Spatio-temporal variations of oceanographic features & their influences on pelagic fishery in the Straits of Malacca using GIS analysis

MUSSE GABOBE HASSAN[1], MOHD. IBRAHIM HJ MOHAMED[2], MOHD. AZMI AMBAK[3], ABDUL RASHID MOHAMED SHARIFF[4] AND H.YANAGAWA[5]

EMAS (Gold)

PROJECT SUMMARY

Pelagic fishery is economically important and associated with spatio-temporal coastal oceanographic changes. Understanding and to manage the resources sustainably requires knowledge on resource distributions and abundance and their relations to spatio-temporal characteristics of the area. Pelagic fish populations in the Straits of Malacca (SOM) have shown fluctuating catches from early 1980s. To understand the reason of such events, a study on the variations of oceanographic features and their impacts on availability of pelagic fisheries had been performed. ArcView 3.2 GIS software was used to determine the spatio-temperal variability of the oceanographic parameters. Variations in commercial fish catch landing, Catch Per Unit Effort (CPUE), several acoustic surveys and sea surface temperatures from 1980-2001 were analyzed using the general linear modeling in order to examine the possible inter-relationships among them. Based on statistical analysis, the null hypothesis that environmental factors mainly sea surface temperature have no effect on pelagic fishery resources was subsequently rejected and the alternative hypothesis was accepted.

INTRODUCTION

Pelagic fishery is universally of economic importance. It is characteristically associated with coastal oceanographic changes, which cause considerable variations in their distributions and abundance over time and eventually fluctuate their catch. Fishery resources are capable of growth in abundance and biomass but only up to a certain limit. Environmental variability can influence the availability of fish to the fishery by dispersing or concentrating fish schools.

Using GIS techniques which has powerful functions for integrating and overlaying spatially referenced data-sets potentially hidden patterns and relationships can be analysed.

Fig. 1: a) *Rastrelliger kanagurta* & b) *Megalaspis cordyla*

Fig. 2:Typical a) Trawl Net & b) Purse seine Nets

RESULTS

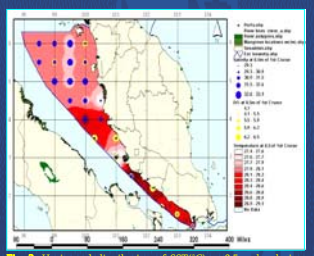

Fig. 3: Horizontal distribution of SST(˚C) at 0.5m the during first (northeast monsoon) MASDEC expedition.

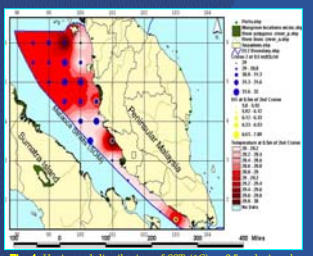

Fig. 4: Horizontal distribution of SST (˚C) at 0.5m during the second (post northeast monsoon) MASDEC expedition.

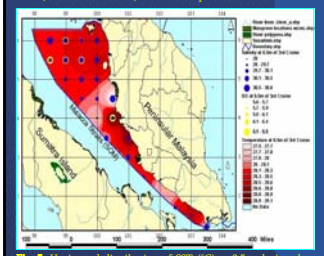

Fig. 5: Horizontal distribution of SST (˚C) at 0.5m during the third (southwest monsoon) MASDEC expedition.

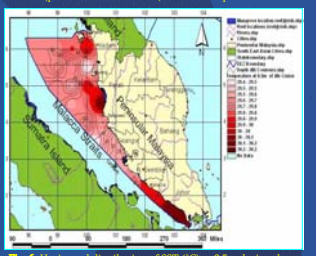

Fig. 6: Horizontal distribution of SST (˚C) at 0.5m during the fourth (southwest monsoon) MASDEC expedition.

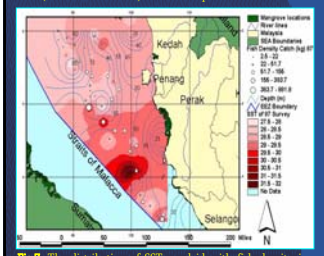

Fig.7: The distribution of SST overlaid with fish density in catch (kg) captured during acoustic surveys for fishery resources along the SOM in 1987.

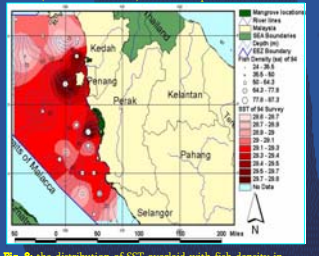

Fig. 8: the distribution of SST overlaid with fish density in (sa) determined during acoustic surveys for fishery resources along the SOM in 1994.

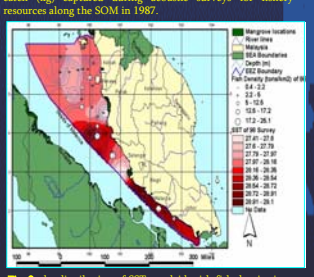

Fig. 9: the distribution of SST overlaid with fish density in tones/km determined during acoustic surveys for fishery resources along the SOM in 1998.

General Linear Modeling Analysis of Acoustic Survey During 1987

Dependent Variable	Parameter	B	Std. Error	t	r^2	Sig.
Density (ln Catch/kg)	Intercept	-3151.8	4118.1	-0.77	-	0.453
	SST	36.22	21.39	1.69	0.44*	0.006
	LONG	22.12	38.61	0.57	0.59**	0.573
	LAT	-5.26	25.38	-0.21	0.63**	0.838

General Linear Modeling Analysis of Acoustic Survey During 1994

Dependent Variable	Parameter	B	Std. Error	T		Sig.
Density (ln/km)	Intercept	-103198	29985.7	-3.44	-	0.003
	SST	687.55	313.72	2.19	0.74**	0.004
	LONG	857.64	296.82	2.89	0.27	0.009
	LAT	121.96	163.18	0.75	-0.29	0.464

General Linear Modeling Analysis of Acoustic Survey During 1998

Dependent Variable	Parameter	B	Std. Error	t		Sig.
Density (ln/km)	Intercept	-212.94	219.37	-0.97	-	0.35
	SST	9.97	1.33	7.5	0.88**	0
	LONG	-0.6	2.12	-0.29	0.58	0.78
	LAT	-0.3	1.68	-0.18	-0.47*	0.86

Table 1: Estimation results for general linear modeling of ddensity in catch (tons/kg) versus sea surface temperature, latitude and longitude.

Project Potential

This project has the potential to:

1. predict changes in catch based on changes in oceanographic parameters;
2. develop mechanisms for fishery management to achieve sustainable development and
3. produce integrated database for fishery managers and other decision makers in the SOM.

Project Achievments

1. Characterize the environmental fluctuations at different times
2. Identify the relationships between these fluctuations and the distribution of pelagic fishery resource and
3. Produce map demonstrating the abundance and spatial distribution of pelagic fish stocks

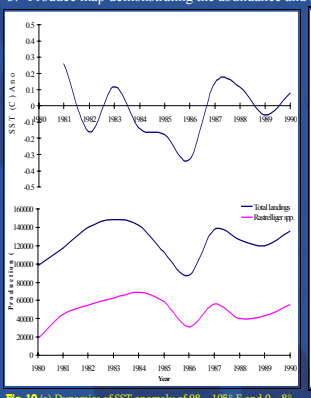

Fig. 10 (a) Dynamics of SST anomaly of 98 – 105° E and 0 – 8° N from 1980-1990. (b) Dynamics of total pelagic fish catch and Indian mackerel (MT) in the SOM, 1980 – 1990.

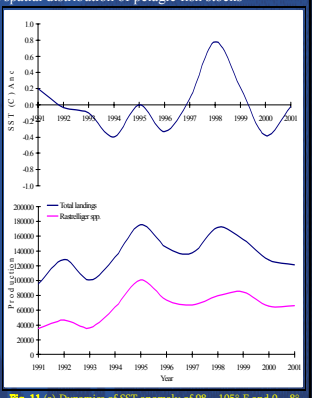

Fig. 11 (a) Dynamics of SST anomaly of 98 – 105° E and 0 – 8° N from 1991-2001. (b) Dynamics of total pelagic fish catch and Indian mackerel (MT) in the SOM, 1991 – 2001.

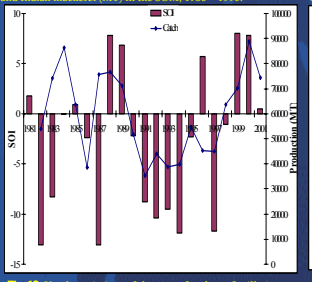

Fig. 12: Yearly variations of the mean Southern Oscillation Index and purse seine catches from 1981-2001.

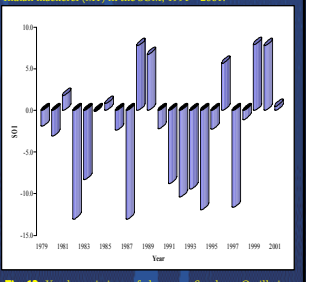

Fig. 13: Yearly variations of the mean Southern Oscillation Index (SOI), an El Nino index from 1979-2001.

Journals & Conference Papers

1. Musse G. H., H. M. Ibrahim, M. A. Ambak, M. S. Abdul Rashid and H. Yanagawa. 2002. Distribution of pelagic fish resources and relationships with oceanographic features in the Straits of Malacca using GIS. In Tropical Marine Environment: Charting Strategies for the Millennium. F.M. Yusoff, M. Shariff, H.M. Ibrahim, S.G. Tan & S.Y. Tai (eds.), p. 775-791. Malacca Straits Research and Development Centre (MASDEC), Universiti Putra Malaysia, Serdang, Malaysia.
2. Musse G. H., H. M. Ibrahim, M. A. Ambak, M. S. Abdul Rashid, T. Namba and H. Yanagawa 2002. Distribution and abundance of small pelagic fishery resources in the Straits of Malacca and, their relationships with oceanographic changes using GIS analysis. Science International, 14(2), 129-141, 2002.
3. Musse, G.H., H. M. Ibrahim, M. A. Ambak, M. S. Abdul Rashid and H. Yanagawa 2003. The impacts of spatio-temporal oceanographic phenomenon on the small pelagic fishery in the Straits of Malacca. Submitted to Fisheries Research.
4. Musse, G. H., H. M. Ibrahim, M. A. Ambak, M. S. Abdul Rashid and Yanagawa H. 2002. Spatio-temporal variations of oceanographic features and their influences on pelagic fishery in the Straits of Malacca using GIS analysis. To appear in conference proceeding of the Second International symposium on GIS/Spatial Analysis for fishery sciences, 3-7 Sept, 2002 Sussex, Brighton, UK. (Submitted for Proceedings)
5. Musse G. H., H. M. Ibrahim, M. A. Ambak, M. S. Abdul Rashid & H. Yanagawa. Spatio-temporal characteristics of pelagic fisheries in the Straits of Malacca and their relations to physical oceanographic variations. Accepted for Oral Presentation at Asia-Pacific Conference on Marine Science and Technology (APCMST), Istana Hotel, Kuala Lumpur, 12 – 16 May 2002. (Submitted for Proceedings).
6. Musse, G. H., H. M. Ibrahim, M.A. Ambak, M.S. Abdul Rashid and H. Yanagawa. 2002. Spatio-temporal sea surface temperature characteristics and their relation to availability of pelagic fisheries in the Straits of Malacca using GIS analysis. To appear a conference proceeding in Third Malaysian remote sensing and GIS conference: Spatial Information Technologies in the New Millennium. 8 – 9 April 2002, legend hotel, Kuala Lumpur. Malaysian Centre for Remote Sensing, Kuala Lumpur, Malaysia. (Submitted for Proceedings)

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Author's Information

[1] Ph. D Candidate, Department of Environmental Sciences, FSAS Universiti Putra Malaysia 43400 Serdang, Selangor, Malaysia

[2] Professor and Director of Malacca Straits R & D Centre (MASDEC), Faculty of Science & Environmental Studies, UPM.

[3] Dean of Faculty of Science and Technology, Kolej Universiti Sains dan Teknologi, Mengabang Telipot 21300 Terengganu, Malaysia.

[4] Head of Dept. of Biology and Agricultural Engineering, Faculty of Engineering, Universiti Putra Malaysia.

[5] JICA Expert, Caribbean Fisheries Training and Development Institute, Port of Spain Republic of Trinidad and Tobago, West Indies.

EARTH OBSERVATION LABORATORY
PUTRA ENVIRONMENTAL LABORATORIES
DEPARTMENT OF ENVIRONMENTAL SCIENCES, FSAS
UNIVERSITI PUTRA MALAYSIA, 43400 SERDANG, SELANGOR MALAYSIA