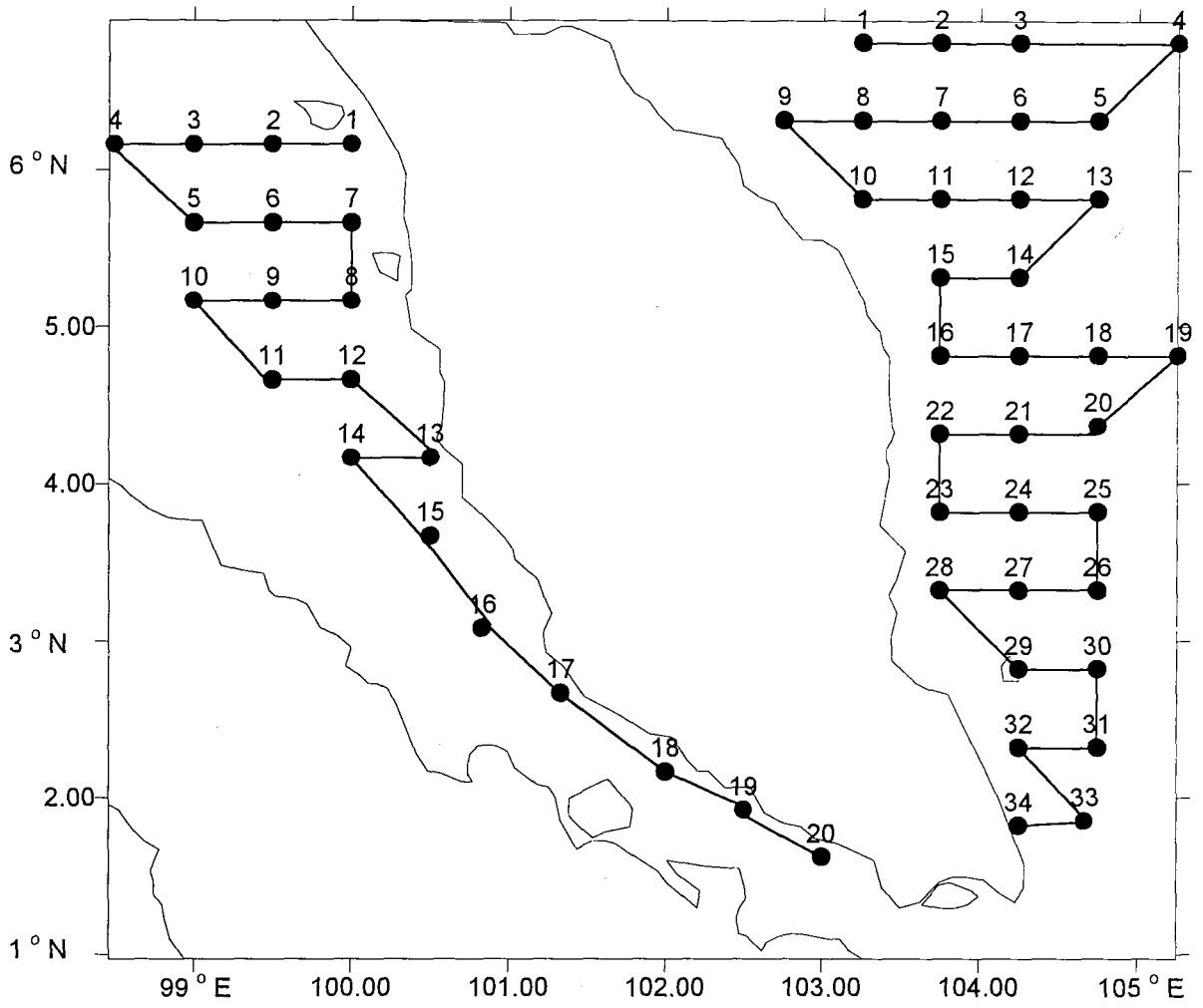
A total of 16 tracks were covered during the 1st survey in the West Coast of Peninsular Malaysia, while 19 tracks were recorded in the 2nd survey. The first survey not covered the parallel or perpendicular tracks to the coastline whilst all transects were surveyed during the second cruise. Only a single track was designed from station number 14 to station no. 20 due to narrow navigation area and quite not safe for fishing boats.

The same characteristics of cruise track were designed for the East Coast of Peninsular Malaysia to cover the coastal waters as well as offshore areas. Restricted areas such as the oil field grounds were excluded from the survey. A total of 23 tracks were recorded for the east coast with the total distant travels about 690 nautical miles.

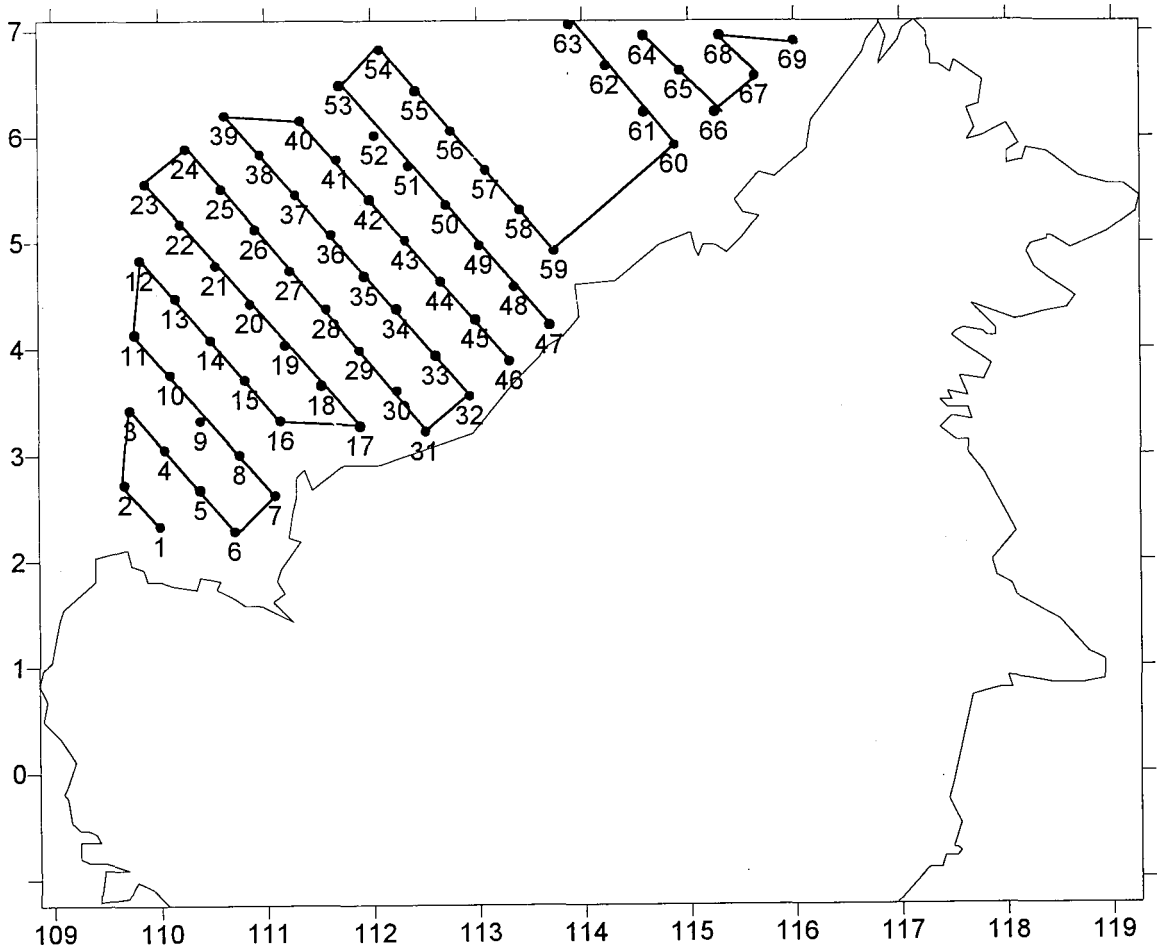
In Sarawak and Sabah (Map 2) a total of 56 transect were surveyed from 8th July to 5th August 1998. However these area not covered the coastal and offshore area of Brunei Darussalam. It is also not covered the East Coast of Sabah due to safety reasons.

Table 1: Survey areas and periods

Survey area	Period	Duration	Remarks
Gulf of Thailand and East coast of Peninsular Malaysia	5th to 28th September 1995	24 days	Pre-NE monsoon (1st Area)
Gulf of Thailand and East coast of Peninsular Malaysia	24th April to 17th May 1996	24 days	Post- NE monsoon
Sarawak, Brunei and west coast of Sabah	10th July to 2nd August 1996	22 days	Pre-NE monsoon (2nd Area)
Sarawak, Brunei and west coast of Sabah	1st May to 24 May 1997	24 days	Post-NE Monsoon
Western Philippines	18th April to 7th May 1998	20 days	(3rd Area)
West Coast of Peninsular Malaysia (KL CERMIN)	24th to 30th March 1998	7 days	First survey *national project
	8th to 24th November 1998	10 days	Re-survey
East Coast of Peninsular Malaysia	24th May to 6th June 1998	14 days	Post-NE Monsoon
Sabah & Sarawak waters	8th July to 5th Aug. 1998	29 days	Post-NE Monsoon
Vietnam waters	29th April to 29th May 1999	30 days	(4th Area under SEAFDEC)



Map 1: Survey transects for acoustic off West Coast and East Coast of Peninsular Malaysia (Number indicates the oceanographic survey stations)



Map 2: Acoustic tracks for Sarawak and Sabah

MV SEAFDEC carried out two acoustic surveys in the Gulf of Thailand and off the East Coast of Peninsular Malaysia. The first survey was conducted during the pre-Northeast (NE) monsoon season from September 5 to 28, 1995. The second survey was carried out during the post-NE monsoon season from April 24 to May 1996 (Albert *et al*, 1997).

MV SEAFDEC carried out another two acoustic surveys off Sarawak, Brunei and West Coast of Sabah from July 10 to August 2, 1996 and the second one from May 1st to May 24, 1997.

In April-May 1998, the interdepartmental collaborative research program in the South China Sea (Area III) off western Philippines commenced through SEAFDEC/MFRDMD coordination. The study was conducted with the inclusion of ocenographic and other activities. This is the first ever acoustic survey done in Philippines waters.

The fourth phase of SEAFDEC collaborative study has been decided in Vietnamese water in the South China Sea area. The survey runs simultaneously with the oceanographic survey and other fishery related projects from 29 April to 29 May 1999.

2.2 Research Vessel

MV SEAFDEC (Photo 1) was deployed to carry out research activities under a special program called "SEAFDEC interdepartmental collaborative research" with two major players, Training Department (TD) and the Marine Fishery Resources Development and Management Department (MFRDMD). The other partner is the Member Countries where the survey area was decided.

For the national project, the survey was carried out by training vessel KL CERMIN (Photo 2) which is 162 GRT purse seine vessel with 29.05 m overall length and 7.2 m width. She cruising with full compliment of 12 crew members and manage to accommodate another 10 scientific members on board. The vessel has the capability to stay at sea for 12 days.

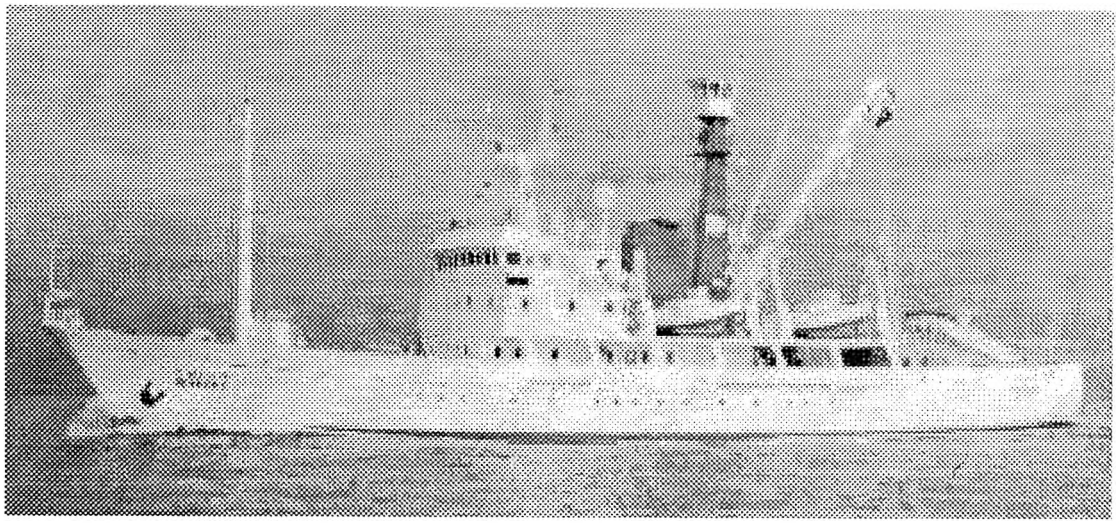


Photo 1: MV SEAFDEC used for SEAFDEC collaborative study

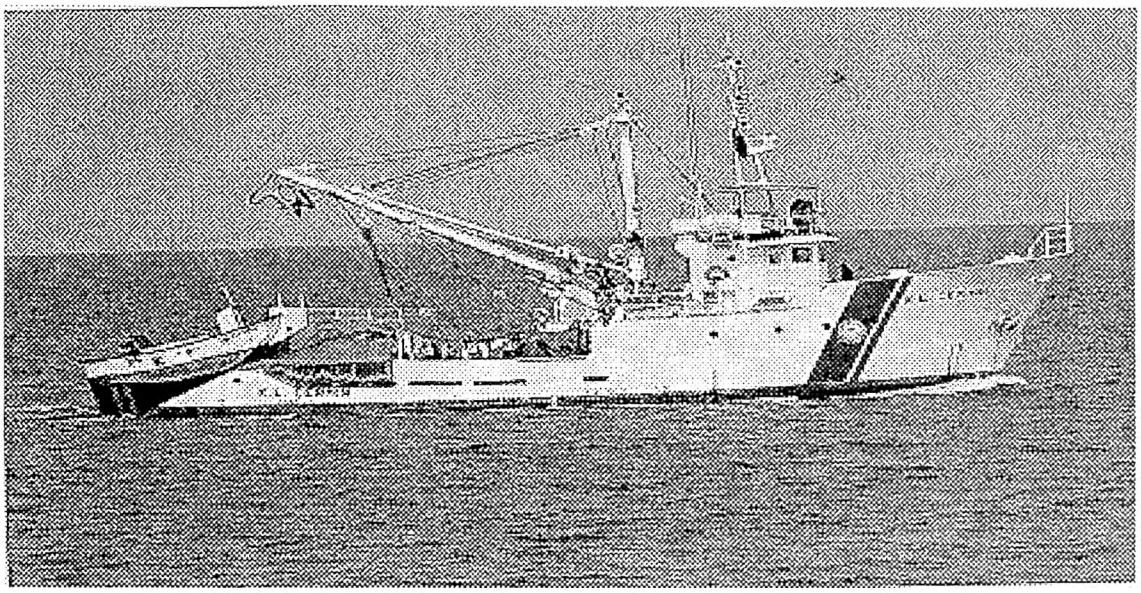


Photo 2: Picture of KL CERMIN used for national acoustic survey

2.3 **Biomass Estimation**

The following expression is used to estimate the fish biomass.

$$Q = (sv / ts).w.a.d \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where; Q = Biomass

$sv = 10^{(sv/10)}$: Backscattering strength

$ts = 10^{(ts/10)}$: Target strength

w = average fish weight (g)

a = survey area (m^2)

d = layer depth (m)

Target strength (TS) was estimated using the Furusawa (1990) equation

$$TS = 20 \log SL - 66 \quad \ldots\ldots\ldots\ldots \quad (2)$$

Where, TS = Target strength (dB)

SL = Fish Standard Length (cm)

3. **Results**

Table 2 indicates the estimated biomass and density of pelagic fish in the South China Sea area. It was obvious that estimation during pre and post Northeast monsoon produced significant different of pelagic resources. Pre-monsoon observed more abundant of pelagic in the survey area.

Table 2: Estimation of biomass and fish density in the South China Sea.

Survey Area	**Area (km2)**	**Density (tonnes/km2)**	**Biomass (tonnes)**
Gulf of Thailand			2,7574,770 (pre) 1,323,150 (post)
East Coast Peninsular	111,129	2.07 1.74	230,037 (pre) 193,364 (post)
East Coast Peninsular	117,892	6.2	730,930 (post)
West Coast Peninsular	31,579	9.8	309,651 (post)
Sarawak and Sabah	303,679	5.6	1,710,703 (post)
Coastal Sarawak	61,378	1.61 5.87	98,819 (pre) 360,289 (post)
Sarawak, Brunei, and Sabah			1,717,852 (pre) 956,396 (post)
Western Philippines	88,749	18.9	1,677,356 (post)
Vietnam waters (coastal)	24,000	17.5	420,000 (post)

In general observation, pelagic fish were found more abundant in coastal area than offshore. It was clearly shown in Vietnamese water and the Gulf of Thailand. However in Sarawak, pelagic were found in large school in between the contour line of 100m to 200m. Similar observations were recorded during pre and post NE monsoon season.

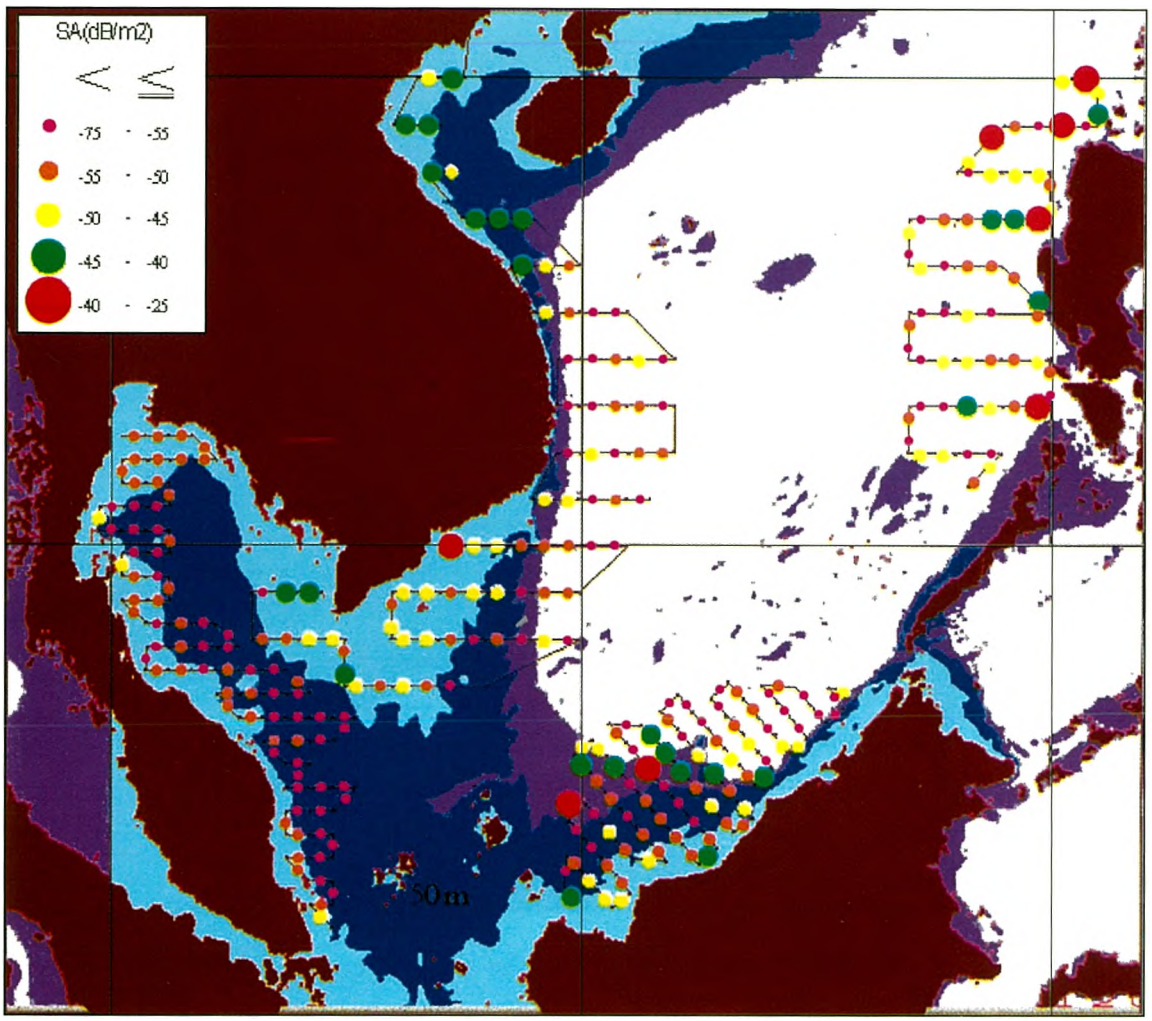


Figure 1: Distribution Map of SA in the South China Sea (created by Mr. S Fujiwara)

In the Philippines, pelagic were recorded higher in the North and South compared to the other parts in Philippines. However, this occurrence was believed correlated to the convergence and divergence process in that area (Penjan *et al*, 1999).

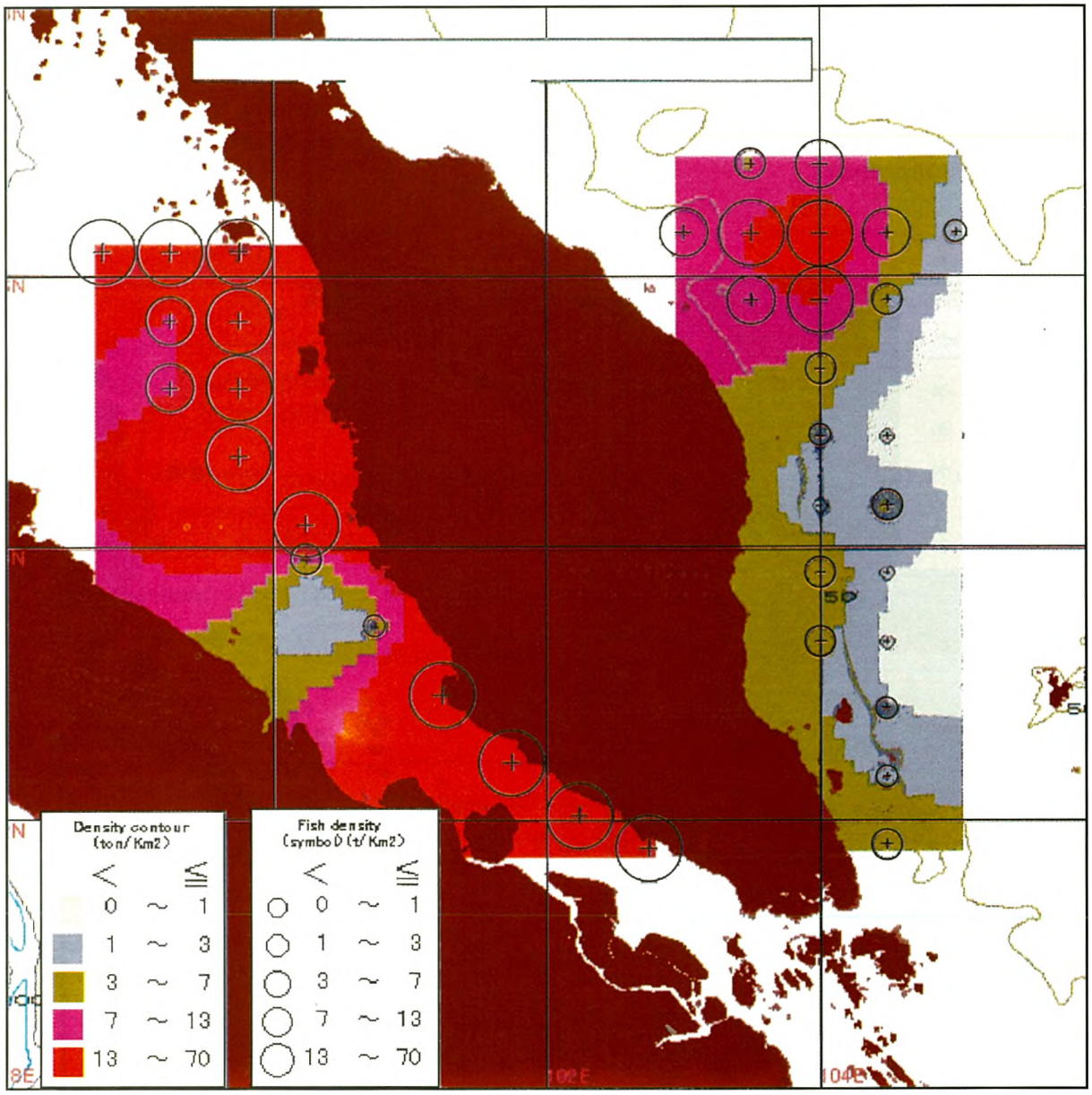


Figure 2: Distribution of pelagic fish density in the west and east coast of Peninsular Malaysia

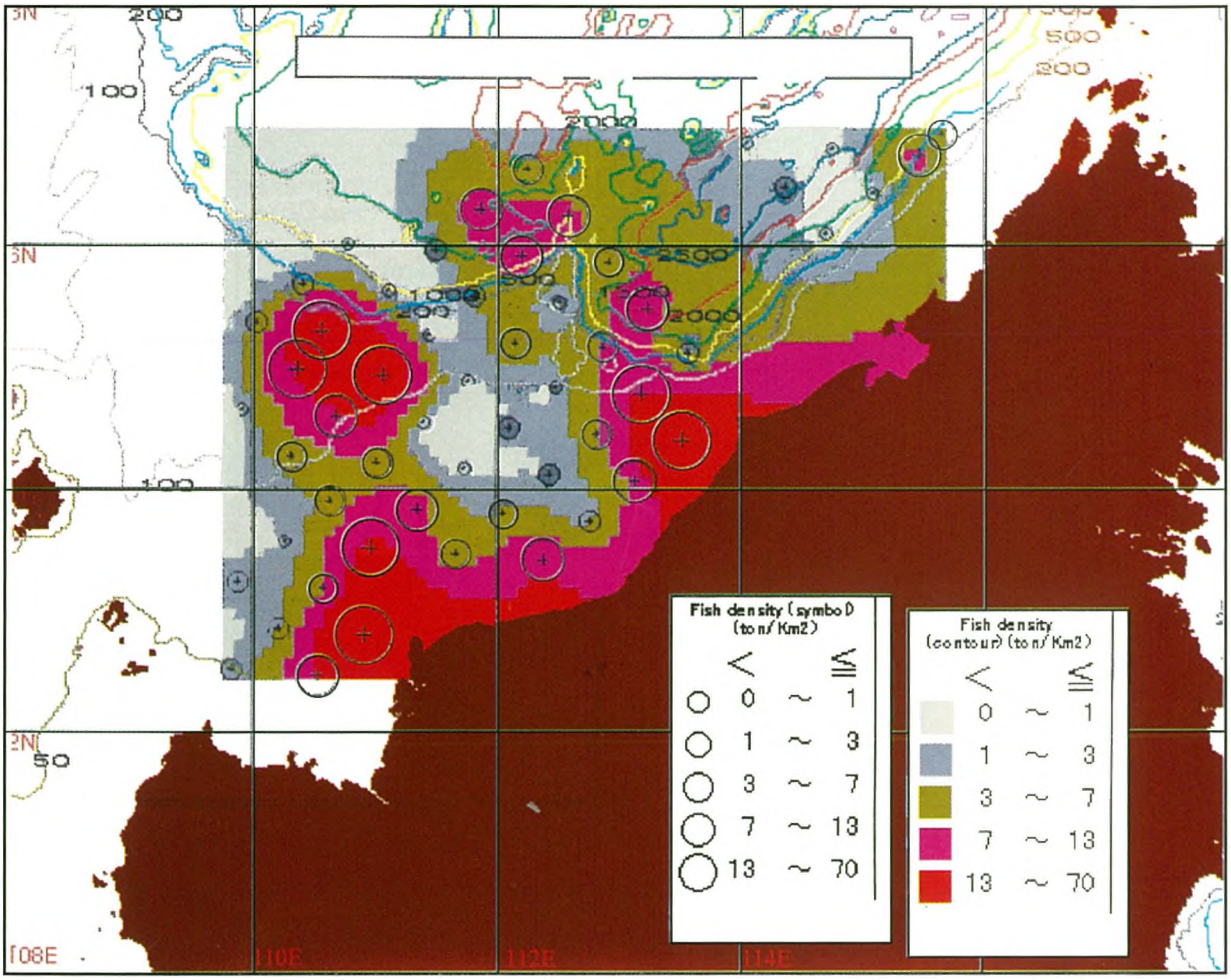


Fig 3: Distribution of pelagic fish density in Sarawak and Sabah

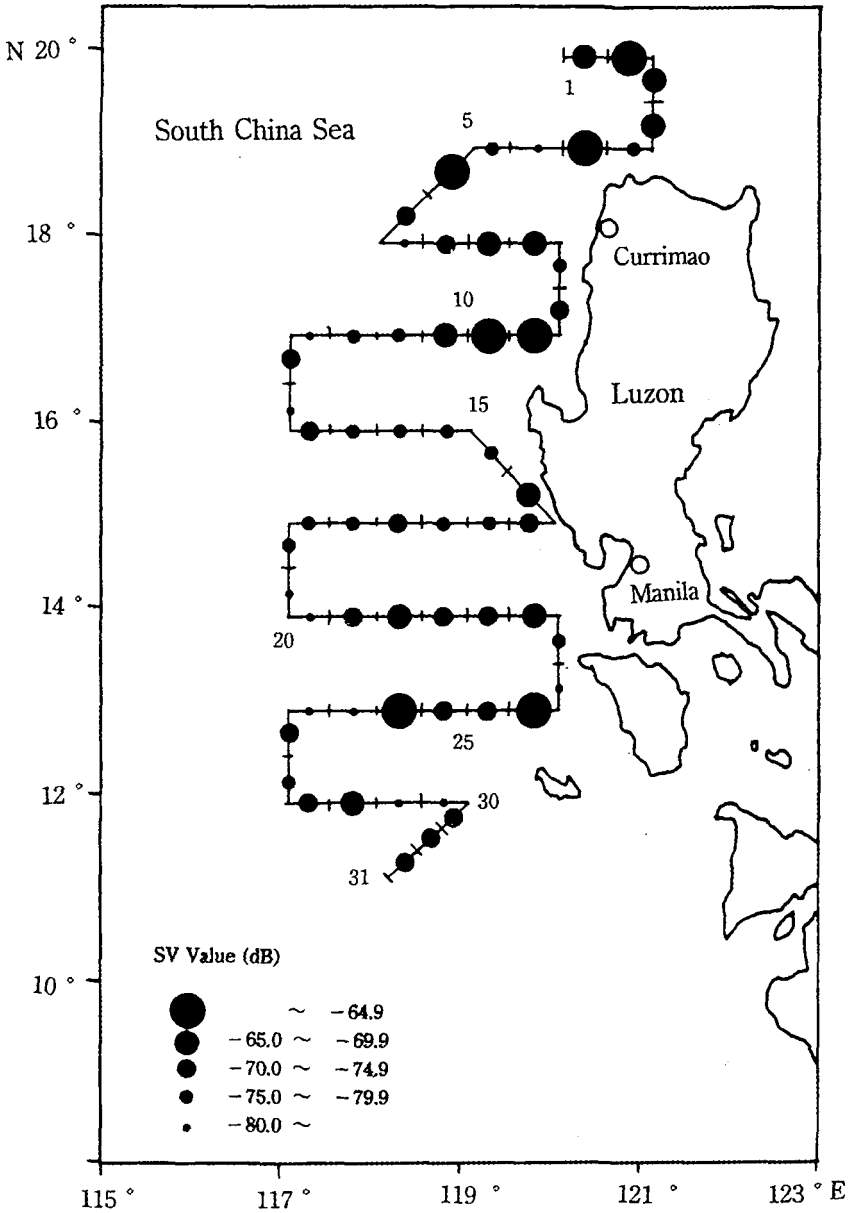


Figure 4: Distribution pattern of SV along the Transect off the western coast of Philippines in April/May, 1998. Numbers indicate the oceanographic stations.

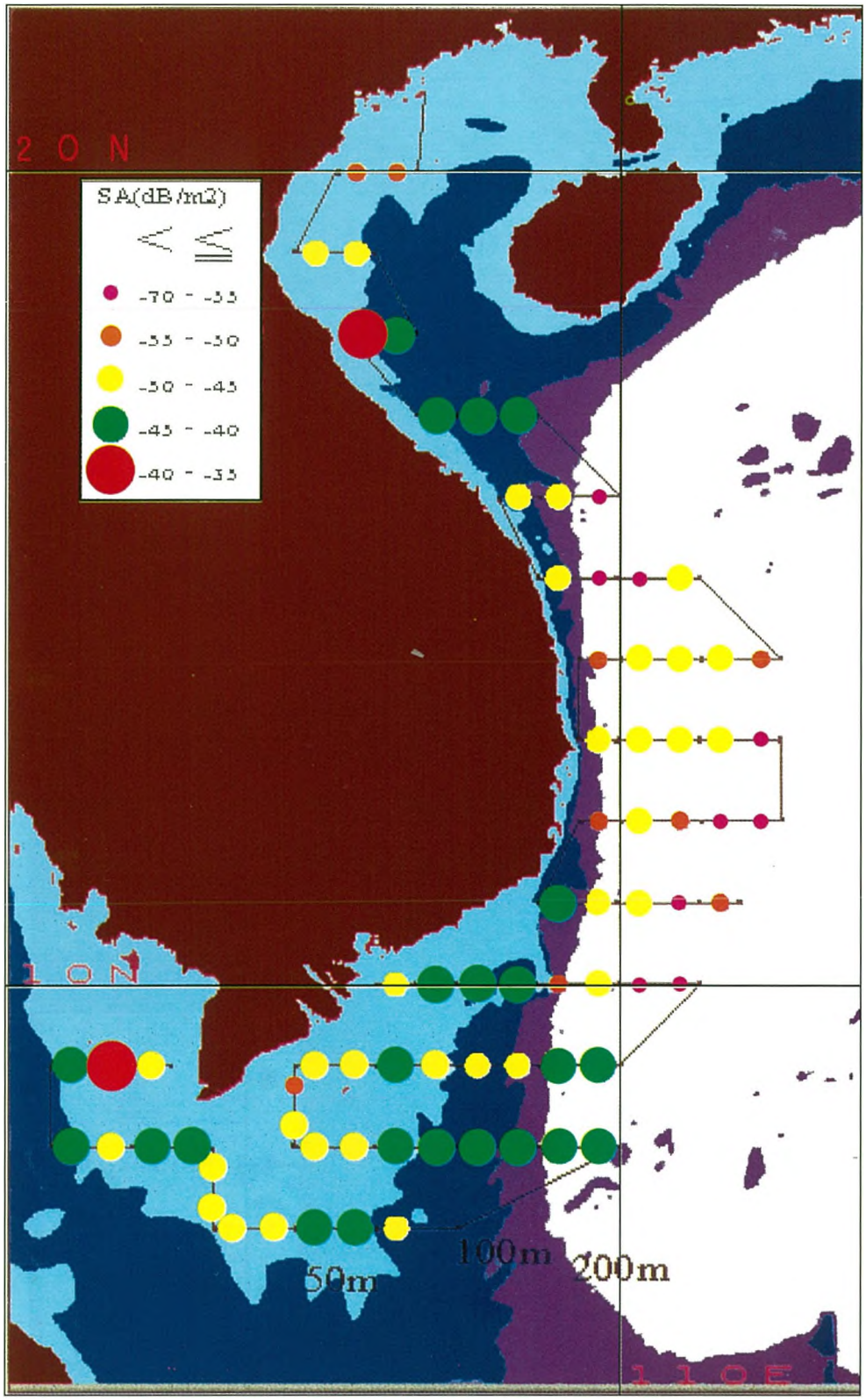


Figure 5: Distribution of SA during post Northeast monsoon (low freq.)

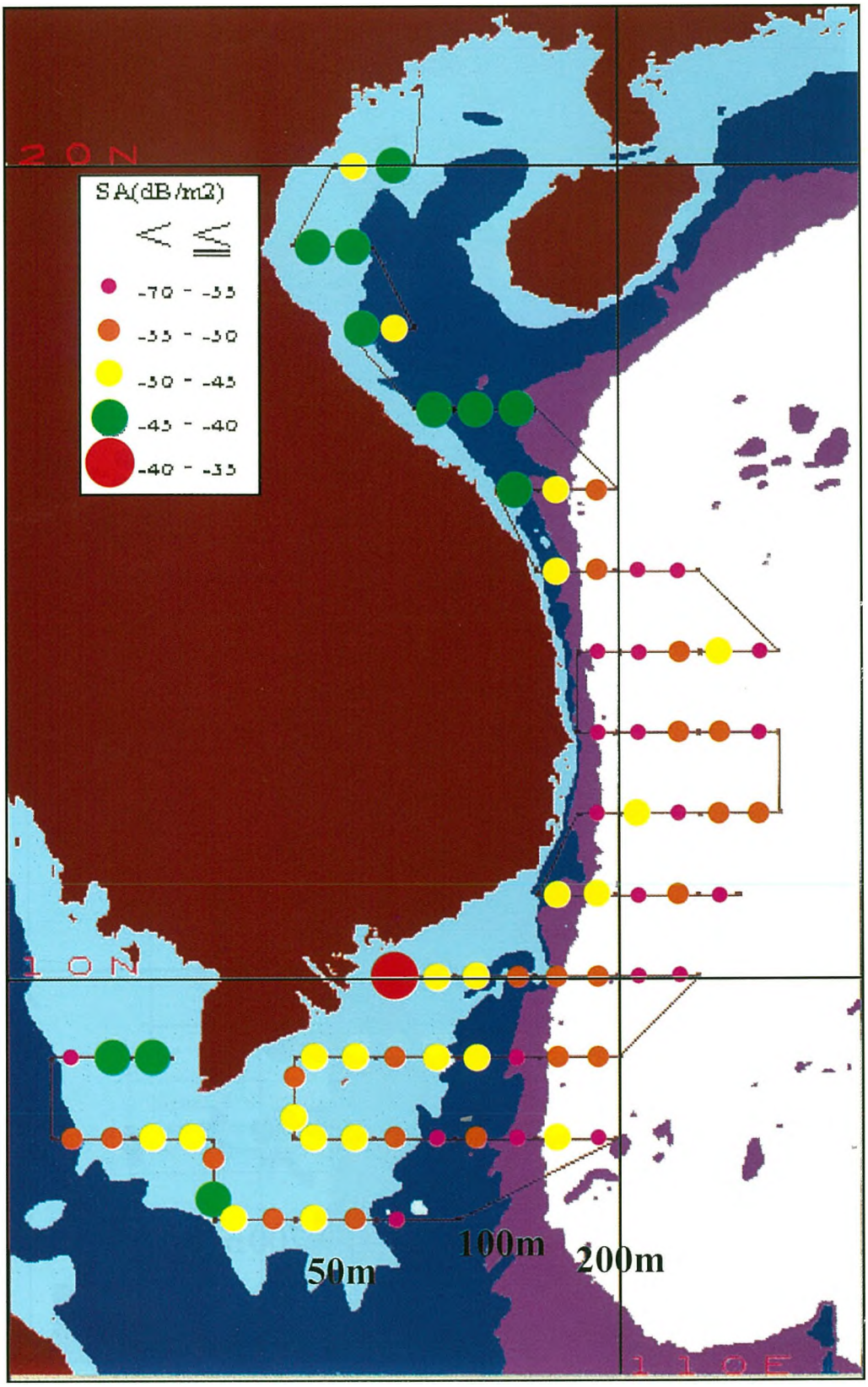


Figure 6: Distribution of SA during post Northeast monsoon season (High Freq.)

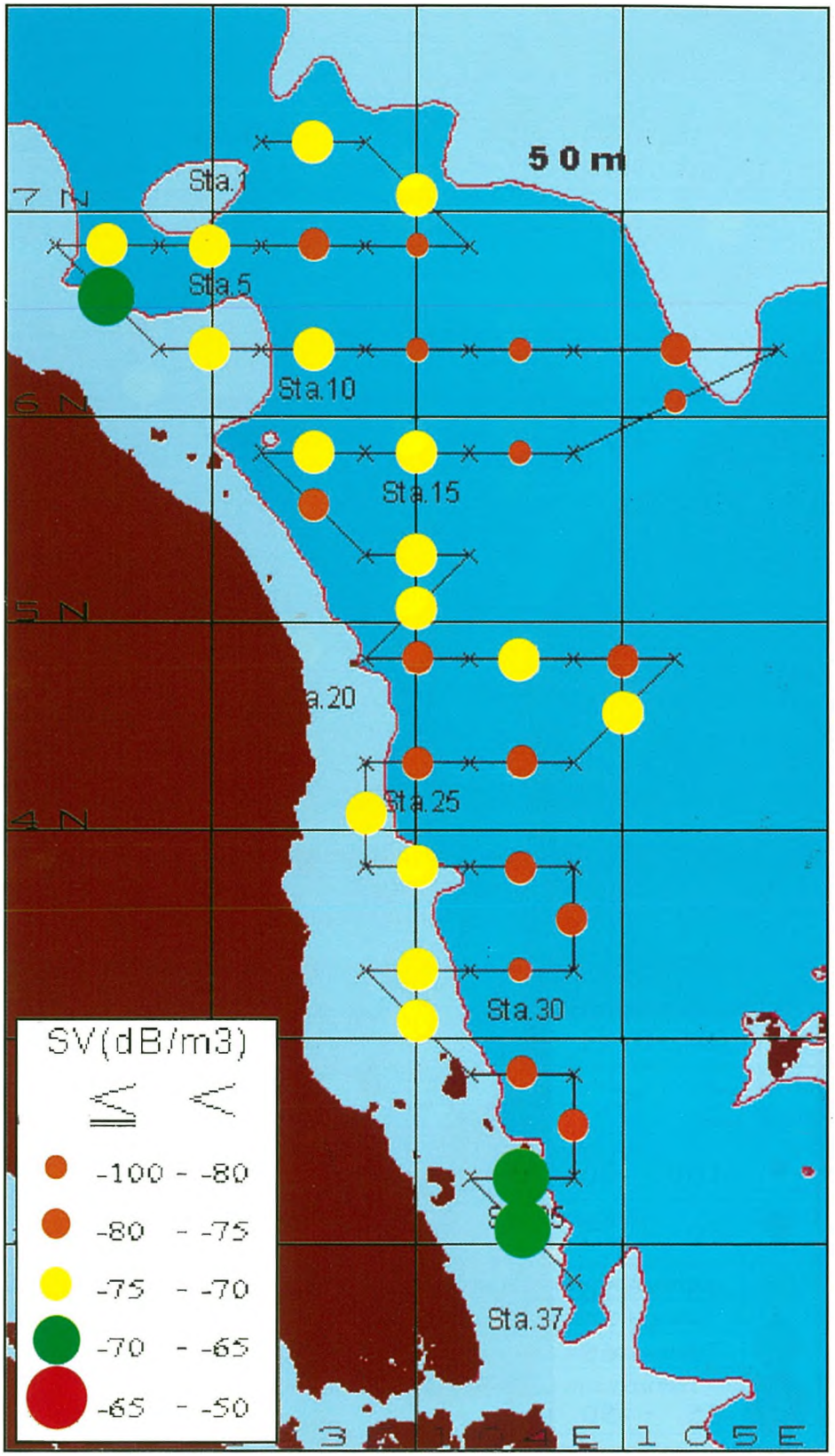


Figure 7: Distribution of SV for the east coast of Peninsular Malaysia (low freq.)

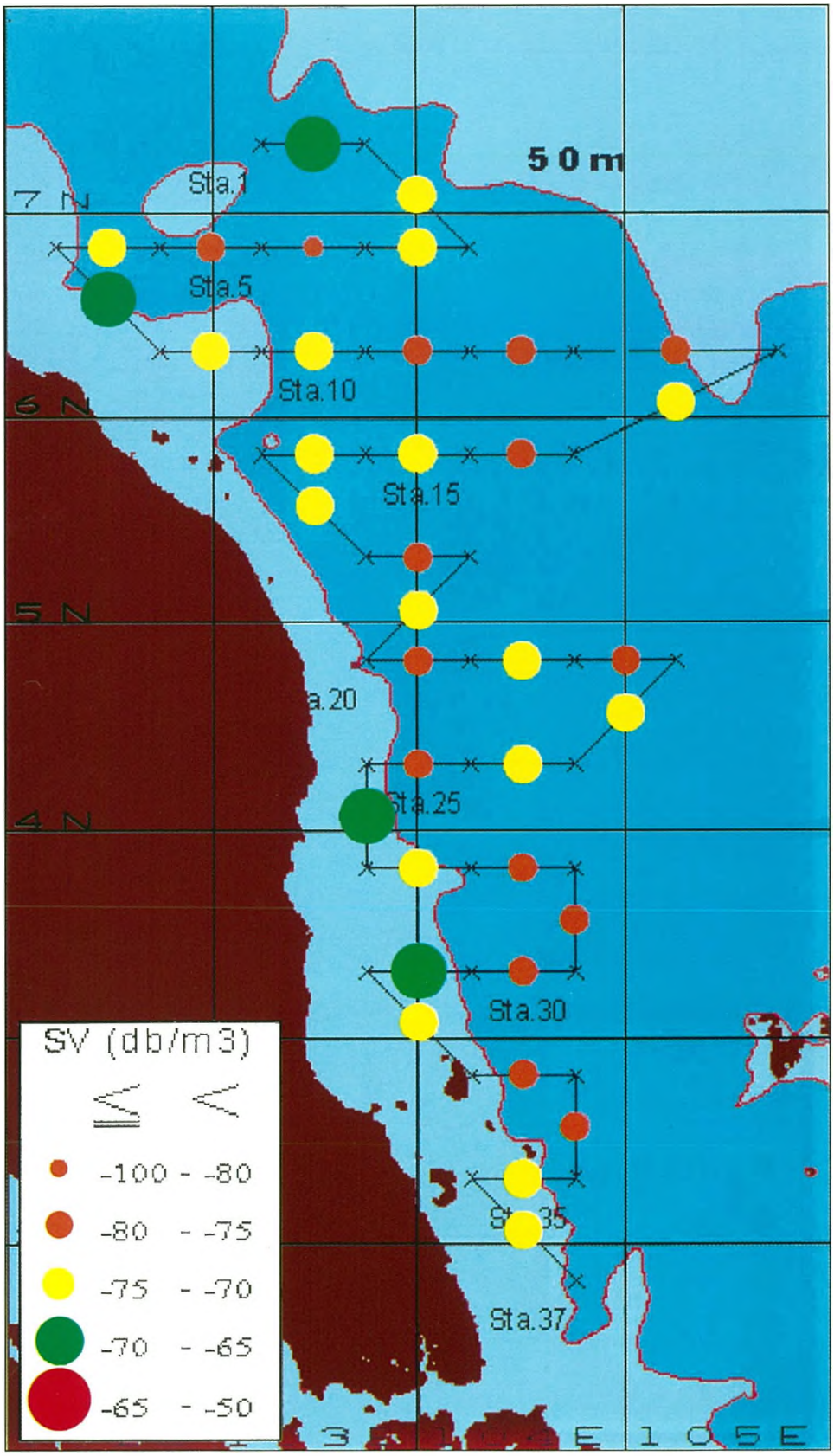


Figure 8: Distribution of SV for the East Coast of Peninsular Malaysia

4. Discussion

4.1 *Resource fluctuation*

Pelagic resources were very well known that fluctuate from time to time depending on season and availability of food source in the area. As the species migrate, it would influence the abundance of such species in the area. Other oceanographically parameters were also important to determine occurrence of these resources. Plankton and thermocline layers were considered as dependant factors for occurrence of pelagic such as tuna. Temperature may also influence but not clearly shown in tropical waters.

4.2 *Dominance pelagic species*

Table 3 indicates the dominant pelagic species used for calculation of estimated biomass in the South China Sea. Species determination was based from the results of sampling program or fishing operations and the annual fishery statistics of the countries concern. In area I, no fishing operation was carried out to determine the dominance species. As the result, historical data from national statistics were used during data analyses.

Scads, Sardin and Indian mackerels are the common species found in the South China Sea. Scads which comprising the roundscads were harvested widely by purse seiners in Sabah and Sarawak and the East Coast of Peninsular Malaysia. The same group of pelagic was also found in Philippines and Vietnam waters. In the West Coast of Peninsular Malaysia recorded higher percentage of Indian mackerel in catch.

Fishing operations for sampling were conducted in area III and IV, but the data collected not good enough to portray the whole survey area. In such cases, the estimated biomass most probably incurred some level of error either overestimated or underestimated.

Table 3: Dominant and representative species used for biomass estimation

Survey Area	**Author**	**Species**	**Estimated Biomass**
Gulf of Thailand	Yutana *et al.*	*Sardinella gibbosa*	2,754,770 (pre) 1.323,150 (post)
East Coast Peninsular	Albert *et al.*	*Decapterus russelli*	230,000 (pre) 190,000 (post)
East Coast Peninsular	DOF	*Selar crumenophthalmus*	730,000 (post)
West Coast Peninsular	DOF	*Rastrelliger brachysoma*	130,000 (post)
Sarawak and Sabah	DOF	*Decapterus macrosoma*	1,710,000 (post)
Coastal Sarawak	Hadil *et al.*	*Decapterus macrosoma*	100,000 (pre) 360,000 (post)
Sarawak, Brunei and Sabah	Yutana	*Sardinella gibbosa*	1,717,852 (pre) 956,396 (post)
Western Philippines	R. Bidin *et al.*	*Decapterus macrosoma*	1,672,000 (post)
Vietnam waters (coastal)	R. Bidin *et al.*	*Decapterus maruadsi*	420,000 (post)

5. Conclusion

The contribution of pelagic fishery to the total landings of Member Countries is significant. In Malaysia about 30 % of the total landings were contributed by surface fishery. A similar trend was observed in Thailand, where pelagic catch accounted about 33% to 38% of the annual total landing. In Indonesia, many purse seiners were used, as trawlers were not allowed fishing in their waters. Therefore contribution from the surface fishery is higher compared to other Member Countries. Brunei also recorded higher percentage of pelagic in their catch or accounted more than 50%.

Acoustic techniques provide rapid and continuous measurements throughout the water column and more complete information on the distribution and behavior of pelagic schooling fishes. Compared to temperate area, the schooling bahavior in tropical waters were more scattered and loose. In addition, the school itself is mixed with multi-species and size which hinder proper recording of the specific target strength.

Biomass estimation using acoustic method would be more meaningful, if representative species of pelagic could be determine for every survey transect. So far, only single species of pelagic was used for calculation of the whole specific study area. The current procedure is not an ideal one due to limited technology and resources for proper sampling.

6. Acknowledgement

The authors would like to thank the Director General of Fisheries Malaysia, Y. Bhg. Dato' Mohd. Mazlan b Jusoh for his permission to conduct the surveys and present this paper. Appreciation also goes to Mr. Ismail Taufid Mohd. Yusoff, the Chief of MFRDMD for his encouragement and guidance to the project success.

Thanks also due to Dr. T. Sasakura, the president of SASA Labo Company for his critical comments during operation of this project. Last but not least, the authors would like to thank acoustic researchers from TD, MFRDMD, BFAR, RIMP, FRI and PPN Sabah for their active participation in data collection and processing.

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