Asia-Pacific
Economic Cooperation

Workshop on Sustainable Fisheries Development in the Region

Ha Noi, Viet Nam
15–17 February 2006

APEC Fisheries Working Group

June 2006

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Asia-Pacific
Economic Cooperation

FWG 02/2004/001

Agenda
Workshop on Sustainable Fisheries Development in the Region

Submitted by: Viet Nam

FWG 02/2004

Ha Noi, Viet Nam
15-17 February 2006

Workshop on Sustainable Fisheries Development in the Region

15 - 17, February 2006

Fortuna Hotel, 6B Lang Ha, Ha Noi, Viet Nam

Day 1: Wednesday, February 15, 2006

MORNING

08:30 - 09:00 Registration

Chaired and Moderated by H.E Mr. Luong Le Phuong, Mr. Nguyen Viet Manh, Mr. Nguyen Chu Hoi, Viet Nam

09:00 - 09:30 **Opening Session**

Introduce on the project FWG 02-2004 by Mr. Nguyen Viet Manh, Deputy Director of International Cooperation Department, Ministry of Fisheries of Viet Nam.

Address by FWG Lead Shepherd - Dr. David Chang (*for Mr. James Sha*)

Welcoming Remarks by H.E Mr. Luong Le Phuong, Vice Minister of Fisheries of Viet Nam.

09:30 – 10:00 Coffee break

10:00 - 11:10 Toward representative system of Marine Protected Areas in Vietnam

Speaker: *Mr. Nguyen Chu Hoi, Assoc. Prof. Dr. Vietnam Association of Natural and Environmental Conservation*

Questions and Answers

11:10 - 12:30 International Legal Regime

Speaker: *Mr. Stetson Tinkham, Deputy Director, Office of Marine Conservation, US*

Questions and Answers

12:30 - 14:00 Lunch break

AFTERNOON

Chaired and Moderated by Mr. Nguyen Viet Manh, Mr. Nguyen Chu Hoi, Viet Nam

14:00 - 14:40	Area Closure: An Experience of Sustainable Fisheries Development in Thailand. Economy report: Thailand
Speaker:	*Mr. Smith Thummachua, Ph.D., Senior Fishery Biologist and Chief, Oversea Fisheries Management and Economic Cooperation Group, Department of Fisheries, Ministry of Agriculture and Cooperatives, Thailand* Questions and Answers
14:40 - 15:50	Consumer demand for sustainable fisheries
Speaker:	*Mr. Frazer MacGilvray, Marine Stewardship Council's Asia* Questions and Answers
15:50 - 16:10	Coffee break
16:10 - 17:20	Application of Satellite remote sensing for biological resources.
Speaker	*Ms. TANG DanLing, Professor, The South China Sea Institute of Oceanology* Questions and Answers

End of day 1

Evening Activity:

18:30 - 20:30	*Welcoming dinner, hosted by Deputy Minister of Fisheries of Viet Nam*
Venue:	***Fortuna Hotel, 6B Lang Ha Street, Ha Noi.*** *All speakers and participants to the Workshop are warmly welcome to attend*
Dress code:	***Smart casual.***

Day 2: Thursday, February 16, 2006

MORNING

Chaired and Moderated by Mr. Stetson Tinkham– US, Mr. Nguyen Viet Manh, Mr. Chu Tien Vinh – Viet Nam

08:30 - 09:10	Main Measures on the Protection of Resources for a Sustainable Fisheries in Malaysia - Economy report: Malaysia
Speaker:	*Mr. Sukarno bin Waginman, Department of Fisheries Malaysia* Questions and Answers
09:10 - 10:25	Sustainable fisheries exploitation in Vietnam
Speaker:	*Mr. Chu Tien Vinh, Dr., Center for Technology Transfer of Aquatic Resources and Environment, Vietnam.* Questions and Answers
10:25 - 10:45	Coffee break
10:45 – 12:00	Factors to consider for the sustainable development of aquaculture industry - A case study in Taiwan
Speaker:	*Mr. Yew-Hu Chien, Prof., Department of Aquaculture, National Taiwan Ocean University* Questions and Answers
12:00 – 13:30	Lunch break

AFTERNOON

Chaired and Moderated by Mr. Stetson Tinkham – US, Mr. Nguyen Viet Manh, Mr. Chu Tien Vinh – Viet Nam

13:30 - 14:40	Sustainable Aquaculture in Asia-Pacific: Concepts, Experiences and Prospects
Speaker:	*Mr. Pedro B. Beuno, Director General, Network of Aquculture Centres in Asia – Pacific - NACA.*
	Questions and Answers

14:40 - 16:00 *Speaker:*	Conservation Aspects of Marine Fisheries *Mr. NI I-Hsun, Dr. Department of Environmental Biology and Fisheries Science, National Taiwan Ocean University, Taiwan*
	Questions and Answers
16:00 - 16:30	Coffee break
16:30 - 17:30	Questions and Answers

Day 3: Friday, February 17, 2006

MORNING

Chaired and Moderated by Mr. Stetson Tinkham - US, Mr. Nguyen Viet Manh, Mr. Pham Van Tho – Viet Nam

08:30 - 09:50	Technology of fisheries exploitation and post-harvest conservation.
	Mr. Pham Van Tho, Dr., National Aquaculture Services Company - NASCO – Vietnam
	Questions and Answers
09:50 - 11:00	Trade issues in sustainable fisheries
Speaker:	*Mr. Greg Schneider, International Trade Specialist NOAA Fisheries Service, US:*
	Questions and Answers
11:00 - 11:15	Coffee break
11:15 – 12:30	Briefing and Closing remark from by Mr. Stetson Tinkham
12:30 – 14:00	Lunch break

AFTERNOON

Free

END OF WORKSHOP

Asia-Pacific
Economic Cooperation

FWG 02/2004/002

Introduce on the Project: FWG 02/2004 Workshop on Sustainable Fisheries Development in the Region

Submitted by: Viet Nam

APEC
VIET NAM 2006

FWG 02/2004

Ha Noi, Viet Nam
15-17 February 2006

STATEMENT OF MR. NGUYEN VIET MANH

DEPUTY DIRECTOR - INTERNATIONAL COOPERATION DEPARTMENT

ON THE OCCASION OF

WORKSHOP ON SUSTAINABLE FISHERIES DEVELOPMENT IN THE REGION

Your Excellency Vice Minister Luong Le Phuong,

Distinguish Participants

On behalf of the Organization Committee, today, I have my honour to express the warmly welcome all participant who join the workshop on sustainable fisheries development in APEC region.

First of all, I would like to state the workshop' reasons.

The workshop, which was initiated by Viet Nam Economy and was endorsed by APEC Fisheries Working Group and APEC Finance Committee in the annual meeting 2003 in Hanoi, is one of the Working Group projects. According to the given plan, this workshop would have been hold in 2005. However, due to some objective as well as subjective reasons, until now the workshop is hold in Hanoi. It is consider as one of the realistic activity to regit the Vietnam APEC 2006.

It is expected that the workshop will profound lots of important information on sustainable development of Fisheries, achieving the APEC objectives of sharing and wide-spreading information. The workshop also develops the practices on sustainable development, enabling the developing economies reach the chance to apply and multiply those practices within fisheries manufacture so as to gain profit, efficiency also assure the long-term sustainability. The project goals are the summary on knowledge of sustainable fisheries development and the analysis on future trend. Thereof, APEC economies could develop the planned strategy as well as complete fruitfully within aquaculture areas and fisheries.

The workshop also provide for APEC Economies an important chance to share experiences, newly raising trend in policies of aquaculture,

manufacture and international trade. It is expected to be the useful forum to multiply the beneficiaries of APEC resources, including INFOFISH, NACA. These organizations will directly benefit from knowledge changes on market conditions for Fisheries Products in region.

Finally, thanks to holding this workshop, APEC could develop a network of information which is expected to assist Economies in market access, management and solve raising problem in Fisheries.

I have the honour to introduce the guest of honour - Vice Minister of Vietnam Fisheries Luong Le Phuong

And the participants include:
- The representatives of economies: The United States; China; Hong Kong, China; Chinese Taipei; Thailand; Malaysia; Viet Nam
- The representatives of NGOs: SEAFDEC, NACA, IUCN, WWF, and MCD, VASEP
- And other Viet Nam related sectors, some Research Institute of Vietnam Fisheries and Provincial Departments for Fisheries.

I would like to introduce Mr David Chang on behalf of Mr James Sha – Chief of APEC Fisheries Working Group presents some words to the workshop.

Thank you all.

Address by FWG Lead Shepherd

The Workshop on Sustainable Fisheries Development in the APEC Region

Hanoi - Vietnam, 15-17 February 2006

Presented by Mr. David Chang
FWG Lead Shepherd Assistant

Director General, Nguyen Van Chau,
Distinguished participants

I am David Chang, Director of Overseas Fisheries Development Council of Chinese Taipei, and the Assistant to the Lead Shepherd of Fisheries Working Group. First, Mr. James Sha, the Lead Shepherd of the Fisheries Working Group wishes me to extend his apology for not being able to attend this workshop, because the Director General of the Fisheries Agency is due for an overseas trip which is overlapping to this workshop, and Mr. James Sha, being the deputy has to stay at home to be the proxy. Instead, he has asked me to represent him in this workshop. I am also asked to deliver an opening remark for him.

On behalf of the Lead Shepherd and also on behalf of Chinese Taipei, I would like to extend my congratulation to Vietnam for hosting this workshop on sustainable fisheries development in the region, an activity responding to the Year of APEC Vietnam 2006. I would also like to extend my appreciation to Mr. Nguyen Van Chau, Director General of the National Directorate of Aquatic Resources Exploitation and Protection of the Ministry of Fisheries of Vietnam, the Project Overseer of this APEC Project, and his staff for their excellent arrangement.

For the fisheries, it is timely for convening such a workshop, shortly after the adoption of the Bali Plan of Action in the 2nd APEC Ocean-related Ministerial Meeting held in September 2005. We all note in the Bali Plan of Action, we have expressed our determination to work domestically, regionally and internationally in the near to mid-term (2006-2009) towards its three objectives. They are: ensuring the sustainable management of marine environment and its resources; providing for sustainable economic benefits from the oceans; and enabling

sustainable development of coastal communities. In the Joint Ministerial Statement made during the Ocean-related Ministerial Meeting, the Fisheries Working Group and the Marine Resources Conservation Working Group were asked to rapidly set priorities and to implement the Bali Plan of Action in collaboration with relevant APEC bodies. Although the present project was approved well before the convening of the 2nd Ocean-related Ministerial Meeting, the matters and lessons surrounding the fisheries have been and are still unchanged.

We all may recall the Plan of Implementation adopted in the World Summit on Sustainable Development held in 2002 in Johannesburg. It calls for maintaining or restoring stocks to levels that can produce the maximum sustainable yield with the aim of achieving these goals for depleted stocks on an urgent basis and where possible not later than 2015. Many of us have read the State of World Fisheries and Aquaculture 2004 published by FAO. FAO estimated that in 2003 about one-quarter of the stocks monitored were underexploited or moderately exploited and could perhaps produce more. About half of the stocks (52 percent) were fully exploited and therefore producing catches that were close to their maximum sustainable limits, while approximately one-quarter were overexploited, depleted or recovering from depletion (16 percent, 7 percent and 1 percent respectively) and needed rebuilding. From various source of information we can note that the status of the world's fish stocks has not much changed since then, and if we are to achieve the goal of maintaining or restoring stock levels that can produce the maximum sustainable yield for those stocks which overexploited, depleted or recovering from depletion, we have to strive harder. Though aquaculture is said to be the last frontier of producing food fish, sustainability and environmentally soundness of aquaculture has been an issue of concern by the international community.

In view of the different states of development among APEC member economies, it is important to convene such a workshop to give opportunities to member economies to share their experiences, practices and lessons, to identify the problems they might have encountered for expertise assistance. The economic development of many economies depend highly on fisheries as sources of national income from export. It is hoped that the presentations and discussions made during this workshop will enlighten fisheries managers and policy makers in formulating their national fisheries policies in such a way that will enable achieving the goal of sustainable fisheries development in the Asia Pacific region.

Before closing I would like to take the opportunity in announcing that the APEC Seminar on Sharing Experiences in Managing Fishing Capacity and the 17th APEC Fisheries Working Group Meeting will be held back-to-back from 8-12 May 2006 in Kaohsiung, the first two days being reserved for the seminar. I cordially welcome all member economies to send delegations to attend the two meetings.

Finally on behalf of the Lead Shepherd, I wish the workshop a very successful and productive one. Representative of Vietnam will certainly take the opportunity of attending the FWG 17 to report the working group the outcome of this workshop.

Thank you for your kind attention.

Asia-Pacific
Economic Cooperation

FWG 02/2004/004

Welcoming Address of H.E Mr. Luong Le Phuong, Vice-Minister of Fisheries of Vietnam

Submitted by: Viet Nam

FWG 02/2004

Ha Noi, Viet Nam

15-17 February 2006

Welcoming Address of H.E Mr. Luong Le Phuong, Vice-Minister of Fisheries of Vietnam

– ***Distinguish Participants,***
– ***Ladies and Gentlemen!***

On behalf of the Ministry of Fisheries of Vietnam economy, I warmly welcome all participants to the Workshop on Sustainable Fisheries Development in the APEC Region and hope you would enjoy good time and spring atmosphere in Hanoi capital.

As you all know, fisheries are one of the productive sectors in the development of an economy, especially in the APEC region. Fisheries products contribute significantly to the sustainable growth of the national economy. However, development policies, institutions and management measures for fishery in some member economies are not really synchronous, equally developed as well as implemented. This situation has been leading to environmental degradation, exhausted resources, and outbreak of diseases, which might have direct impacts on the economies within the APEC region, especially in developing member economies if which the management policies and systems have not been developed yet.

I do hope and belief that at the workshop, speakers, policy makers and experts in the fisheries sector from all APEC member economies will share information and experiences in order to assist APEC economies on sustainable fisheries. As a result of the workshop, valuable information regarding sustainable fisheries development will be extended and new communication channels

will be set up among APEC economies. The workshop will also produce a full report, which will be circulate to all member economies to provide useful indicators for policymakers, fishermen as well as private sector to use as a reference tool in the future.

This workshop therefore is a direct response of the Statement from APEC Ministers on Fisheries and Ocean with the main goals are to "*maximize the economic benefits from, and the sustainability of fisheries resources for the common benefit of all APEC members*" and "*Towards healthy Ocean and Coastal for sustainable development and prosperity of Asia-Pacific community*". The common goal is towards sustainable fisheries development will contribute to the improvement of socio-economic benefits, food security and livelihoods for coastal communities.

Distinguished Participants!

Based on the profound understanding of the reality relationship between national economic development and protection and sustainable utilization of natural resources, Vietnam is implementing fisheries development programs in orientation of ensuring efficiency and people's lives as well as the sustainability of the ecosystem, especially marine ecology.

We have been also actively participating in all activities of regional fisheries organizations and cooperating with other APEC economies in resources surveys and information share aimed at making regional and national fisheries policy based on sustainable environment and ecosystem.

Distinguished Participants,

As being the host of the APEC Summit 2006, Vietnam has been effortful and actively prepared for events of the year APEC

Vietnam 2006. Our workshop today is one of first activities in the Year of APEC Vietnam 2006 which will be incepted in the February 2006.

I wish in the coming time to get supports and assistances from all APEC economies in order to the year APEC Vietnam 2006 to be great success, contribute to motivate towards the goal of setting up a prosperity and sustainable development region for benefit of all people in which each economy has opportunity of growth and sustainable development.

I declare to open the Workshop on Sustainable Fisheries Development in the APEC Region.

Wish the Workshop would be fruitfully successful.

Thank you very much for your attention!

Asia-Pacific
Economic Cooperation

FWG 02/2004/005

Towards a Representative System of Marine Protected Areas in Viet Nam

Submitted by: Viet Nam

FWG 02/2004

Ha Noi, Viet Nam
15-17 February 2006

Towards a Representative System of Marine Protected Areas in Viet Nam

Dr. Nguyen Chu Hoi
Vietnam Association of Natural and Environmental Cosersation
E-mail: nchoi52@yahoo.com

1. Background

Viet Nam has a large seas with some 2,779 nearshore islands (covering 1.636 sq. km. of the sea-floor) and two offshore archipelagos. Among these islands, there exist 82 islands with 1 sq. km in area (92%) and 23 of these islands in 10 sq. km, and 3 of them in 100 sq. km. The mainland is surrounded by the Bien Dong Sea (South China Sea) which includes two gulfs, the Gulf of Tonkin in the north and the Gulf of Thailand in the south. The average depth of the sea is 1.140 m and sea-water volume is about $3{,}928 \times 10^6$ cubic kilometers. Administratively, Viet Nam has divided into 4 levels: Central, provincial, district and commune. Twenty-nine coastal provinces and 125 coastal districts are situated along 3,260 km of coastline (except island's coastline). This area includes over half of Viet Nam's major cities and greater than 50% of the total 82,032,300 population lives in coastal provinces (as of 2004).

Viet Nam's seas is rich in biodiversity with some 11.000 species of marine animal, plants and seabirds are recorded. Among them, there exist 2.038 species of fish with over 110 species of economically value. In Viet Nam's seas there is about 1.122 km^2 of coral reefs and are centrally distributed in coastal waters in Central and offshore islands. The key coastal and marine ecosystems in Vietnam seas primarily provide profits of some 60-80 millions USD/ha/year (ADB Report, 1999), and value only from fish and woods of mangroves has been estimated about 6000 USD/ha/year.

The marine fish reserve is about 4.2 million tons (except marine shrimps and squids) with permissible limit of fishing some 1.7 mill. tons. Coastal waters provide 80% of the economy's total fishery catch, which contributes to over 2.5 billion USD worth of GDP exports in 2005. It also contributes about 10% of total national export value, 47% animal protein for the people and provides millions of employment opportunities in rural areas. To date, 80% of the economy tourists visit the coastal region with the number increasing annually (about 3 millions tourists in 2005).

Viet Nam has signed the United Nations Convention on the Law of the Sea 1982 (UNCLOS) and declared about baseline following the spirit of the Convention. Therefore, Vietnam also has claimed an Exclusive Economic Zone (EEZ) of 1.000.000 sq. km - three time more than land area, and so it has every 100 sq.km of mainland per 1 km of coastline (Maritime Index = 0,01). Therefore, the Viet Nam's seas play very important role in strategic directions of the country's development, as well as in management policy system of the Government. In the same time, the coastal and marine fisheries and tourism have been considered as high priorities in the country's economic development strategy in the future.

However, economic activities, in its currently managed state, has caused loss of biodiversity, coastal pollution, degradation of marine ecosystems, destruction of coastal habitat, over fishing, oil spills, and other coastal disasters. These cause increasing benefit conflicts in multi-use of coastal and marine resources, so the Government has fostered conservative activities to maintain sustainability of the seas, especially in the context of long and complicated sovereignty disputes of the marine waters where there exist high conservation potentials.

2. Fisheries Development and Needs of Marine Protected Areas in Viet Nam

As the above mentioned, the Viet Nam seas provide biodiversity and natural resources base – inputs for fisheries development and livelihood support for coastal communities. Therefore, Vietnamese fisheries sector has a very important role in the national economy. However, besides such advantages, the seas are also sensitive ecologically areas, suffering from many risks of natural changes and impacts from human activities in the context of multi-use. The fisheries sector is characterized as a traditionally small-scale fisheries. The character is caused complicated environmental problems for fisheries development, so although the fisheries production of Viet Nam has increased continuously with a high speed in both capture fisheries and aquaculture in the last decade, but coastal marine living resources have been speedily reduced. Therefore, the fisheries sector has been identified as a key economic sector, which is needed to be given a high priority in the way towards the sustainable development in the framework of Agenda 21 of Viet Nam.

The long-term objectives of the fisheries sector have been emphasized by Viet Nam's Prime Minister in the 2001 Annual Meeting, that "Viet Nam has the plenty of potentials for fisheries development and should promote the

development of the fisheries sector faster and stronger...The final goal of the fisheries sector is to improve competitive advantage of the country and to provide benefits for its workers". Under the leadership of the Government, the fisheries sector continues to develop in the way of industrialization and modernization. To the year 2010, the fisheries sector projection will be able to meet some main targets: total fisheries production reaches to 4,000,000 tons, of which approximately 1,800,000 tons from capture fisheries in the EEZ; the sector's export value of different species reaches to 4 billions USD and employment opportunities in fisheries sector are created for 4,700,000 persons.

Owing to the above mentioned efforts in fisheries development, the fisheries sector has contributed considerably to poverty reduction and hungry elimination in coastal communities and is one of the few alternative livelihood options for many poor coastal communes.

Besides the opportunities and achievements in development, the fisheries activities, especially in coastal areas, are facing some challenges which if will be unsolved and unregulated, should also be reduced in the near future. These include:

(1) The status of unplanned production, which is clearly shown in many areas, especially in coastal fishing and aquaculture, which has resulted in disease outbreaks in aquaculture, fishery resources over-exploitation, and impacted strongly economic effectiveness of fishing and aquaculture, even ineffective in some places. The main reason is that the planning and management policies have not kept pace with the demands of the practical market and "mass movement of the people".

(2) The marine living resources in the nearshore has been exploited equal or even higher than the acceptable sustainable yield. Recent studies show that the total marine captured fish production has continuously increased, but the production of one fishing unit or catch per unit effort (CPUE - ton/hp/year) in the nearshore tends to be decreased from 0.92 ton/hp/year to 0.34 ton/hp/year (in 2003). This shown a signal of over fishing together a downward tendency in the stock, production and the size of captured fish.

(3) Some common economic-valued marine species, which have normally been exploited with a large amount, up to now, have become rare, such as sardine (*Clupanodon*), lobster, abalone, scallops and squid. The hundreds of marine species have been listed in endangered, threatened species list and in the Vietnamese Red Book. The reasons of this problem

are: using destructive methods such as dynamite, toxic chemicals, small mesh size net, fishing in breeding and prohibitive times; destroying important natural habitats for fisheries development such as coral reefs, seagrass beds and mangroves.

(4) The local communities and fishers are generally poor, their intellectual standards are limited and lacking of investment capital for production development. In 2004, the Vietnam Government has identified 157 poorest coastal communes over the country, which concentrated in Central region. This creates the impacts on the local socio-economic and fisheries development. In the past years, although the fisheries sector reached to the important achievements, but the economic growth does not have strong impacts on the improvement of fishers and aquaculturists life. Therefore, they have to continuously destroy nearshore marine living resources with the expectation of higher income.

(5) Coastal and marine areas, where there exits a high concentration of fisheries and aquaculture activities, are suffering various natural disasters and environmental consequences such as coastal flood, typhoon, erosion, oil-spills, eutrophication and marine microalgae bloom. These areas even suffer negatively environmental impacts originating from fisheries production activities such as aquaculture, fishing and fishery processing, etc. The above mentioned natural disasters and environmental consequences have done big damage and loss for coastal fisheries and aquaculture. For example, Cyclone Lynda typhoon which killed 3,000 fishers off Ca Mau in 1997 was one of the only typhoons to hit the south in living memory; Over 700 coastal aquaculture ponds have been destroyed in December, 2005 by the coastal flooding in Central Viet Nam.

In order to overcome the challenges, from viewpoint of sustainable fisheries development, the Viet Nam Ministry of Fisheries (MoFi) recognises that: The fisheries sustainability almost depends upon maintaining the interconnectivity of typical coastal and marine ecosystems; Almost impacts (70%) on the coastal ecosystems and marine fisheries originates from outside more than inside them, even from coastal watersheds. Therefore, coastal marine fisheries management should be undertaken by integrated and intersectoral approaches to mitigate benefit conflicts between the coastal marine fisheries (including aquaculture) development and other sectors in the context of the multi-use and sectoral management. Thus, the establishment of a representative marine protected area (MPA) system and its effective management are one of the foci of the Government to meet

practical demands of fisheries sector and other service sectors, as well as to implement the international commitments signed by Viet Nam Government.

3. Representative System of MPAs in Viet Nam

3.1. The Benefits and Historical Aspects

The MPAs have been recognised as an effective and uncostly tool to maintain and manage coastal marine living resources, to protect biodiversity and to meet other marine conservation targets, as well as coastal people livelihoods. Basically, the MPAs with no-take, core zone and limited fishing zone have fostered effectively fisheries management: the reduced fishery stock has been restored and sustained. Assessment of 89 MPAs in the world, Benjamin S. Halpern (2003) confirms that establishing the MPA has resulted in increased 02 time in density of marine organisms, 03 time in biomas, organism size and biodiversity 20-30% more than outside the MPA.

The general benefits of MPA establishment maybe summarised as following:

- *Creating the benefits within the MPA site* such as: biodiversity conservation, especially marine ecosystems and coastal habitats; caused renewable effect of the stock, increased biomas, size, abundant and diversity of the species and individuals which living within the MPA site; restored natural habitats for the threaten, endemic species outside the MPA; increased reproductive effect and genetic diversity of the species living in the MPA.

- *Creating the benefits outside the MPA site* such as: spillover effect of the larvas and juveniles from the MPA site out to surrounding areas (1-1000 km) and adding them for the stocks after 3-5 years; maintaining fisheries production around the MPA; preserving ecosystems and species which are attractive for tourists and facilitate sustainable tourism development.

- *Creating the other benefits* such as: providing scientific information; creating ecologically corresponding sites in marine environmental monitoring and research activities; liking to cultural value conservation.

Viet Nam has about 1.000.000 fishers living in coastal areas whom life depending upon coastal marine living resources, so MPA establishment is very urgent for their income generation. Therefore, Viet Nam government has identified the establishment of protected areas (PAs) in general and MPAs in particular as high priorities. The first PA - Cuc Phuong National Park was established in the mainland by 1962 to conserve the forest. Since 1980, Viet Nam has undertaken the national programme on expanding the

PAs system and a present list of 121 PAs sites established with over 2 million hectar, occupied about 6% territory naturally area of the country, but only 16% of protected marine area as a component of certain mainland PA. It means that there is not the MPA site in the true sense of the word, so far.

In fact, Viet Nam has historically later in establishment of MPAs in comparison with mainland PAs. The marine component has been only identified in Cat Ba (in 1989) and Con Dao (in 1986) National Parks and in 1992 both them has been listed in the book on the Representative MPAs in the World after Caracat Park Congress. The first MPA initiatives belonged to Vietnamese marine scientists through the national programmes on marine research and survey during 1980-1995. The Institute of Oceanogaphy (IO) in Hai Phong (HIO) and in Nha Trang (NIO) have surveyed typical ecosystems for marine conservation such as coral reef, seagrass bed, lagoon, bay, upwelling area etc. and evaluated their biodiversity potentials, as well as proposed a checklist of priority sites for conservation purpose.

Especially, in 1993-1995 under the support of WWF/VN-0011 project, the IO/WWF joint survey team has surveyed biodiversity by using diving SCUBA technic and assessed conservation potentials of 7 coral reef areas in Viet Nam seas as first proposed 7 MPAs. In the same time, the project has trained first 12 underwater divers (PADI certificate) from the IO marine scientists.

In 1998-99, under leadership of Ministry of Science, Technology and Environment (MoSTE), the HIO has researched in scientific baselines for representative MPA system of Viet Nam, including a list of 15 MPA sites. The MoSTE submitted the MPA system planning to the Prime Minister (PM) for consideration. After that, the PM has appointed the MoFi to improve the MPA system planning with formulation of attached regulation of MPA establishment and management. All documents have been resubmitted to the PM in 2000. Unfortunately, in that period Viet Nam has a lack of institutional arrangement for MPA management, except Ministry of Agriculture and Rural Development (MARD) responsible to manage the PAs on mainland. Thus, until 2003 the PM has also required the MoFi to perfect the submitted MPAs planning and regulation to resubmit again to the PM for approval. In process of pre-preparing the MPAs system planning and regulation, the Law of Fisheries has been enacted (2004) with the Decree No. 27/2005/ND-CP on guiding the implementation of the Law of Fisheries relating to the MPAs (in March, 2005) and the master plan of fisheries sector development toward year 2010 and vision 2020 has just been approved by Decision No. 10/2006/QD-TTg in January 2006. Therefore, the MPa system

planning and MPA establishment and management have to update for maintaining consistent with the above mentioned documents. So far, the representative MPA system and regulation in commentation before submission to the PM tentatively in April, 2006.

Additionally, in 1999 under ADB support, another system of over 30 MPA sites has been proposed, including above mentioned 15 MPAs and remaining coastal protected areas (CPA) sites. The Nhatrang MPA site is one of proposed 15 MPA which has been established in 2001 as separated pilot MPA under support of WB/GEF/IUCN/Danida. It is first MPA site managed in Viet Nam, the second pilot site is Culaocham MPA with the support of Danida and Condao MPA site is in preparation.

3.2. Overview of the MPA system Planning towards 2015

Biogeographically, the Viet Nam seas are belonging to Indo-Polynesian province, marginal sea C in bio-geographical classification system of Hayden, Ray, Dolan (1984) and East Asia sea number 13 in classification system of IUCN/CNPPA (1995).

In order to interpret the planning, based on existing, secondary source and surveyed additionally data, the scientists/planners have divided the Viet Nam seas into 06 marine biodiversity zones: Tonkin gulf (from north down to Con Co island), coastal waters of Middle Central (down to Varella cape), coastal waters of Southern Central (down to Vung Tau), coastal waters of East-southern (down to Ca Mau cape), coastal waters of West-southern (down to Ha Tien of Thailand gulf) and offshore.

To facilitate the planning, the planners have also identified 09 conservation potential clusters, including marine waters with islands which are of important ecosystems and habitats for conservative purpose at different degree. They are Coto- Daotran island cluster, Halong-Baitulong bay, Catba-Longchau-Bachlongvi, Honme islands, Honla-Conco, Soncha-Lyson, Nhatrang-Condao, Thochu-Phuquoc and Truongsa.

Based on the relative range of conservation potentials and MPA site profile, a first list of representative system of 15 MPAs with high conservative values has been selected (table 01) and should be submit to the PM for approval after commentation of the line agencies and sectors according to Government's procedure. The 15 MPAs are grouping in 03 IUCN/WCPA categories which edited in the Law of Fisheries – marine park (I), species and habitat protected area (II), and aquatic naturally resources preserved area (III).

Table 01: The list of 15 MPA sites in Viet Nam planned towards 2015

Ordinal	**MPA name/Province**	**Category**	**Proposed area (ha)**	**Biogeography/ biodiversity zone**
1	Daotran island/ Quang Ninh	III	4100	C-01
2	Coto islands/ Quang Ninh	II	7850	C-01
4	Catba islands/ Hai Phong	I	10.900	C-01
5	Bachlongvi island/ Hai Phong	III	90.750	C-01
6	Honme islands/ Thanh Hoa	III	6700	C-01
7	Conco island/ Quang Tri	II	2.490	C-01
8	Soncha-Haivan / Thua Thien-Hue	II	3.026	C-02
9	Culaocham islands/ Quang Nam	I	6700	C-02
10	Lyson island/ Quang Ngai	III	7.500	C-02
10	Nhatrang bay/ Khanh Hoa	I	10.500	C-03
11	Namyet ialand/ Khanh Hoa	II	20.000	C-06
12	Phuquy island /Binh Thuan	III	16.680	C-03
13	Honcau island/ Binh Thuan	II	12.390	C-03
14	Condao islands/ Baria-Vungtau	I	23.000	C-04
15	Phuquocs islands/ Kien Giang	II	51.500	C-05

In the planning, 05 key programes should be implemented in the period of 2006-2015 with total evaluated funds of 100 billions VND, include the international supports. They are:

- (1) Programme on surveying biodiversity and socio-economic issues in the proposed MPA sites in order to develop a management plan

- (2) Programme on improving institutional capacity to manage effectively the MPAs in Viet Nam

- (3) Programme on strengthening awareness of local communities of MPA

- (4) Programme on improving livelihoods of local people living within and around the MPA site

- (5) Programme on sustainable financing to manage the MPAs

3.3. Decentralization of MPA Management

The MARD was a first authority responsible to state management of the PAs in Viet Nam in long time (since 1962). Until 2 of May 2003, the PM has enacted the Decree No. 43/2003/ND-CP in which the term 8C appointed the MoFi to be responsible to state management of MPAs and aquatic resources protected areas on mainland.

In September 2003, the PM has also approved the Strategy of PAs Management of Viet Nam towards 2010 in which the Government has appointed the MoFi responsible in MPA management, the MARD in forestry management and Ministry of Natural Resources and Environment (MoNRE) in wetland management.

In November 2003, the Law of Fisheries has been endorsed by National Assembly and enforced in July 2004. The chapter II, term 9 of the law deals with MPA planning and management, as well as the role of the MoFi in state management of MPAs. The Decree No. 27/2005/ND-CP on guiding the implementation of the Law of Fisheries relating to the MPAs (March, 2005). In the degree, MPa definition, criteria of MPA categories, MPA management and finacing have been pointed. To concretize the degree guidelines, a regulation of MPA establishment and management of Viet Nam has been drafted by MoFi which introduces some aspects of decentralized administration of MPA management. According to the above mentioned documents, the MoFi plays a role in state management through development of a legal framework, technical supports, international cooperative promotion and supervisor or check. The MoFi will appointed the

coastal provinces to be responsible to manage administratively the MPAs established in marine waters of the province. The MoFi will only manage directly the MPA with transboundary aspects or inter-provincial MPAs. The province will decided directly the MPAs in small-scale which is established and managed by local communities.

4. Reconmendations

Viet Nam continues new efforts to achieve the coastal and marine biodiversity targets and fisheries sustainability. This is not only the strategic purposes, but also the responsibility of the Vietnamese Government in making a contribution to implement the international commitments of Viet Nam following the spirit of the 2002 World Summit on Sustainable Development and the Millennium Development Goals for the global common benefits from oceans, coasts and islands. The representative system of MPAs of Viet Nam established will contribute to development of effectively managed global network of MPAs in 2012 like Viet Nam committed. In the context, the assistance and experiences of the regional and international communities through bilateral and multilateral cooperation are very needed.

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INTERNATIONAL LEGAL REGIME

FISHERIES DEVELOPMENTS

LEGAL REGIME - binding

- UNCLOS – “States have a duty to cooperate.”
- UN Fish Stocks Agreement
- FAO Compliance Agreement
- Regional Fishery Management Organizations

LEGAL REGIME – non-binding

- FAO Code of Conduct for Responsible Fisheries
- FAO International Plans of Action (IPOA)
  - Shark conservation and management
  - Seabird bycatch avoidance
  - Capacity
  - Illegal, Unreported and Unregulated Fishing

LEGAL REGIME - binding

The United Nations Convention on the Law of the Sea establishes that States have “a duty to cooperate” in the conservation and management of living marine resources.

LEGAL REGIME - binding

Two new instruments clarify and expand on the concepts contained in the UNCLOS regime:

- the UN Fish Stocks Agreement
- the FAO Compliance Agreement

LEGAL REGIME - binding

UNCLOS also contemplates that multilateral regional fishery management organizations will manage specific stocks of fish in specific areas of the ocean, and that States will responsibly manage resources within their own waters

LEGAL REGIME - binding

What can States do to make these binding agreements work?

LEGAL REGIME - binding

(1) Join regional fishery management organizations within whose convention areas their fleets fish.

LEGAL REGIME - binding

(2) Conduct an effective scientific stock assessment program upon which to base domestic and multilaterally agreed management measures.

LEGAL REGIME - binding

(3) Devise and operate a system of effective control over vessels that fly the flag of your State and over nationals of your State who work on fishing vessels wherever they operate.

LEGAL REGIME - binding

(4) Consistent with the laws of your State, consider developing new methods of controls, such as:

- Sound port state measures like dockside inspection of catches and logbooks);
- Increased penalties for fisheries violations;
- Implementation of multilaterally agreed trade measures against States whose vessels do not follow the rules

LEGAL REGIME - binding

What can fishermen do to make these regimes work?

LEGAL REGIME - binding

FOLLOW THE RULES!

LEGAL REGIME - binding

If international regimes are not effective, and if fishing activities are not sustainable, the fishing sector will collapse.

If we all follow the rules, fishing will continue.

LEGAL REGIME – non-binding

Some have called the 1990s the "decade of documents" because we have negotiated so many binding and non-binding instruments.

LEGAL REGIME – non-binding

The FAO Code of Conduct for Responsible Fishing is a comprehensive, non-binding set of instructions that States and fishermen can follow to achieve sustainable fisheries.

LEGAL REGIME – non-binding

The Code itself does not give specific instructions for solutions to several pressing global sustainable fisheries problems.

LEGAL REGIME – non-binding

In the mid-1990s, the Food and Agriculture Organization of the United Nations adopted a series of "international plans of action" to deal with four specific problems:

- Shark Conservation and Management;
- Seabird Bycatch Avoidance;
- Excess Capacity of the world's fishing fleets and
- Illegal, Unreported and Unregulated (IUU) Fishing

LEGAL REGIME – non-binding

What can States do to implement these plans?

- Conduct science-based assessments to determine if your fleets face a given problem.
- Follow the detailed guidelines contained in the IPOA's (or prepared by FAO) and produce an effective "National Plan of Action."

LEGAL REGIME – non-binding

What can fishermen do to implement these non-binding plans of action?

- Pay attention to them!
- Work with governments to develop common-sense approaches to their implementation.

LEGAL REGIME – non-binding

Why should fishermen care about them?

SHARKS: if no management measures are developed, trade in the fins of several shark species will probably be affected by CITES rules.

This could shut down fisheries for OTHER species.

LEGAL REGIME – non-binding

Why should fishermen care about them?

SEABIRDS:

- Economic reason: each hook that catches a bird cannot catch a fish!
- Conservation reason: several species of seabirds may be approaching extinction and bird conservation groups may take action.

LEGAL REGIME – non-binding

Why should fishermen care about them?

CAPACITY:

- One way or another, pressure on the world's fish stocks must be reduced.
- Rational, sustainable fishing, not increased fishing, is essential to preserving the fishing sector.

LEGAL REGIME – non-binding

Why should fishermen care about them?

IUU:

- All fishermen should understand the need for this plan of action:
- Someone else is catching fish that would be available to YOU if everybody followed the rules!

DRIFTNETS

In the early 1990s, the international community responded to concerns about the use of large-scale high seas driftnets.

DRIFTNETS

The United Nations General Assembly adopted a consensus resolution calling for an end to the use of large-scale high seas driftnets.

DRIFTNETS

The international community developed consensus that “large-scale” meant nets greater than 2.5 kilometers.

This definition appears in the “Wellington Convention” and in U.S. domestic legislation.

DRIFTNETS

U.S. law describes large-scale driftnets as a net or series of nets whose length exceeds 2.5 kilometers.

DRIFTNETS

Some fishermen question whether deploying many nets shorter than 2.5 km from the same boat might be permissible.

The United States believes that, under our legislation, the answer to that question is, “No!”

DRIFTNETS

In the summer of 2003, patrol flights conducted under the enforcement plan of the North Pacific Anadromous Fish Commission (NPAFC) located several large-scale high seas driftnet vessels fishing for squid in the North Pacific Ocean.

DRIFTNETS

Eventually, patrol vessels identified the flag state of some of these vessels, contacted authorities of the flag state, and turned the vessels over to the flag state for prosecution.

The vessel owners and masters were severely punished.

The NPAFC patrols for 2004 have begun.

IS THERE ANY GOOD NEWS?

Delegates to the recent APEC Fisheries Working Group meeting heard several APEC Economy reports on fishing capacity reduction programs.

Chile’s report was very interesting.

IS THERE ANY GOOD NEWS?

Chile reported that it had, through a combination of effort control measures and quota allocation measures, reduced its fishing capacity in a major fishery within its exclusive economic zone to levels that were both sustainable for fish stocks **and** profitable to fishers.

IS THERE ANY GOOD NEWS?

Chile further reported two remarkable aspects of this capacity reduction program:

- No government subsidies (buy-backs) were involved and
- License fees now return $16 million annually to the Chilean treasury.

CONCLUSIONS

- There are few simple solutions.
- There are enough documents!
- International action is needed.
- Cooperation, involvement and support by fishermen is essential.
- Success is possible.
- We must succeed!

Asia-Pacific
Economic Cooperation

FWG 02/2004/007

Area Closure: An Experience of Sustainable Fisheries Development in Thailand

Submitted by: Thailand

FWG 02/2004

Ha Noi, Viet Nam

15-17 February 2006

Area Closure: An Experience of Sustainable Fisheries Development in Thailand

By Dr Smith Summachua

I. Introduction

Thailand has managed its fisheries by implementing the limit and control of entry to fisheries or input control for many decades. This has been conducted through licensing scheme to control the increase of fishing capacities and to sustain the fish stocks. Additionally, other fishery rules and regulations *inter alia* protected or closed areas in marine and fresh waters have also been implemented for fisheries management and resource conservation. This paper attempts to identify the contemporary implementation of closed areas in Thailand. Why are they important? What are their present circumstances? Are they really successful to sustain fisheries industry on the continuing basis?

II. Overview of Fisheries in Thailand

Due to the excellent geographic location, Thailand has dual access to exploit marine living resources both in the Gulf of Thailand and in the Andaman Sea. It is apparent that fisheries industry has played a very active role in the national economy and food security. In 2004, fisheries industry generated 111,392 million Baht (US$ 2784.8 million) or contributed approximately 1.71 percent of the Growth Domestic Product (GDP) or about 17.01 percent of the Agricultural GDP.

Thailand is one of the top ten fishing nations having large volume of catch in the world. It produced about 3.797 million metric tons of fish in 2002 of which 2.643 million metric tons were marine fish production (Department of Fisheries, 2004). From 1992 to 2000, growth of marine fish production of Thailand is steady and was maintained at 2.7-2.8 million metric tons. In 2002, the production from marine capture fisheries still dominates the total fisheries production. It contributed 2.643 million metric tons with the value of 58,374 million Baht (US$ 1459.35 million). Catch composition was squid and cuttlefishes (7%), shellfish (1.3%), shrimps (3.2%), crabs (1.6%), trash fish (26.4%), other food fish (59.4%), and others (1.1%).

In 2002, Thailand exported 1.450 million metric tons of fish and fishery products to international markets with the value of 169,186 million

Baht (US$ 4229.65 million). Three major markets are the U.S., Japan, and EU.

Fisheries generate great opportunity for employment. Piumsombun (2002) noted that 161,670 fishermen have engaged in marine fisheries.

Fisheries in Thailand evolved gigantically in the early sixty when the otter board trawlers were deployed. At present, trawl, gill net, purse seine, encircling net, push net, and long line are the main fishing gears used in commercial and artisanal fisheries.

III. Fisheries Management and Conservation Measures

During the past four decades, rapid development of fisheries in Thailand results in overexploitation, excess fishing capacity, conflicts among users, rent dissipation, and environmental degradation. It is the prime concern of the Thai government to reverse this negative situation in order to ensure that fisheries are sustainable for present and next generations. A large number of management measures have been implemented.

Fisheries management and sustainable development in Thailand is entrusted to the Department of Fisheries. It is responsible for research, development, and management of fishery resources and environment to promote sustainable fisheries and food security.

Rules and regulations governing the rational use of fishery resources in sustainable manner have been stipulated and promulgated. Based on the provisions of the Fisheries Act of 1947 amended in 1953 and 1985, the following management measures have been promoted through Ministerial Notifications and Decrees:

1. Prohibition of certain fishing gears.
2. Allocation for using certain gears during spawning and nursing seasons.
3. Prohibition to fish within certain periods.
4. Prohibition to fish within certain areas.
5. Prohibition to fish for specific species.
6. Limit of new entry in particular trawler.

Apart from defying afore-mentioned rules and regulations, the Department of Fisheries has also engaged in management strategy and actions to ensure the sustainability of fisheries such as installing the artificial

reefs, decentralization of the authority to provincial officers and local communities (community-based management).

IV. Successful Implementation of Area Closure for Sustainable Fisheries: A Case Study of Indo-Pacific Mackerel in the Gulf of Thailand

Sukhavisidth (1996) claimed that 5 species of mackerels have been found and taxonomically identified in the Gulf of Thailand (Figure 1), namely Indo-Pacific mackerel (*Rastrelliger neglectus*), Indian mackerel (*R. kanagurta*), Faughn's mackerel (*R. faughni*), shortbody mackerel (*R. brachysoma*), and slender mackerel (*R. sp.1*). The Indo-Pacific mackerel and the Indian mackerel are generally abundant in the coastal areas.

The main production of Indo-Pacific mackerel comes from capture fisheries in the Gulf of Thailand. In 2002, Thailand produced 146,422 metric tons of Indo-Pacific mackerel valued 3,942.983 million Baht (US$ 98.57 million) of which 115,642 and 30,780 metric tons were derived from the Gulf of Thailand and the Andaman Sea respectively (Department of Fisheries, 2004). The statistics of Indo-Pacific mackerel taken from the Gulf of Thailand and the Andaman Sea were lumped together until 1984 (Figure 2). It was apparent that the productions of Indo-Pacific mackerel in the Gulf of Thailand in the late 80s to 90s fluctuated, but in the increasing trend. After 1998, the annual production has been maintained at the level over 0.1 million metric tons. The production dropped from 115,642 metric tons in 2002 to 112,479 metric tons in 2003.

The main fishing gears are purse seine and encircling gillnet. They are also caught by trawl.

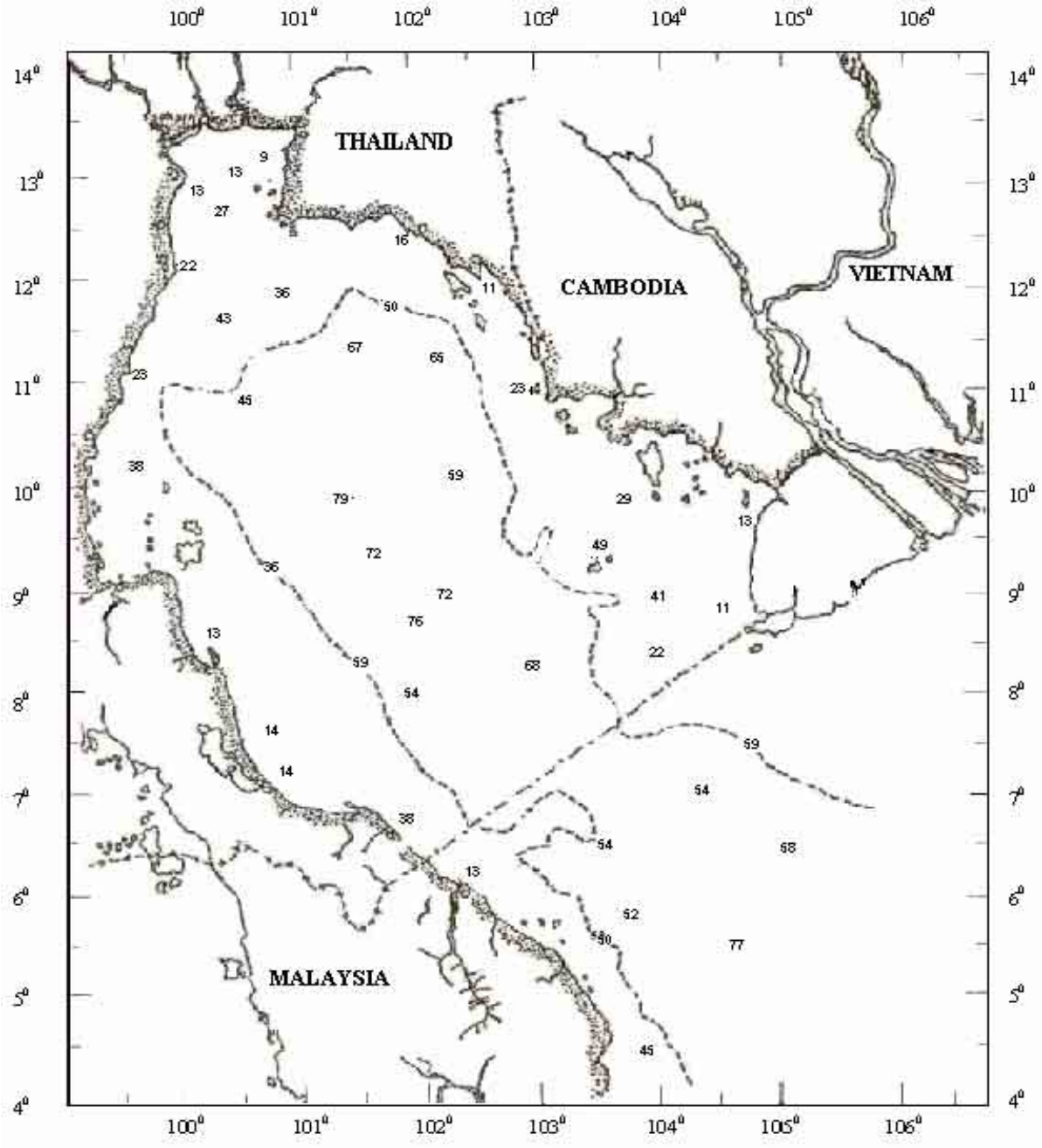

Figure 1. The Gulf of Thailand
Source: Adapted from Chullasorn (1997)

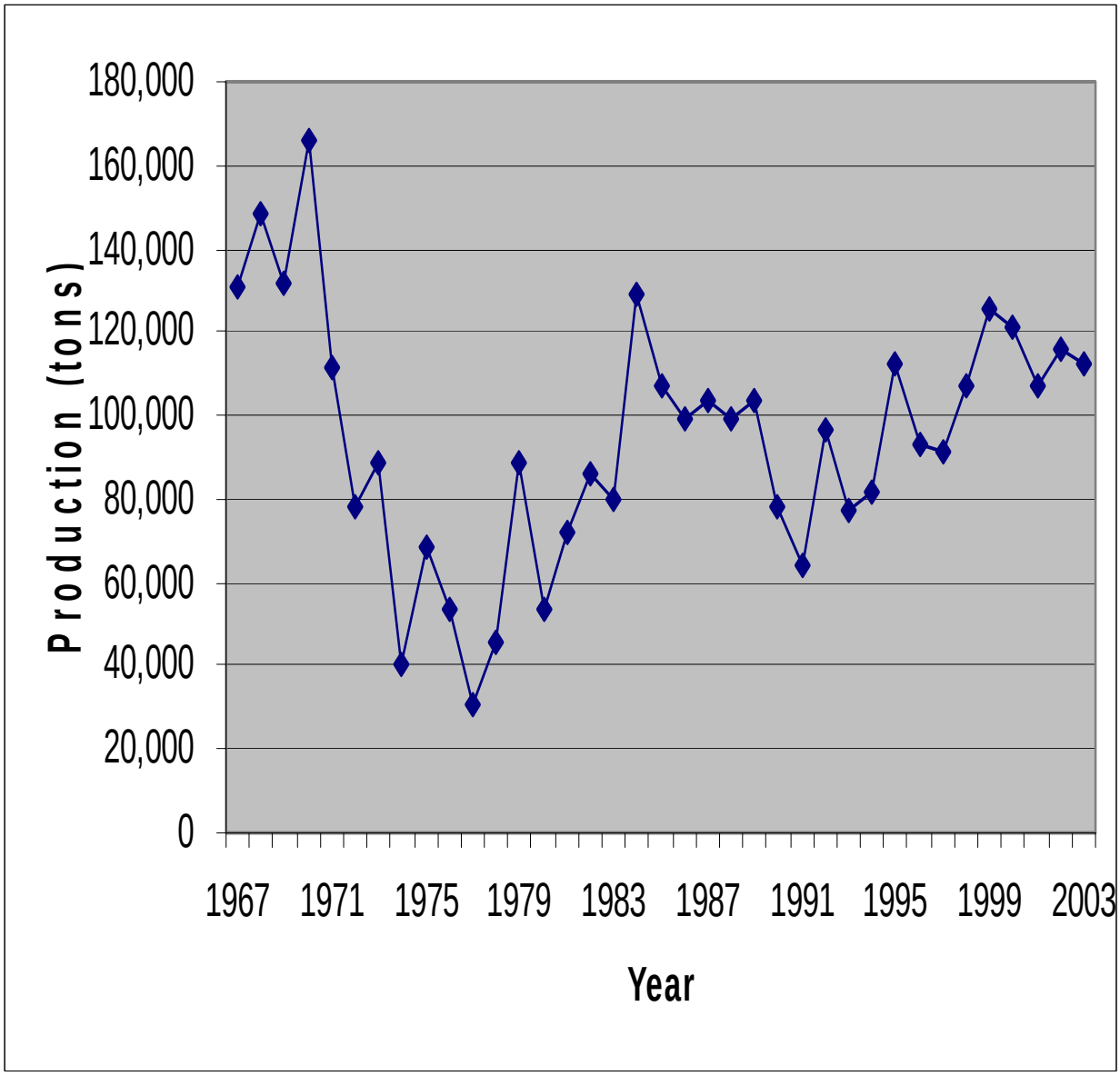

Figure 2. Production of Indo-Pacific Mackerel During 1967-2003

Source: Department of Fisheries (1969-2005)

Under the "1957 Mackerel Investigations Program", fisheries biologists in Thailand had collaboratively conducted extensive research on the biology, bio-economics, and stock assessment of mackerel in order to perceive and identify the life cycles and to assess the potential production of Indo-Pacific mackerel in the Gulf of Thailand. The results of the intensive tagging experiments during 1960-1965 (26,864 fish released and 4,191 captured) illustrated the 3 migratory routes of Indo-Pacific mackerel in the Gulf of Thailand (Somjaiwong et al., 1974). So far, Thailand is able to obtain the complete understanding of the life cycles and its distribution in the Thai waters. This is the indigenous species distributing exclusively in the Thai waters in the Gulf of Thailand (Figure 3). By analysis of the length-frequency distribution from commercial catches compared with the data from tagging, it was estimated that at least 7 spawning occur each year whereas only 2 strong peaks in February to March and July to August occur (Sucondhamarn et al., 1970).

Normally, during October and November every year, adult spawners migrate from the inner Gulf downwards the South to small islands off Chumphon, Surat Thani, and Prachuap Kirikhan provinces for breeding and spawning which usually starts in February and March. Naturally, a female Indo-Pacific mackerel lays about 20,000 eggs per spawning. (Wiwatchaiset, 1999) After eggs are reproduced, they consume approximately 1 day to hatch and become larvae. They then move closer to the shore for seeking refuge and food for their growth. The juveniles later migrate back to the inner Gulf where foods are abundant. They are recruited for fisheries when they are about 4 months old, at which time, they reach the marketable size of 14 centimeters (Wiwatchaiset, 1999). Generally, they can reach the maximum growth within 8-9 months with the length of 16- 20 centimeters. At this stage, they eventually are ready to become the next spawner. It is disclosed that the areas off PrachuabKirikhan, Chumphorn, and SuratThani are the most important spawning and rearing grounds for the Indo-Pacific mackerel in each year.

The Indo-Pacific mackerel becomes the basic staple of the Thai people. The production of Indo-Pacific mackerel showed declining trend down from over 100,000 metric tons during 1967-1971 to 31,024 metric tons in 1977. Such sharp decrease of the production was the driving force later on

to establish rules and regulations to ensure that fishery can be carried out in the sustainable manner. At the same time, a lot of gears had been developed or modified to catch the Indo-Pacific mackerel in the Gulf of Thailand. The regulation was deemed necessary due to the sharp decline in average annual catches of Rastrelliger spp. (Phasuk, 1993). At the same time, catch of the demersal fishes also dropped precipitously from 297.6 kilograms per hour in 1961 to 49.2 kilograms per hour in 1982 (Phasuk, 1993).

According to Article 32 of the Fisheries Act B.E. 2490, Minister or Governor is entitled to declare closed areas to protect the spawning and nursery grounds and to prohibit the use of certain types of fishing gears during this period for some commercially important species. The first regulation stipulating the conservation and management of Indo-Pacific mackerel and other economic species was issued on 25 August B.E. 2491. This regulation has been amended through times (18 March B.E. 2502, 8 March B.E.

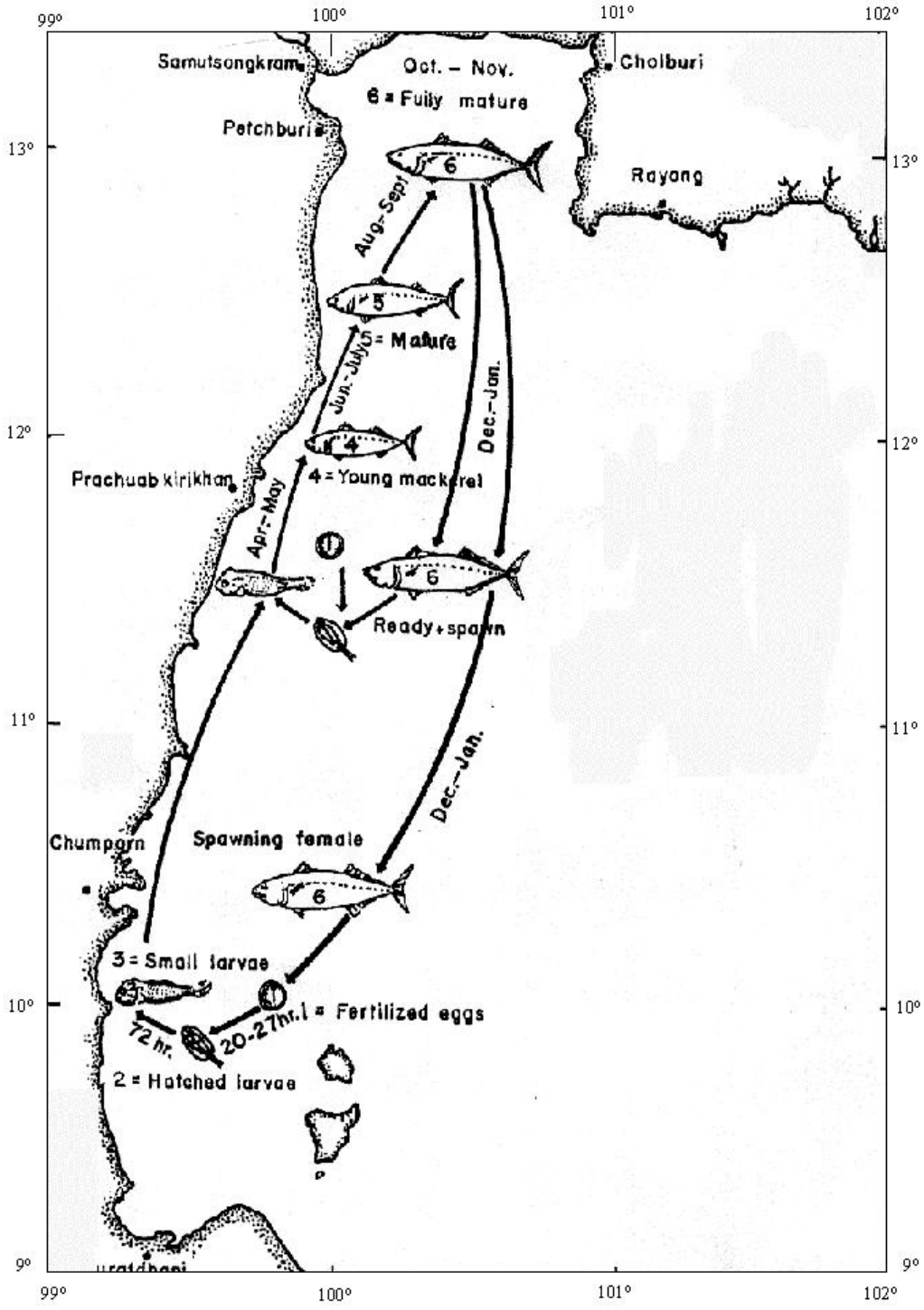

Figure 3. Life Cycle of the Indo-Pacific Mackerel in the Thai Waters

Source: Menasveta (1980)

2505, 13 October B.E. 2515, 7 November B.E. 2518, 3 March B.E. 2526, and 29 August B.E. 2526).

In 1984, Thailand eventually declared a management measure based on the life cycle information with the view to enhancing the production of Indo-Pacific mackerel in the Gulf of Thailand. The Notification of the Ministry of Agriculture and Cooperatives, Re: Using of Certain Kinds of Fishing Appliances in Spawning and Breeding Seasons in Some Localities during Determined Period, B.E. 2527 was given on 28 November 1984. The area of approximate 26,400 square kilometers in the Gulf of Thailand is regularly closed during 15 February to 15 May every year. This management strategy aims to protect the economically important demersal and pelagic fish species distributing off the coast of PrachuabKhirikhan, Chumphon, and SuratThani. The objectives are as follow:

- To control fishing operations in these areas.
- To maintain the balance of resources utilization and potential to sustained yields.
- To research and study on the status of Indo-Pacific mackerel before, now, and after the areas are set up.
- To maintain the sustained production of Indo-Pacific mackerel at 100,000 metric tons per year or 40 percent of the total production of mackerel.
- To control and reduce, if possible, the undesirable fishing vessels such as trawler, and purse seiner in the conservation areas.
- To arouse public awareness for sustainable development and to provide precise understanding to the fishermen.

In this area, the employment of all types and sizes of trawlers, all types of purse seiner and gillnets with mesh size less than 4.7 centimeters are prohibited. However, this regulation would definitely create economic hardship to the traditional fishermen. Therefore, beam trawlers and anchovy purse seiners operating in the daytime during 15 February to 31 March are exempted and allowed to use in these conservation areas.

With the successful result, the government finally closed the areas in the Andaman Sea in the next following year.

So far, the regulation had been amended due to change in fisheries circumstance as well as the adaptation of new or modified gears to catch many brood stocks and young Indo-Pacific mackerel by the fishermen in the

Gulf of Thailand. The latest regulation is the Notification of the Ministry of Agriculture and Cooperatives, Re: Prohibition of Certain Kinds of Fishing Appliances in Spawning and Breeding Seasons in the Locality of PrachuabKirikhan, Chumpon and SuratThani Provinces given on 24 September B.E. 2542.

By virtue of section 50 paragraph two of the Constitution of the Kingdom of Thailand B.E. 2540 and section 32 (1) (2) (4) and (5) of the Fisheries Act B.E. 2490, the following gears are prohibited to be used in the protected area (Figure 4) during 15 February to 15 May of each year:

- Every kind of trawls used with motor vessels except trawls used with only one motor vessel of which the length is not more than 16 meters and fishing only on night time.
- Every kind of surrounding nets used with motor vessels.

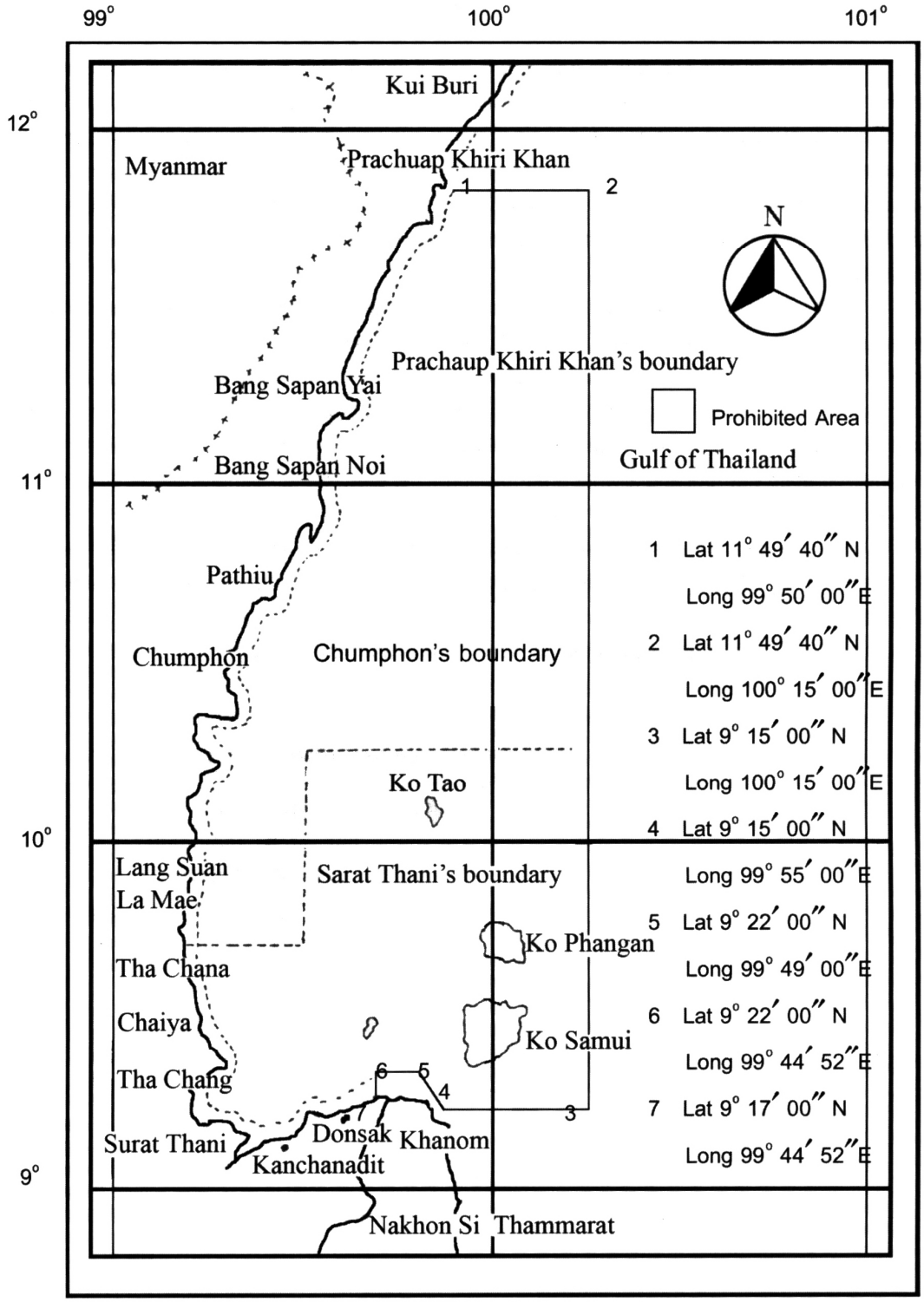

Figure 4. Closed Area off PrachaubKiriKhan, Chumphon, and SuratThani

- Encircling gill net used with a motor vessel in fishing by method of entangling for catching mackerel or by other similar method.
- Falling nets or lift nets used with an electricity generator in fishing of anchovies.
- Push nets used with a motor vessel of more than 16 meters in length.

Nevertheless, the regulation allows fishing in the area for academic purposes in which a written permission from the Director-General of the Department of Fisheries must be obtained.

Based on the scientific researches undertaken within the area, it is apparent that the production of Indo-Pacific mackerel has been increased during the closed period. Figure 5 displayed that Catch Per Unit of Effort (CPUE) of Indo-Pacific mackerel was magnified during 15 February to 15 May of every year. The average CPUE carried out by the Department's research vessel increased from 22.66 kg/hr to 42.66 kg/hr during 2003-2005. Then, it declined immediately after the open access began. The average CPUE was 39.66 kg/hr. It was clear that stocks of Indo-Pacific mackerel in the closed area remain stable. The area closure enhances the abundance of fish stocks through protection of breeding, nursing grounds prior to recruitment to fisheries.

The Department of Fisheries experiences the successful management of this stock by establishment of the area closure. However, such success could not be possible without the costly and effective monitoring and enforcement. In 2005, the Department of fisheries spent approximately 7,861,538.28 Baht or US$ 196,538.45 for public relation, and monitoring, control, and surveillance by 10 patrols. If the regulation is violated, fishing gear must be forfeited. In 2005, 43 cases of violation were arrested and 182 fishermen were charged. Nevertheless, the violation was lower than the last two years (50 cases in 2003 and 60 cases in 2004).

V. Conclusion

By and large, it is essential for the government to maintain sustainable fisheries and aquaculture and to ensure food security. Rules and regulations governing the rational resource use have been promulgated to ensure that the wealth from the seas is secured, the contribution of fisheries is sustained, and food security of their people is maintained or increased.

Area closure has been implemented in Thailand for more than a couple decades. It is quit clear for the Department of Fisheries of Thailand that this measure is a successfully strategic tool for fisheries management. It remains essential to establish more closed areas in the other areas both in the Gulf of Thailand and in the Andaman Sea, if possible. Furthermore, the critical coastal habitats should also be maintained, restored, or protected. The government may consider establishing marine closed areas in the Thai waters throughout the year.

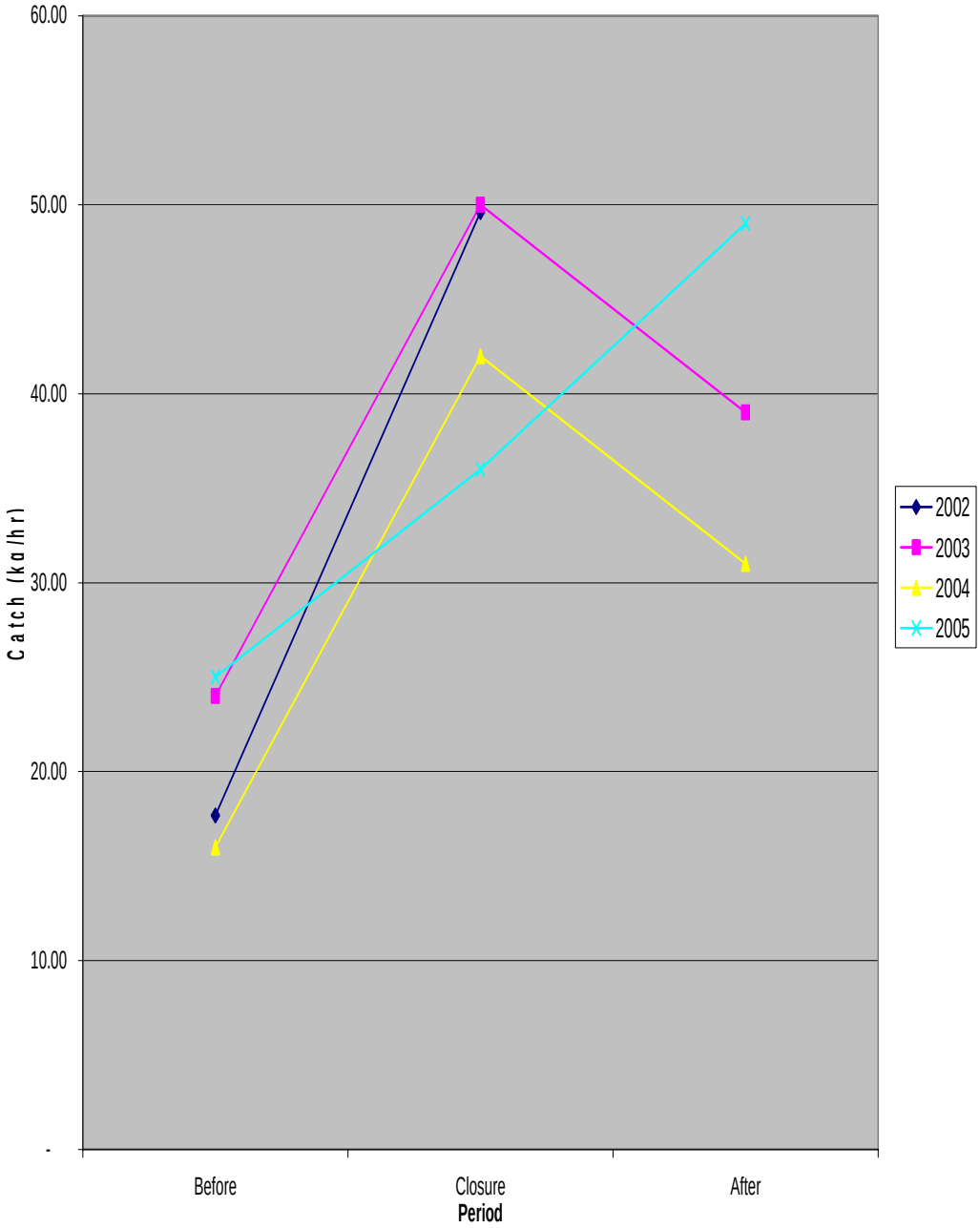

Figure 5. Average CPUE of Indo-Pacific Mackerel during 2002-2005

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Eco-labels and the consumer demand for sustainable fisheries

Workshop on Sustainable Fisheries Development in the APEC Region

Hanoi, Vietnam

15-17 February 2006

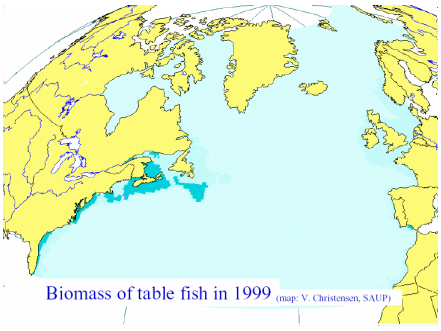
A Major Global Problem

- 28% of the world's fish stocks are over-exploited, depleted or in recovery
- Bycatch is a significant factor in many fisheries
- 1 billion people in Asia depend on ocean fish for their entire supply of protein
- 200 million people depend directly on the fishing industry

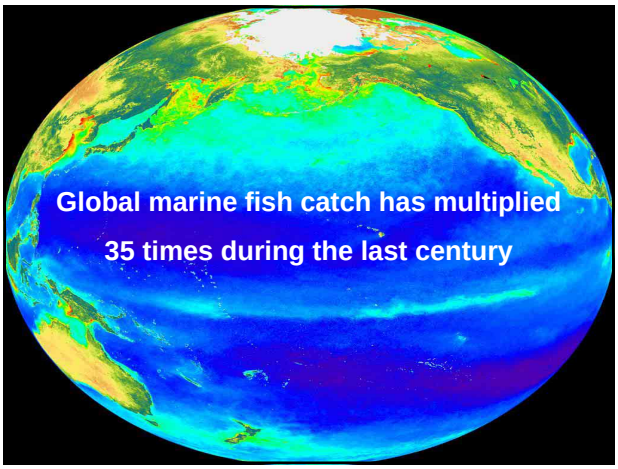
Seafood consumption is growing

- Increasing population
- Modern catching techniques
- More accessible to consumers
- Healthy message
- Branded Marketing
- Seafood consumption is rising:
  - U.S. and Europe has doubled in the last 30 years
  - Total world capture:
  - 1960: 18m MT – 2002: 93.2m MT

But stocks are decreasing…



Biomass of table fish in 1999 (map: V. Christensen, SAUP)



What has been done?

- Strengthen fisheries science
- Impose stricter effort and catch limits
- Marine protected areas
- Enact better fisheries laws, stronger treaties, tougher regulations
- Decommissioning of vessels
- Quota reductions

Obstructions to Management Efforts

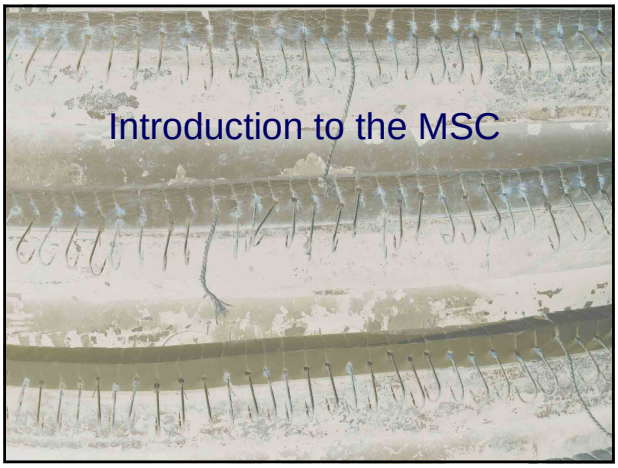
- The market often undermines good management – IUU catch, e.g. toothfish
- Poor traceability and control
- Politics often defeats good resource management

To summarize:

Many commercial fisheries worldwide are not in good shape (but many are!)

A growing number of people are uneasy about buying seafood because of environmental concerns

Environmental labeling helps concerned consumers support well managed fisheries



Marine Stewardship Council (MSC) History

- Founded in 1997; fully independent since 1999
- Not-for-profit, non-governmental, global
- Funded by various charitable foundations and corporate organisations
- A market based incentive to improve management of fisheries world-wide
- Fisheries measured against a rigorous environmental standard

MSC Objectives

- Working to conserve the world's seafood supply for the future and encouraging responsible fisheries
- Working in partnership with all stakeholders including: fisheries, processors, retailers, consumers, conservationists
- Use of a product label to recognise responsible fishery management practices and providing consumers with the best environmental choice in seafood

MSC Roles

- **Standard Setting**: MSC Principles & Criteria and associated certification methodology
- **Accreditation**: MSC assesses, approves & monitors independent certifiers
- **Logo Licensing**: trademark rights owned by Marine Stewardship Council International (MSCI), the trading arm of the MSC
- **Promotion**: Encouraging the post harvest sector, retailers and consumers to purchase products bearing the MSC label

Seafood certification

Wild harvest:

Various proposals but no current 3rd party alternatives to the MSC. FAO has set standards for standard setters.

Aquaculture:

A variety of existing systems, most set up under existing organic standards

Some of the issues globally

WTO – allegations of being a barrier to trade

Discrimination – developing countries

Standards – flexible but meaningful

'Right to manage' – fisheries agencies

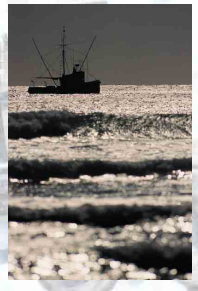
Client capacity

NGOs and continuous improvement

FAO Guidelines on eco-labels

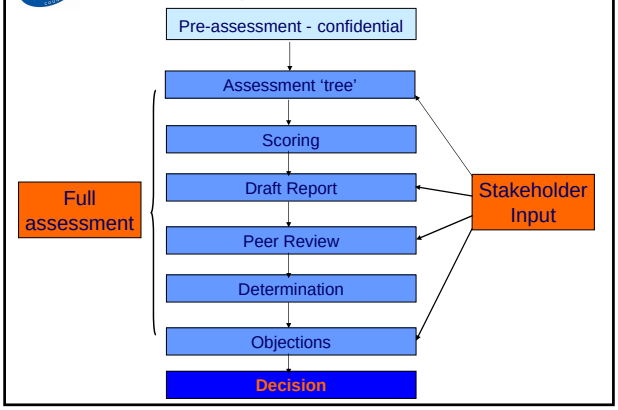
- **The MSC worked closely with the FAO on the development of these guidelines.**
- **The MSC principles and criteria are almost 100% compliant with the FAO guidelines.**
- **By June 2006 the MSC will have made the necessary changes to its principles and criteria to be totally 100% compliant with the FAO.**

The MSC Standard



Known as the MSC Principles and Criteria

Fishery Certification



Assessment result

The results of the assessment can take the following forms:

1. The fishery fails and no certificate is issued

The fishery has the option of addressing the issues that have caused the failure and reapplying.

2. The fishery can pass but with conditions

All fisheries to date have had requirements to fulfill that address deficiencies. These generally have a time frame for compliance and failure to comply results in the withdrawal of the certification.

3. The fishery may pass with no further action

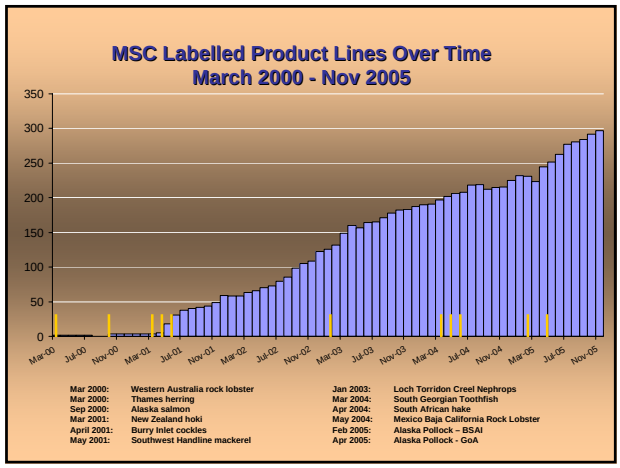
Ongoing Validation

- **Fishery certification lasts 5 years.**
- **Annual audit by certifier to ensure fishery continues to meet certification requirements.**
- **35 Post certification audits done to date – some audited more than once per year. The audits can be obtained from the MSC web site.**
- **These audits check for progress on any Conditions placed on the certification whilst also evaluating any significant changes to the fishery which may have occurred, amongst other factors**

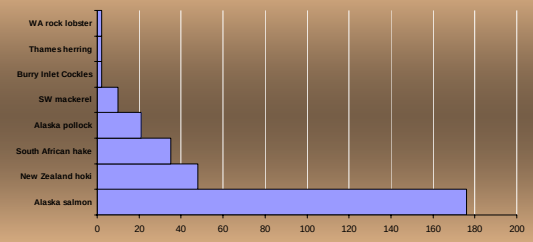
MSC Chain of Custody

Who needs it?

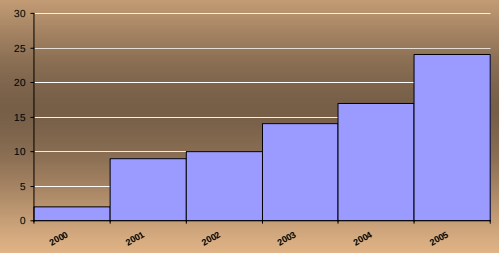
- Every party in the supply chain that takes ownership of the product before it's in its final, ***consumer-ready packaging***
- The CofC requirements therefore:
  - START: immediately after the fish is caught - i.e. when processing or transport begin
  - END: with the company that applies the logo (i.e. puts the product into its final packaging)



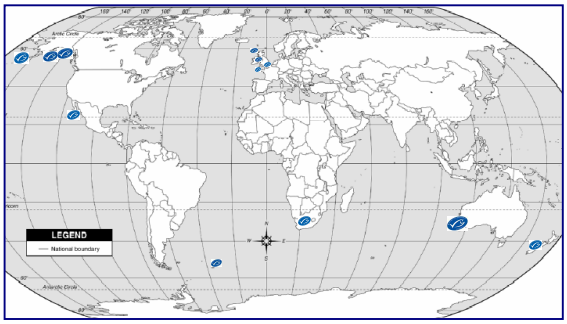
MSC Labelled Product per Certified Fishery



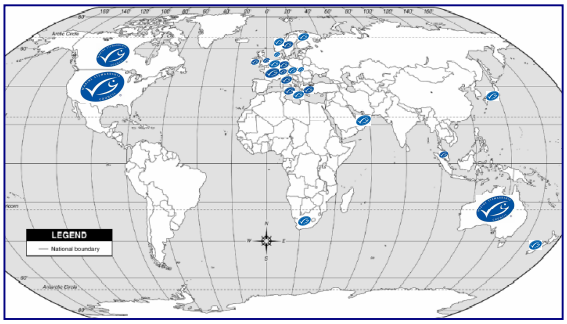
Number of Countries MSC Labelled Products are on Sale over the past five years



Geographical Distribution of Certified Fisheries



Geographical Distribution of Certified Products



The Green Market

1. Consumers are becoming more concerned about food origins and the companies they buy from
   - More than nine million polled consumers avoid companies with a poor environmental image *(MORI 2002)*
   - 17% of consumers are influenced by ethical considerations when making a purchase *(Millennium Poll)*
2. Retailers and Processors are becoming more committed to Corporate Social Responsibility
3. Consumers are increasingly buying environmentally friendly food products
   - 2.1% growth in consumer spending in the wider British economy
   - 19% growth on ethical purchases (2000-01)
   - Ethical purchases - Food: 24% growth from 2000-2001 (UK)

Consumer Choice for Sustainability

- Key priority in today's sourcing
- Market shifts underway as sourcing policies change
  - New species
  - Ways of marketing
- Need mechanisms to identify those sustainable sources with confidence

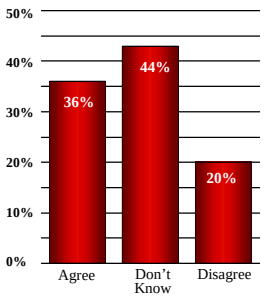
- **Sustainability is no longer optional**
  - **Capitalise on these trends**

Awareness of Overfishing

Country	Percentage response
France	53%
Netherlands	82%
Germany	49%
Switzerland	76%
United Kingdom	62%
Belgium	47%
	Source: IPOS Deutschland, April 2001
Australia	65%
	Source: Aslin et al, Sept 2003

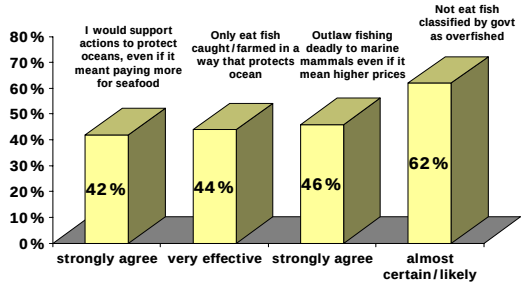
Discarding Unwanted Catch

- **Agree / Disagree:** *"Discarding of unwanted catch by commercial fishermen is a serious problem."*
- **Over 1 in 3 agree with this statement**
- **Data from USA**



NFI 2001

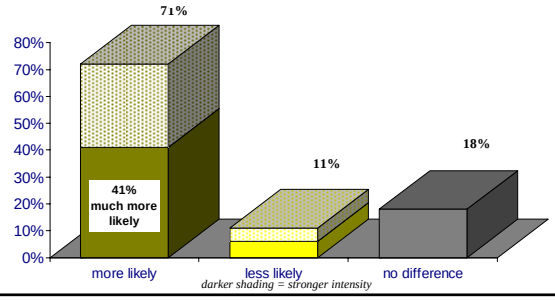
People Are Willing To Modify Their Purchase Behavior To Help The Oceans



Consumers Would Be Attracted By An "Environmentally Responsible" Seafood Label

Would you be more or less likely to buy seafood that had an "environmentally responsible" label or wouldn't it make any difference?

4-In-10 Much More Likely to Purchase Such Seafood



Corporate Social Responsibility

- Increasing pressure from green groups on retailers, eg Greenpeace and ASDA in Europe
- Retailers are making public statements on their seafood sourcing policies
- Unilever – by 2015
- Wal-Mart – the next 3 – 5 years

Unilever

WAL★MART ALWAYS LOW PRICES. Always.

Benefits of Certification: For the Fishing Industry

- Evidence and recognition of good fisheries management
- Heightened management of fisheries
- Preferred supplier status and potential for improved returns
- New markets

Benefits of Certification: For Retailers and Wholesalers

- Demonstrates commitment to buy from sustainably managed sources
- Increased confidence in sustainability of product
- Meeting Consumer Demand

Benefits of Certification: For Consumers

- Confidence that buying MSC-certified products will not contribute to overfishing or harm marine ecosystems
- Empowers consumers to support management efforts in regard to sustainable fisheries

Further Information?

Marine Stewardship Council
Unit 10, 46-48 Urunga Parade
Miranda NSW 2228
Australia
Ph: +612 9524 8400

Frazer McGilvray
Regional Manager – East Asia
Frazer.McGilvray@msc.org

The Marine Stewardship Council

Hanoi, Vietnam, 15-17 Feb 2006

Workshop on Sustainable Development in the APEC Region

DanLing Lingzis TANG

Emial: lingzistdl@126.com

Application of satellite remote sensing for marine biological resources

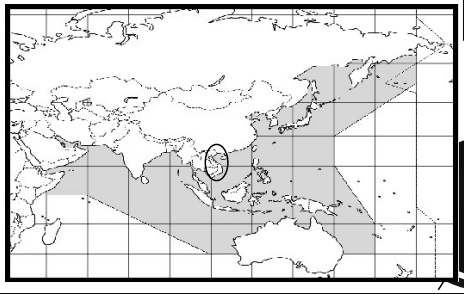
唐丹玲 DanLing TANG (lingzis)

Chinese Academy of Science
South China Institute of Oceanology, China

Http://lingzis.51.net: Lingzis' little back yard

Study area: Asian waters

- **30 countries**
- **60% of the world population**



UNEP: (GEO-4) (Global Environment outlook) Mekong River

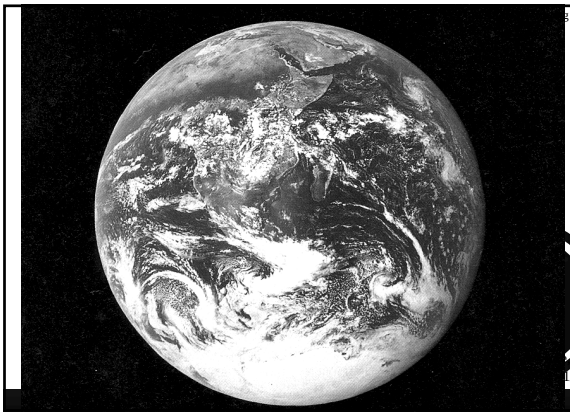
1.Introduction
2.Primary production for fisheries
3.Harmful algal bloom for aquaculture
4. Case studies

1.Introduction

Satellite remote sensing

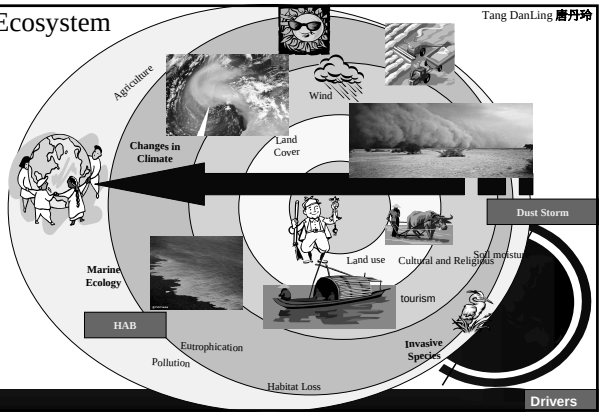
- **Chl-a**
- **Sea Surface Temperature (SST)**
- **Wind**

2.Primary production (FAB) for fishers
3. Harmful algal bloom for aquaculture
4. Case studies



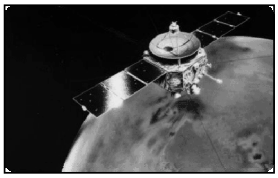
Ecosystem

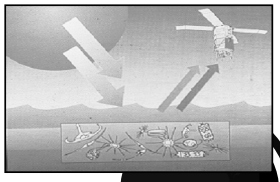
Tang DanLing 唐丹玲



Tang DanLing 唐丹玲

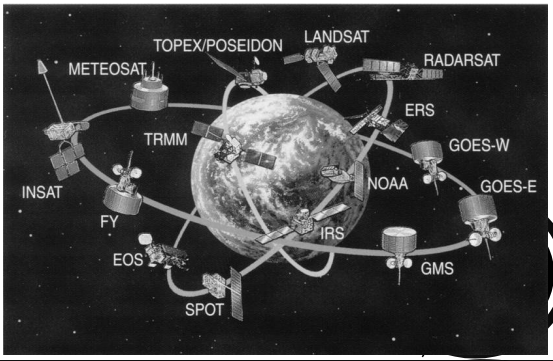
Call for satellite remote sensing





Large area coverage
Long time measurements

Tang DanLing 唐丹玲



Tang DanLing 唐丹玲

Advantages

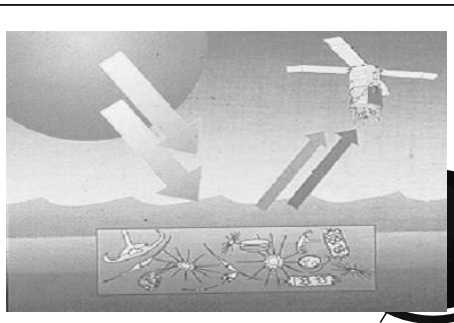
- **large coverage**
- **continuous data**
- **regular revisit capabilities**

- **spectral resolution / spatial resolution**

- **enhance digital data**
- **ability to combine satellite data with others**
- **large archive of historical data**
- **……**

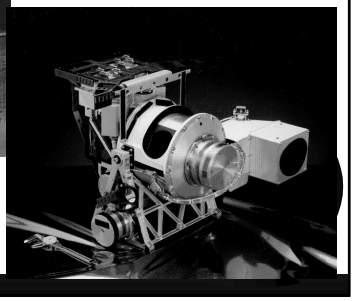
A. Ocean Color

Tang DanLing 唐丹玲

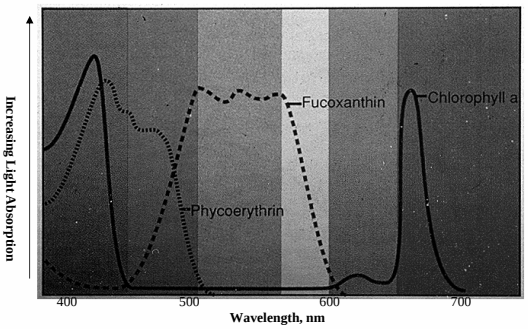


Tang DanLing 唐丹玲

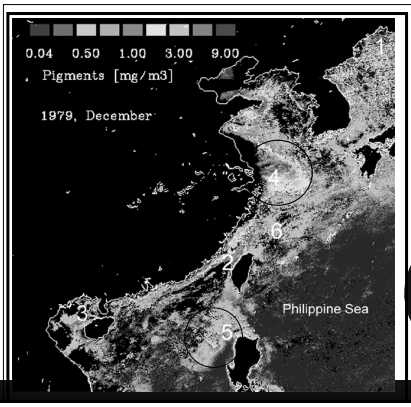
SeaWiFS Instrument



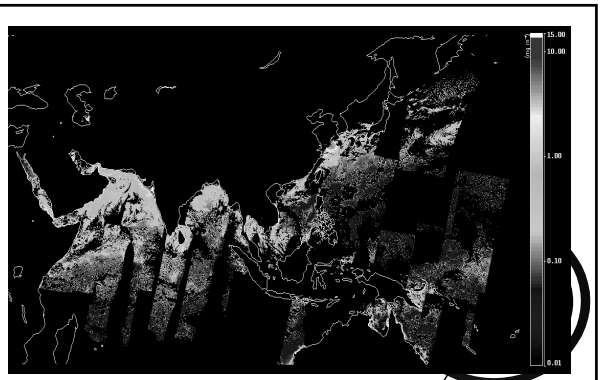
Tang DanLing 唐丹玲

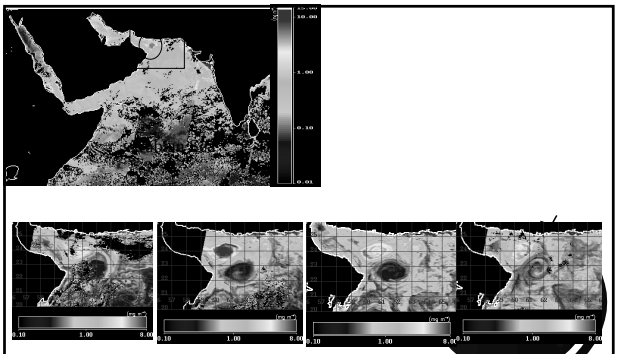


Tang DanLing 唐丹玲



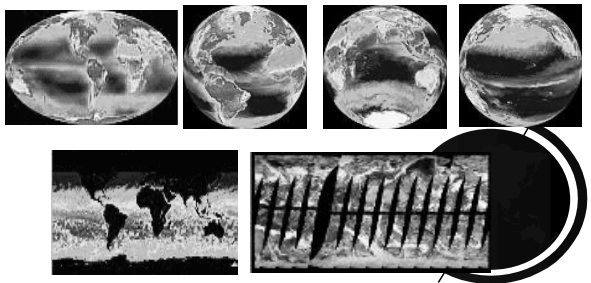
Coastal Zoon Color Scanner (CZCS, USA)





Tang et al., 2001. Remote sensing J of Environment

Tang DanLing 唐丹玲

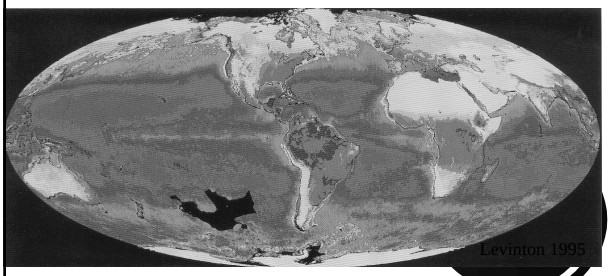


Tang DanLing 唐丹玲

- Environment
- Marine biology
- Satellite remote sensing
- Ocean science
- Environmental science

Tang DanLing 唐丹玲

Phytoplankton Biomass (Chlorophyll)
(Satellite image)



Levinton 1995

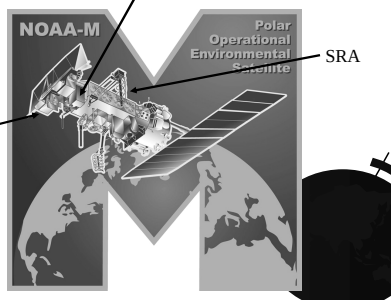
Tang DanLing 唐丹玲

B. Sea Surface Temperature (SST)
AVHRR

NOAA

National Oceanic and Atmospheric Administration

AVHRR



SRA

HIRS
Sounder

Advanced Very High Resolution Radiometer

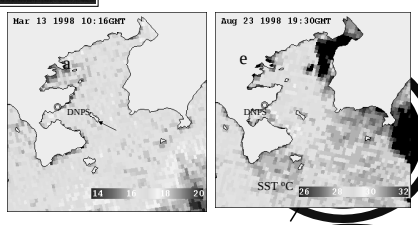
AVHRR derived products

海表面温度SST

Tang DanLing 唐丹玲

Thermal plume from Daya Bay,
Nuclear Power Station, China

Impact on Ecosystem?



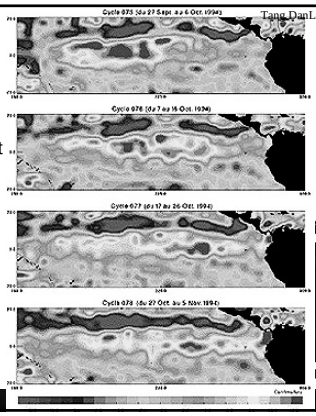
Tang et al., 2002. Remote sensing J of Environment

Tang DanLing 唐丹玲

El Niño

SST showing
the progressive shift of
warmer waters to the east

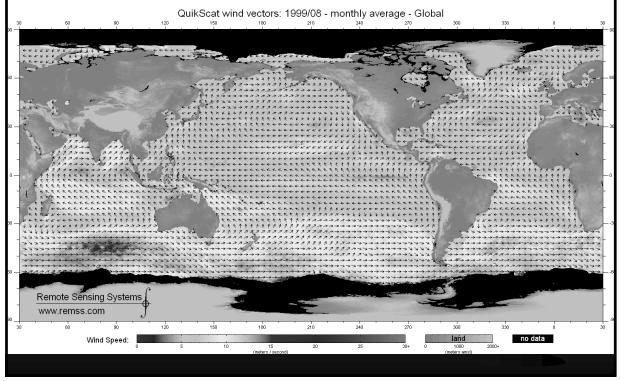
the little child



Tang DanLing 唐丹玲

C. Sea Surface Wind (SSW)
D. Sea Surface Height (SSH)
E. ….

Tang DanLing 唐丹玲



Tang DanLing 唐丹玲

Other satellite remote sensing produces

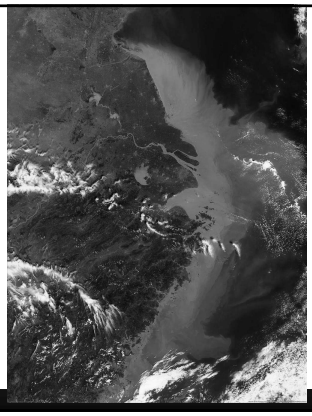
Tang DanLing 唐丹玲

Bohai

Tang DanLing 唐丹玲

Hong Kong

Tang DanLing 唐丹玲



Yangtze River

1. Satellite / Satellite Data

Sensor / Optical / Algorithm

Validation / Processing /computer program

3. Oceanography

- **Current / upwelling /Atmosphere, Monsoon**

4. Ecology/ Marine Biology

- **Primary production / Phytoplankton / harmful algal bloom / fisheries / aquaculture**

5. Environment

Discharge / Entrophication

Satellite remote sensing of SST & PC…

- Upwelling
- River water runoff
- Ocean current fronts

Fisheries oceanography (⇦FAB)

- Fish migration & distribution
- Fish concentration & Abundance
- Carrying capacity (from primary productivity)

1.Introduction

Satellite remote sensing

2.Primary production for fishers

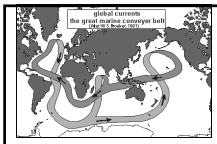
1. **Upwelling**
2. **Phytoplankton bloom**

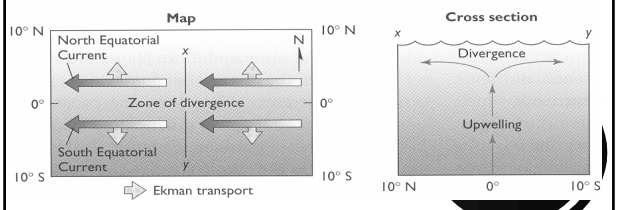
3. Harmful algal bloom for aquaculture

4. Case studies

1. Upwelling / fishing ground

El Nino/ La Nina





Equatorial Counter Current

Equatorial Upwelling

High Nutrients, Low Production

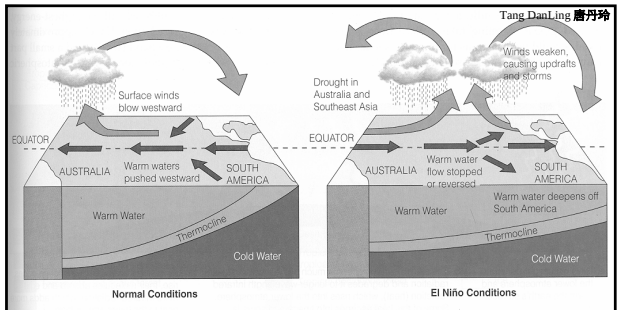
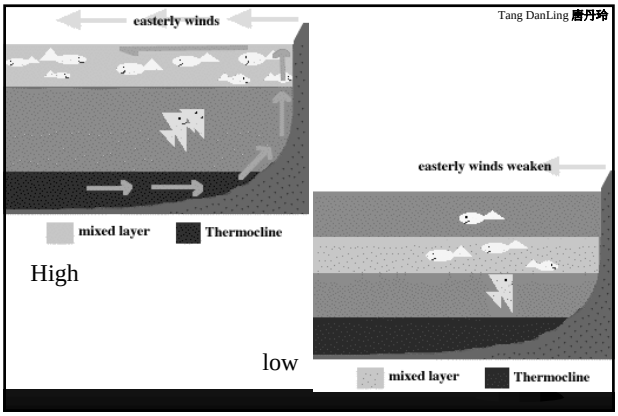


Figure 6-6 Normal surface winds blowing westward cause shore upwellings of cold, nutrient-rich bottom water in the tropical Pacific Ocean near the coast of Peru (left). The warm and cold water are separated by a zone of gradual temperature change called the thermocline. Every few years a climate shift known as the *El Niño-Southern Oscillation* (*ENSO*) disrupts this pattern. Westward surface winds weaken, which depresses the coastal upwellings and warms the surface waters off South America (right). When an ENSO lasts 12 months or longer, it severely disrupts populations of plankton, fish, and seabirds in upwelling areas and can trigger extreme weather changes over much of the globe (Figure 6-7).

Miller, 2001



El Niño

SST showing
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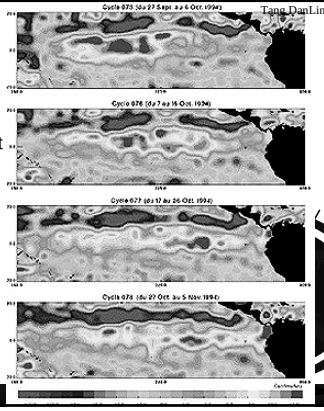
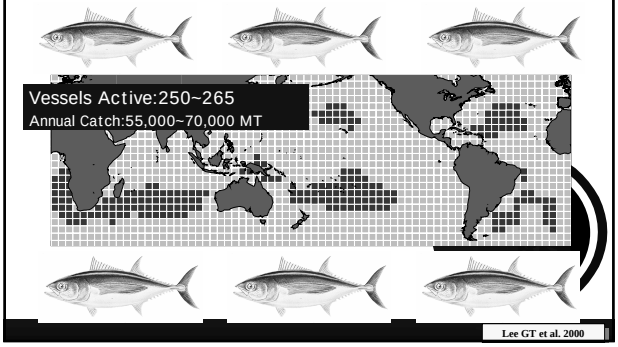
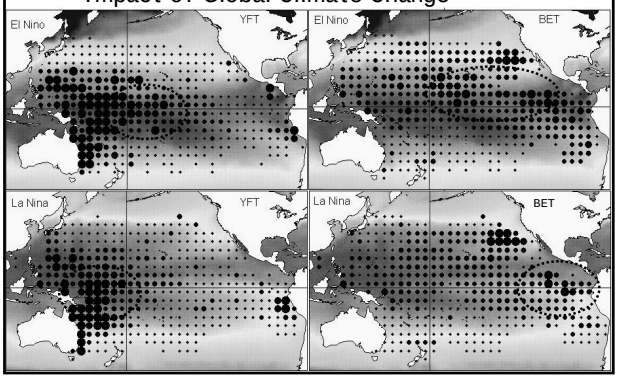


the little child

Fishing Grounds for Albacore Longliners



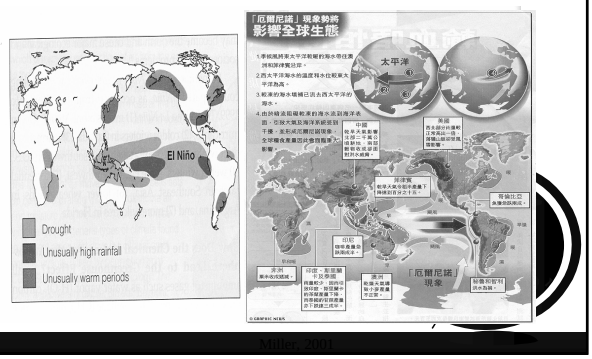
Impact of Global Climate Change



Upwelling: good fishing ground

- Upwelling areas occupy only 0.1 % ocean
- Fisheries production in upwelling areas account for 50% of world fisheries production
- Equals to fisheries production of the whole coastal areas in the world
- e.g. Anchovy in Peru upwelling fishing ground

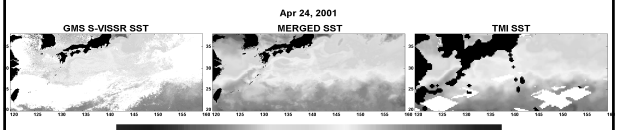
Climate Changes -> Ecology->Economy



Miller, 2001

Tang DanLing 唐丹玲

New Generation SST



Geostationary Met. Satellite
Hourly Infrared

AVHRR、VIRS

Merging by objective analyses

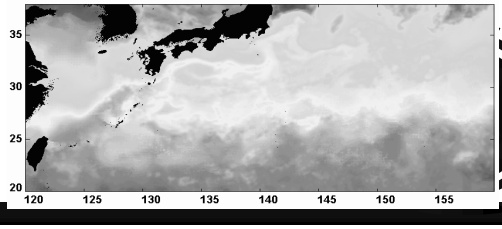
TMI SST
Microwave SST
Cloud free

Cloud-free, High Resolution, Quality-Controlled 5 Km Spatial Resolution, Daily SST Product

Tang DanLing 唐丹玲

No Gap > Filling All Model Grids
High Resolution > Capture Oceanic Structures
Daily > Capture Their Temporal Variations

Forecasts of Ocean Short-term Variations (Ocean Weather Forecasts) Operational Oceanography

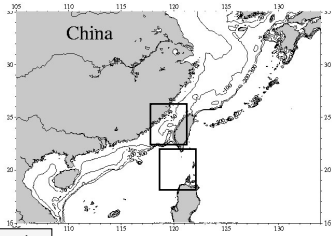


Tang DanLing 唐丹玲

2. Upwelling / fishing grounds

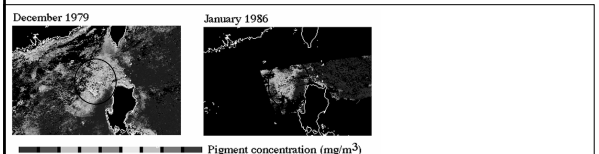
Luzon Strait

Taiwan Bank

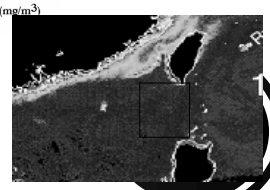


Tang et al., 1998. Marine ecology progress series

Tang DanLing 唐丹玲



Coastal zone color scanner (CZCS)

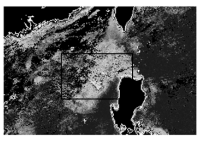


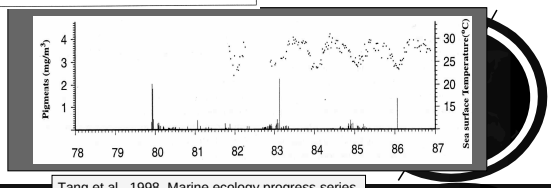
Tang et al., 1998. Marine ecology progress series

Tang DanLing 唐丹玲

Time series of Chl-a and SST

Date	Bloom center	Pigment value (mg m^{-3})	Fig.	Method	Source
November and December 1979	18.5°N, 117.5°E	2.5	3a	Pigment concentration, CZCS data	This study
September to November 1980	17.0°N, 118.0°E	2.17	Text cite 'Discussion'	Chlorophyll *a*	Fan (1985)
February 1983	20.0°N, 119.0°E	2.5	3c	Pigment concentration, CZCS data	This study
February 1985	19.5°N, 120.0°E	1.5	3d	Pigment concentration, CZCS data	This study
January 1986	18.5°N, 117.5°E	2.0	3b	Pigment concentration, CZCS data	This study

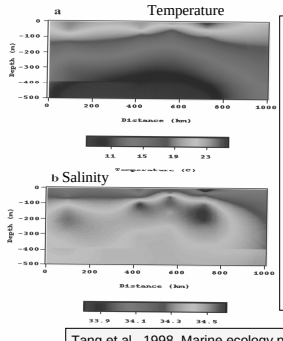


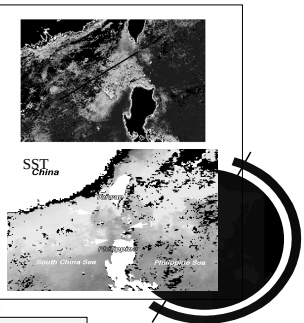


Tang et al., 1998. Marine ecology progress series

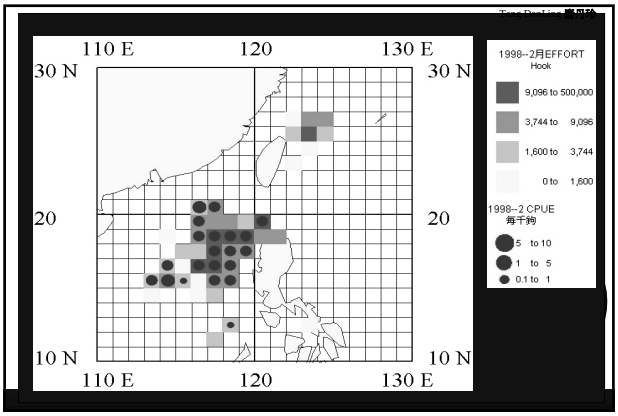
Tang DanLing 唐丹玲

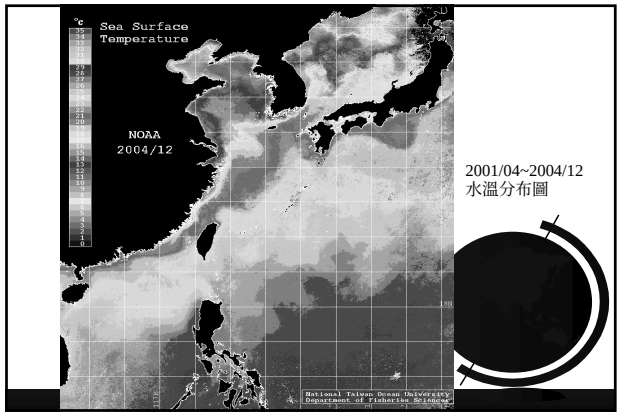
Low temperature / high salinity -Upwelling

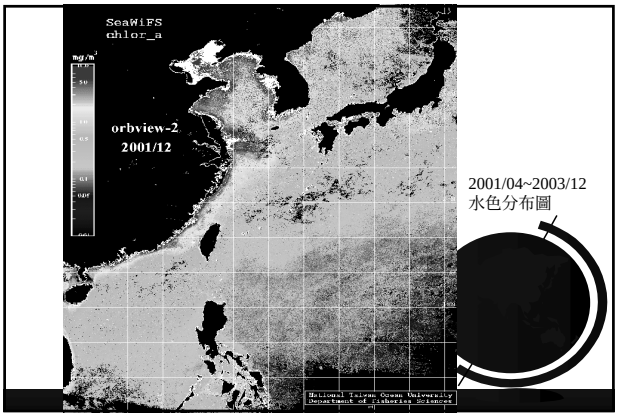


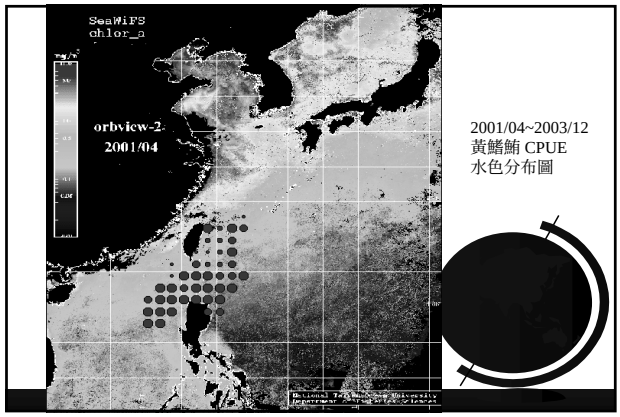


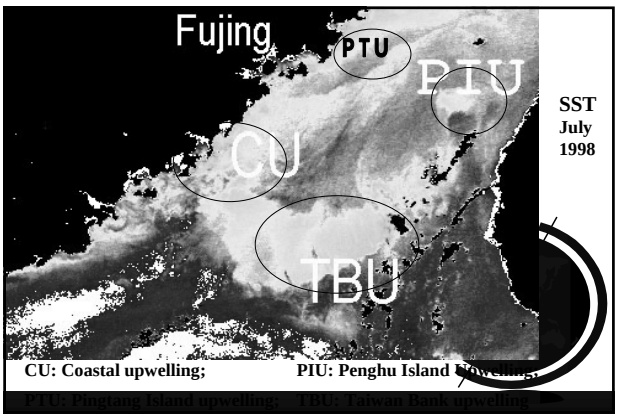
Tang et al., 1998. Marine ecology progress series

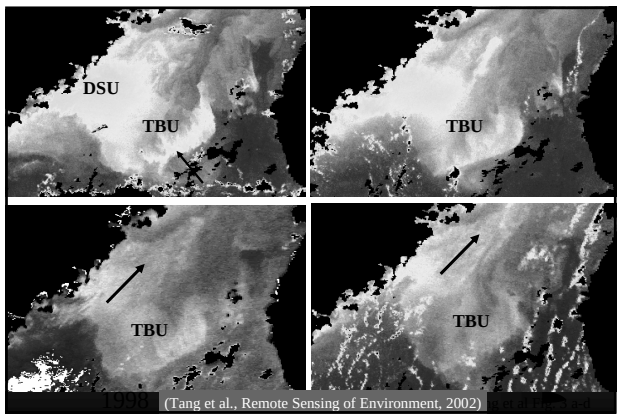

110 E
120
130 E
30 N
20
10 N
1998--2月EFFORT
Hook
9,096 to 500,000
3,744 to 9,096
1,600 to 3,744
0 to 1,600
1998--2 CPUE
每千鉤
5 to 10
1 to 5
0.1 to 1

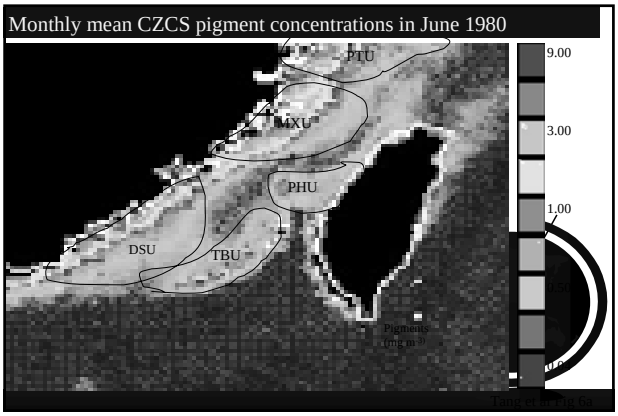

Sea Surface
Temperature
NOAA
2004/12
2001/04~2004/12
水温分布圖

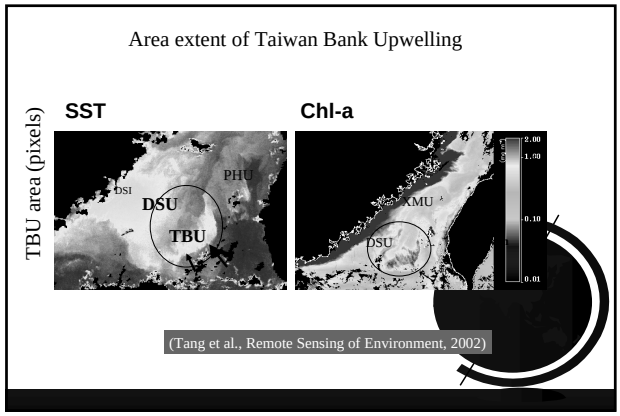

SeaWiFS
chlor_a
orbview-2
2001/12
2001/04~2003/12
水色分布圖

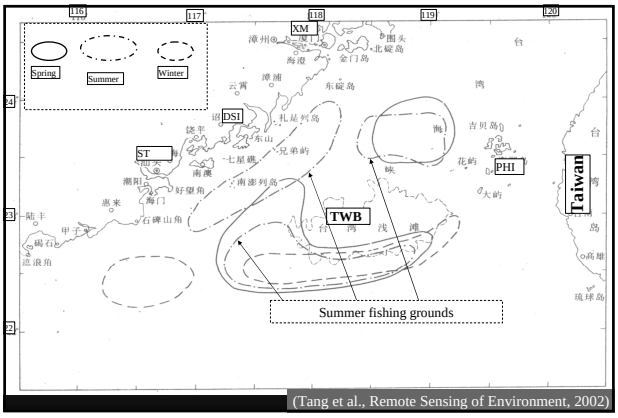

SeaWiFS
chlor_a
orbview-2
2001/04
2001/04~2003/12
黃鰭鮪 CPUE
水色分布圖

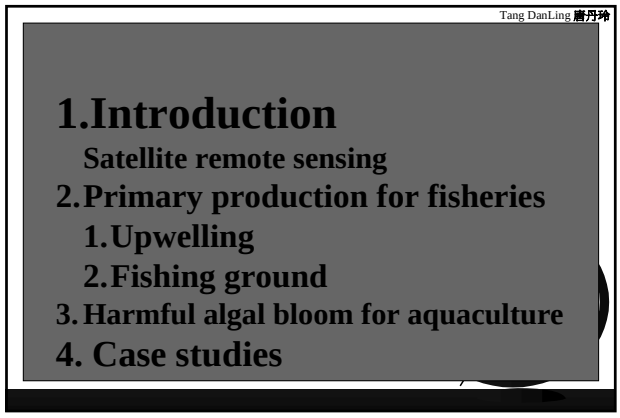

Fujing
PTU
PIU
CU
TBU
SST
July
1998
CU: Coastal upwelling;
PIU: Penghu Island
PTU: Pingtang Island upwelling;
TBU: Taiwan Bank upwelling

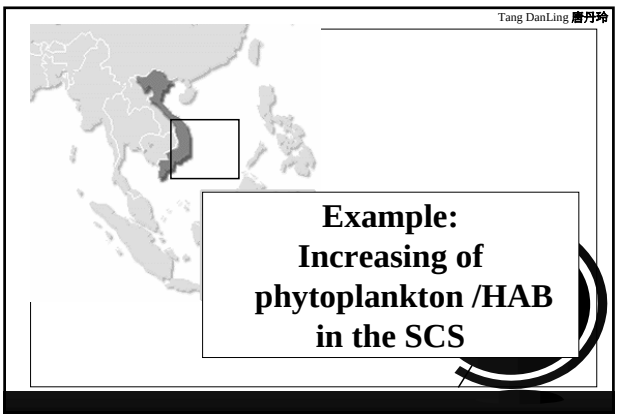

DSU
TBU
TBU
TBU
TBU
1998
(Tang et al., Remote Sensing of Environment, 2002)

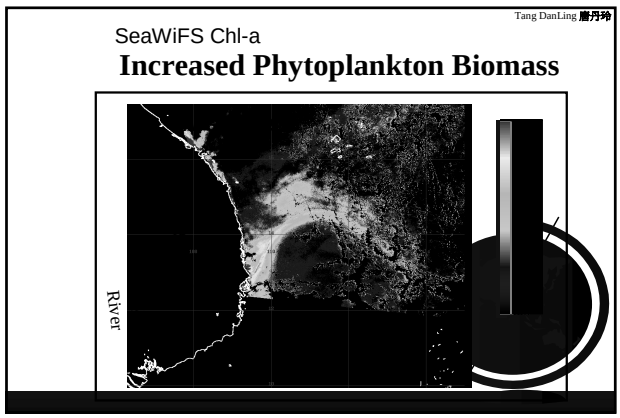

Monthly mean CZCS pigment concentrations in June 1980
PTU
MXU
PHU
DSU
TBU
9.00
3.00
1.00
Pigments (mg m-3)
Tang et al., Fig 6a


Area extent of Taiwan Bank Upwelling
SST
Chl-a
TBU area (pixels)
DSI
PHU
DSU
TBU
XMU
DSU
2.00
1.00
0.10
0.01
(Tang et al., Remote Sensing of Environment, 2002)

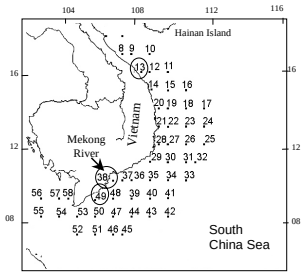

116
117
118
119
120
XM
Spring
Summer
Winter
DSI
ST
PHI
Taiwan
TWB
Summer fishing grounds
(Tang et al., Remote Sensing of Environment, 2002)


Tang DanLing 唐丹玲
1.Introduction
Satellite remote sensing
2.Primary production for fisheries
1.Upwelling
2.Fishing ground
3.Harmful algal bloom for aquaculture
4. Case studies


Tang DanLing 唐丹玲
Example:
Increasing of
phytoplankton /HAB
in the SCS


Tang DanLing 唐丹玲
SeaWiFS Chl-a
Increased Phytoplankton Biomass
River

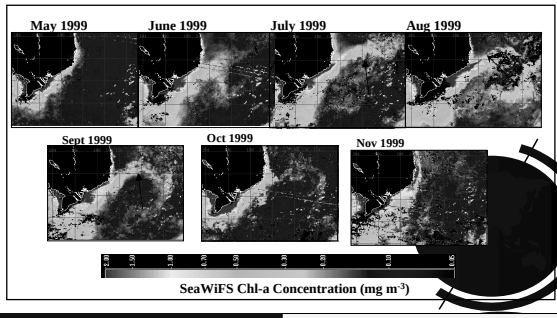
Tang DanLing 唐丹玲



In situ measurements of Chl-a (May 1999)

Tang DanLing 唐丹玲

Monthly Average Chl-a



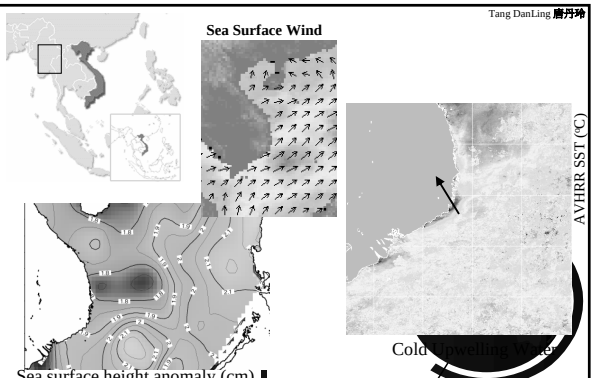
Tang et al., 2004. Marine ecology progress series

Tang DanLing 唐丹玲

1. Offshore increased phytoplankton
2. 7 weeks

---Water condition?
---Nutrients resource?

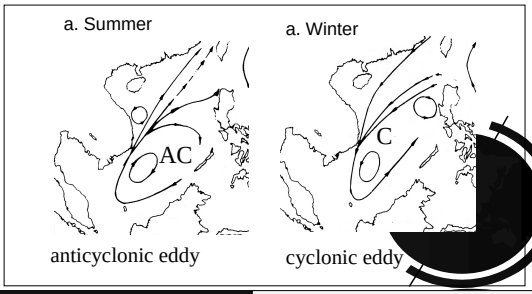
Tang DanLing 唐丹玲



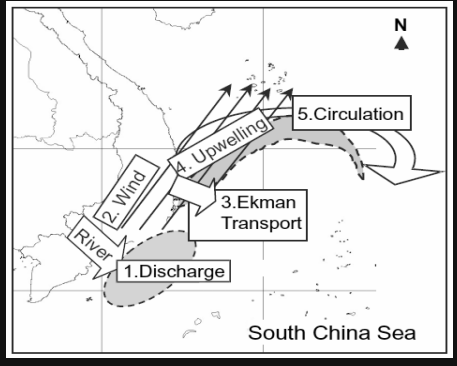
Tang et al., 2004. Marine ecology progress series

Tang DanLing 唐丹玲

Upper layer Mean Circulation Patterns in the SCS

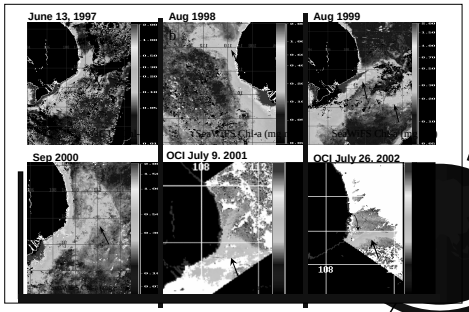


Tang et al., 2004. Marine ecology progress series

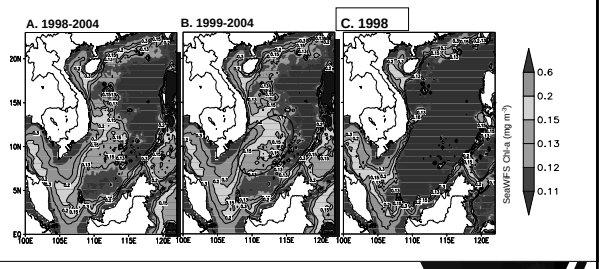


Every year?
or a temporal case?

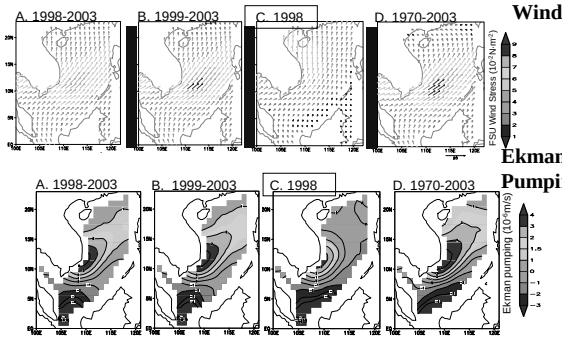
Chl-a in 1997 -2002



Tang et al., 2004. Marine ecology progress series

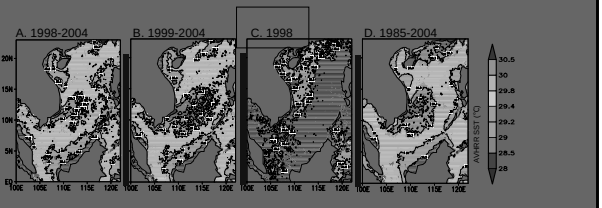


Chao & Tang, 2006

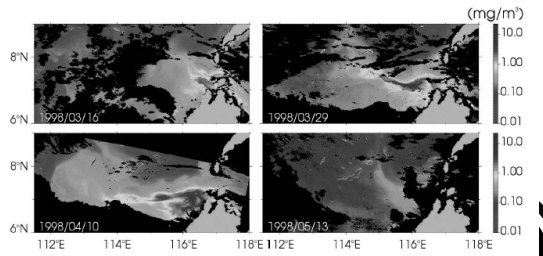


Chao & Tang, 2006

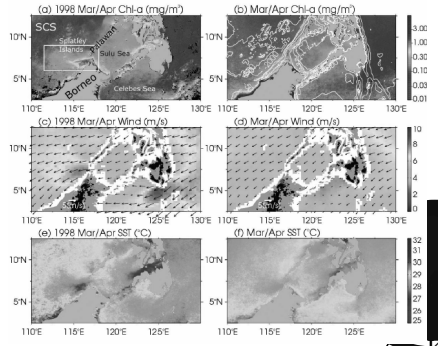
SST



Chao & Tang, 2006



Chao & Tang, 2006



Kawamura

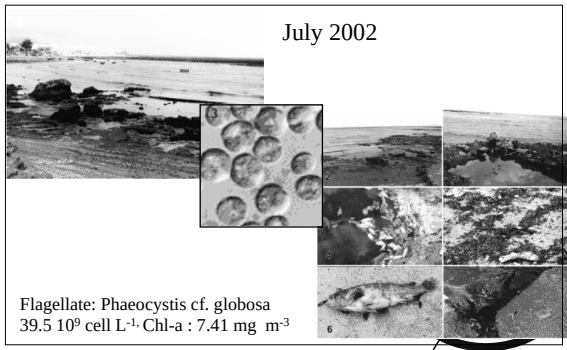
High phytoplankton biomass

Harmful algal bloom?

FAB?

1.Introduction

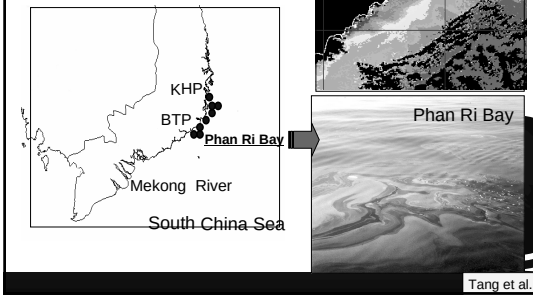
2. Primary production for fishers
3. Harmful algal bloom for aquaculture
4. Case studies

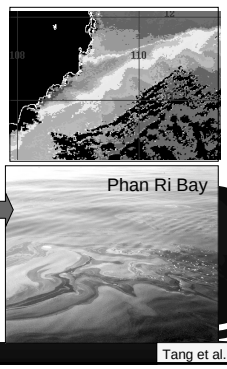


Flagellate: Phaeocystis cf. globosa
39.5 10^9 cell L^{-1}, Chl-a : 7.41 mg m^{-3}

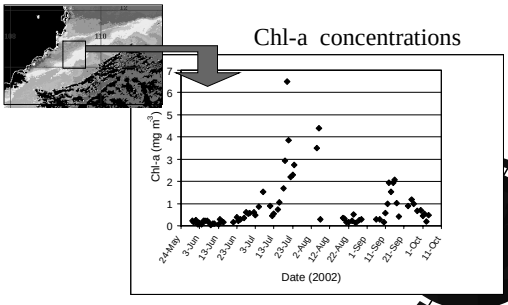
Tang et al., 2004. JGR

Red Tide (HAB)





Tang et al., 2004. JGR



Tang et al., 2004. JGR

Tang et al., 2004. JGR

Tang DanLing 唐丹玲

- **phytoplankton bloom**
  - **Southwesterly monsoon / Every year**
  - **Primary production**
- **HAB**
  - **upwelling / wind ＞ eutrophication**

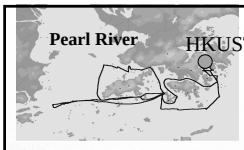
1998, Hong Kong

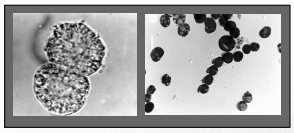
'Red tide' reaches China

The algae suffocates fish after entering their gills

Grouper

Tang DanLing 唐丹玲





Cruises , Nov 1998

Dinoflagellate (resemble)
Gymnodinium catenatum Graham

Tang DanLing 唐丹玲

Result:

Sea surface temperature (NOAA)

Tang DanLing 唐丹玲

- ✦Chlorophyll surface > Bottom
- ✦Salinity surface < bottom
- ✦Oxygen surface > bottom
- ✦Wind 5 m/s

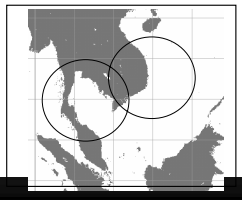
----→ Water Stratification

Tang DanLing 唐丹玲

Comparison between the Gulf of Thailand and the western South China Sea:

Seasonal phytoplankton blooms

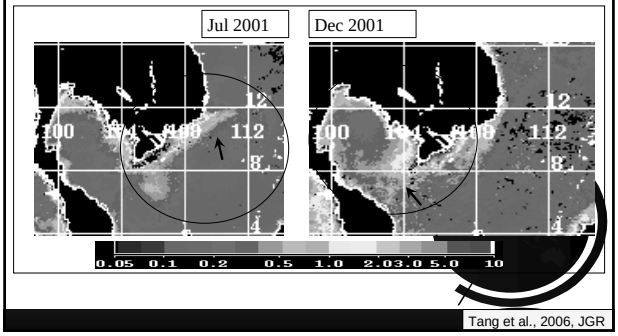
associated with monsoon and coastal environments



Tang et al., 2006, JGR

Tang DanLing 唐丹玲

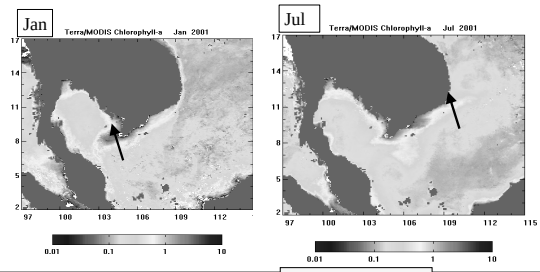
SeaWiFS Chl-a



Tang et al., 2006, JGR

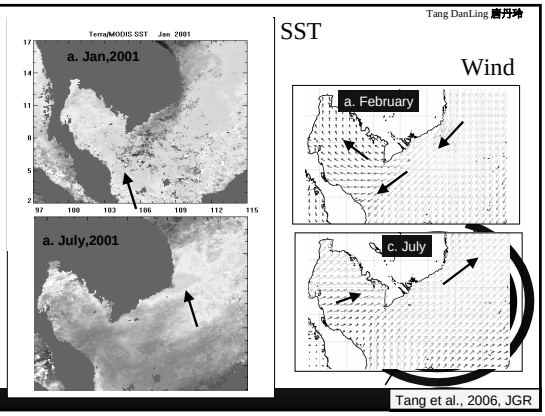
Tang DanLing 唐丹玲

Terra / MODIS Chl-a (2001)



Tang et al., 2006, JGR

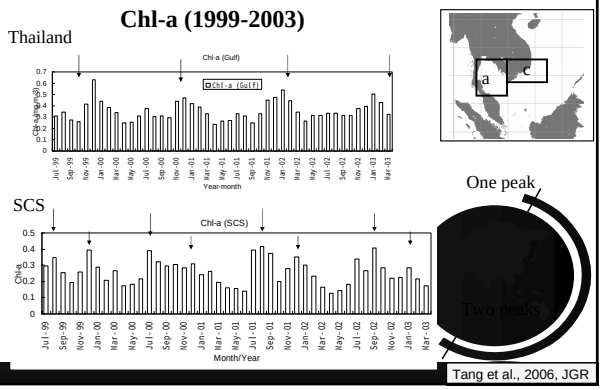
Tang DanLing 唐丹玲



Tang et al., 2006, JGR

Tang DanLing 唐丹玲

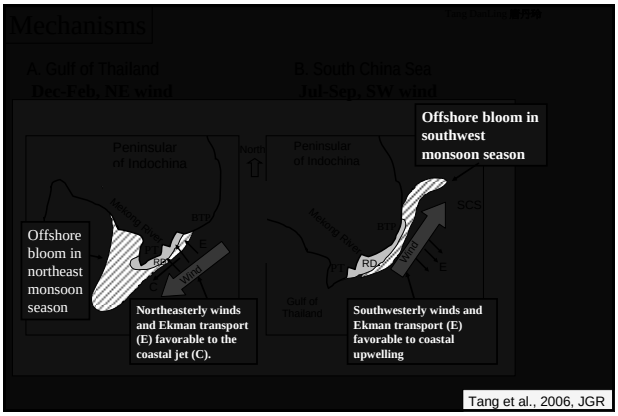
Chl-a (1999-2003)



Tang et al., 2006, JGR

Tang DanLing 唐丹玲

Mechanisms



Tang et al., 2006, JGR

Tang DanLing 唐丹玲

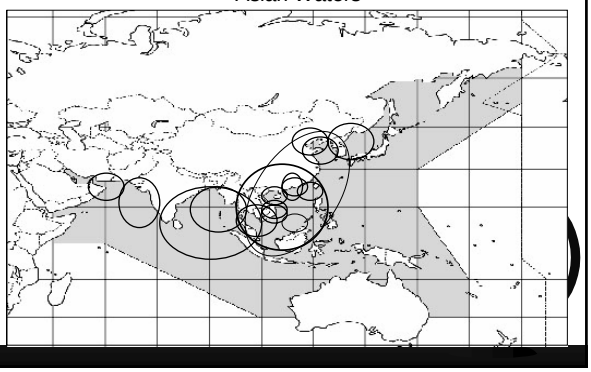
1.Introduction

- Satellite remote sensing

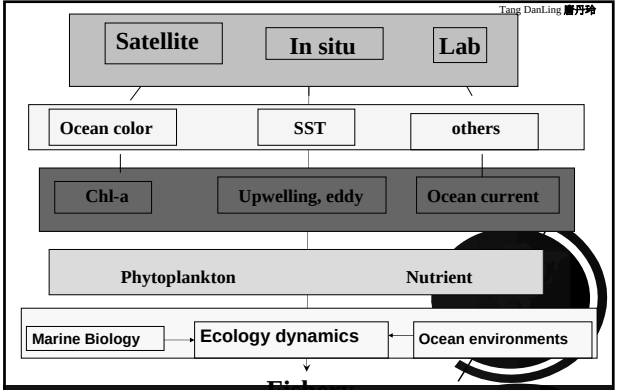
2. Primary production for fisheries
3. Harmful algal bloom for aquaculture
4. Other case studies
   1. Tsunami
   2. Sand storm

Asian Waters

Tang DanLing 唐丹玲

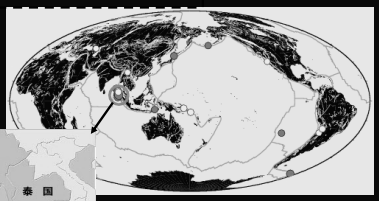


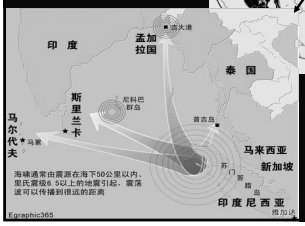
Tang DanLing 唐丹玲



(1) South Asian Tsunami

Tang DanLing 唐丹玲

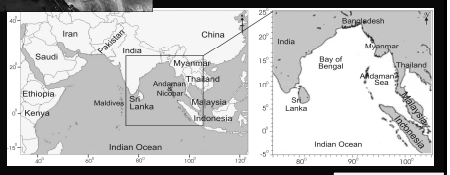




December 26, 2005
March 28, 2006

Tang DanLing 唐丹玲

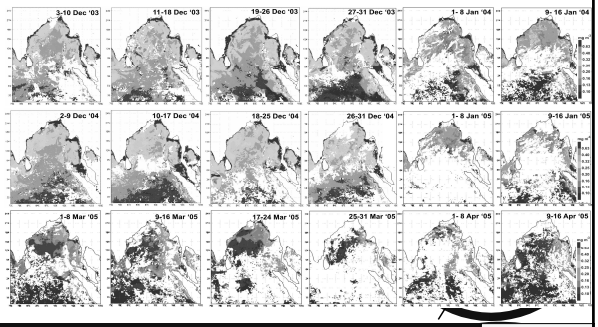
Returning waves of tsunami at the Golden beach of Chennai, India



Tang et al., 2006

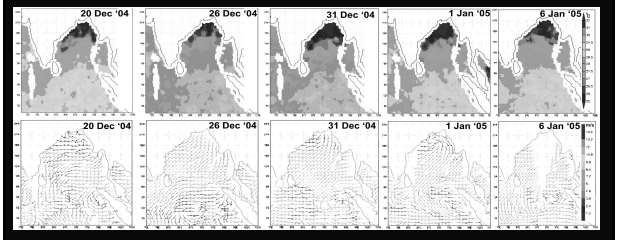
Tang DanLing 唐丹玲

Chl-a concentrations/ blooms



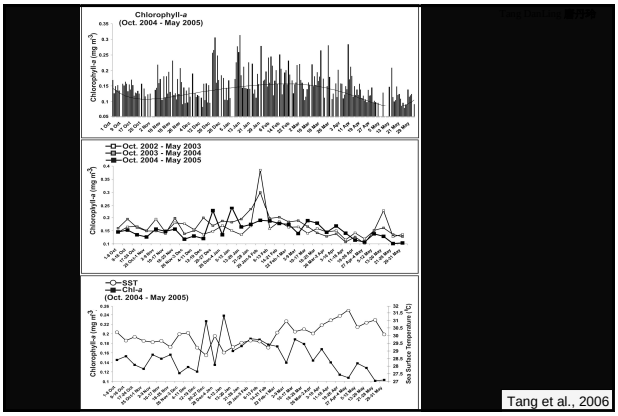
Tang et al., 2006

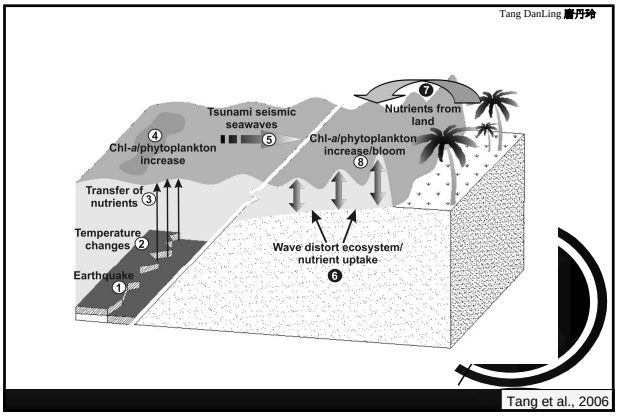
SST



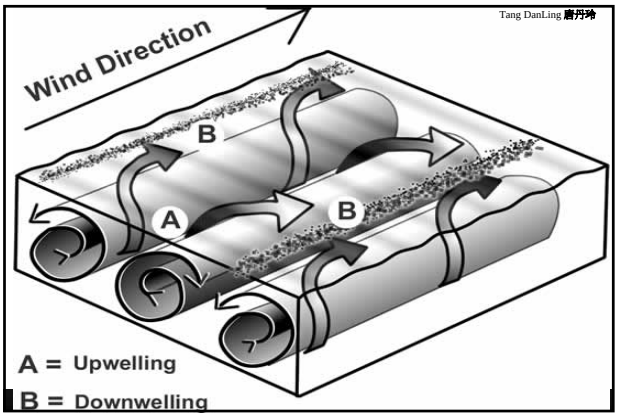
Wind

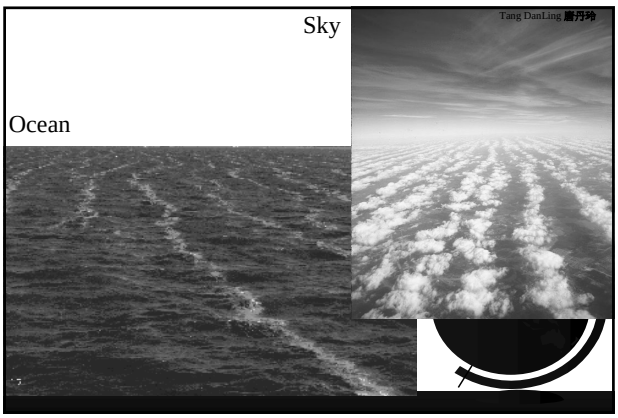
Tang et al., 2006

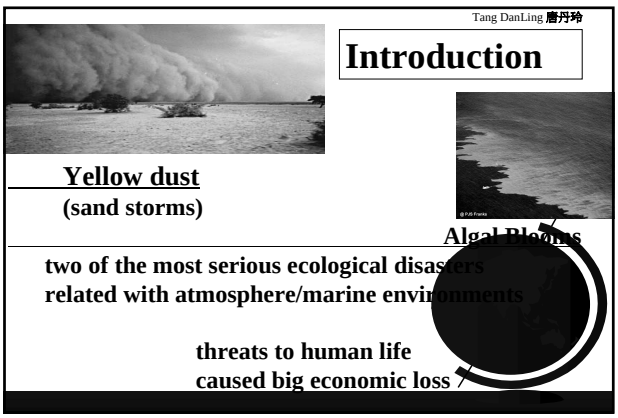

Chlorophyll-a
(Oct. 2004 - May 2005)
Oct. 2002 - May 2003
Oct. 2003 - May 2004
Oct. 2004 - May 2005
SST
Chl-a
(Oct. 2004 - May 2005)
Tang et al., 2006


Tang DanLing 唐丹玲
Tsunami seismic seawaves
Nutrients from land
Chl-a/phytoplankton increase
Chl-a/phytoplankton increase/bloom
Transfer of nutrients
Temperature changes
Earthquake
Wave distort ecosystem/ nutrient uptake
Tang et al., 2006


(2)
Yellow dust
(sand storms)
Tang DanLing 唐丹玲
2004/07/12

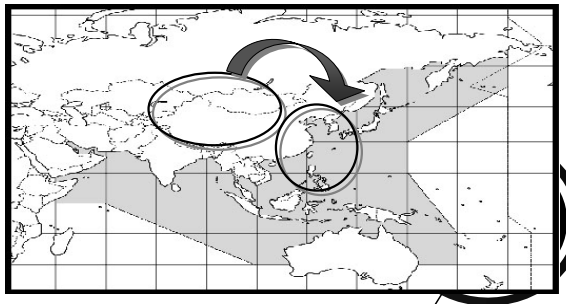

Tang DanLing 唐丹玲
Wind Direction
B
A
B
A = Upwelling
B = Downwelling


Sky
Ocean
Tang DanLing 唐丹玲


Tang DanLing 唐丹玲
Introduction
Yellow dust
(sand storms)
Algal Blooms
two of the most serious ecological disasters
related with atmosphere/marine environments
threats to human life
caused big economic loss

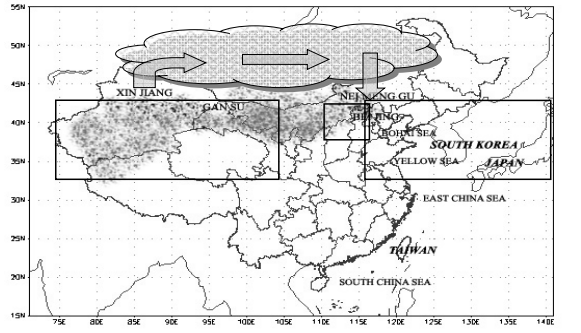
Tang DanLing 唐丹玲

Research Area



Tang DanLing 唐丹玲

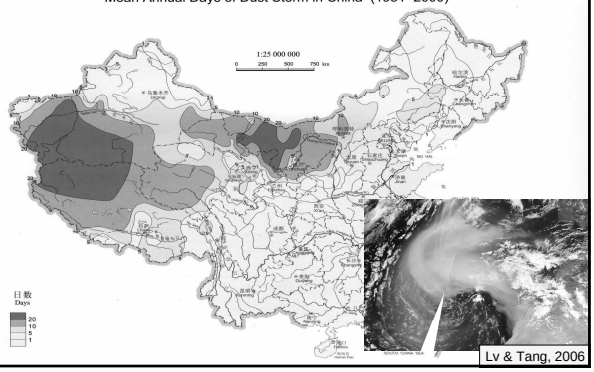
Research Area



Lv & Tang, 2006

Tang DanLing 唐丹玲

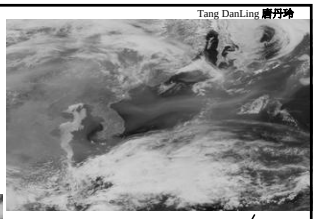
中国沙尘暴年均日数(1951~2000年)
Mean Annual Days of Dust Storm in China (1951~2000)

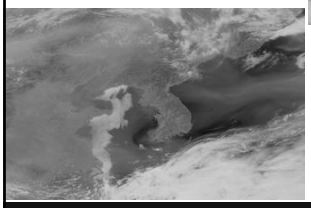


Lv & Tang, 2006

Tang DanLing 唐丹玲

(a) China, April 7, 2001, as captured by SeaWiFS





(b) Japan, April 7, 2001, as captured by SeaWiFS

Lv & Tang, 2006

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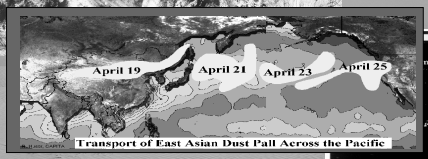
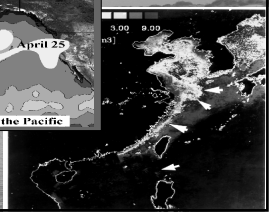
Dust storm from Xinjiang to Pacific

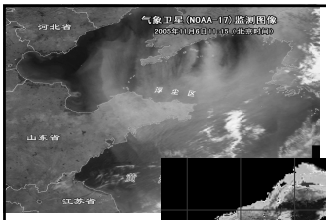
Phytoplankton distribution



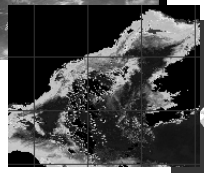


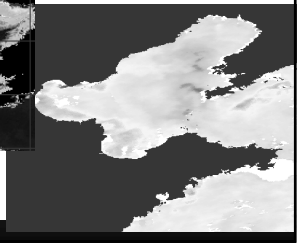
Seawifs Chl-a

Tang DanLing 唐丹玲



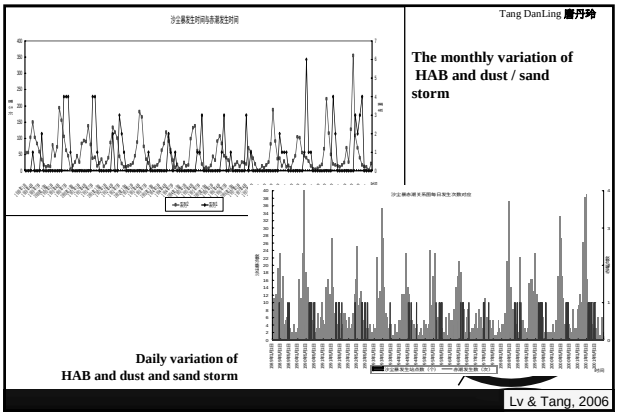
Phytoplankton blooms in Bohai





(Tang et al., 2005, Advances of Space Research)

Tang DanLing 唐丹玲



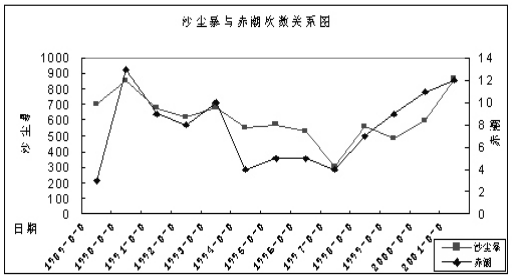
The monthly variation of HAB and dust / sand storm

Daily variation of HAB and dust and sand storm

Lv & Tang, 2006

Tang DanLing 唐丹玲

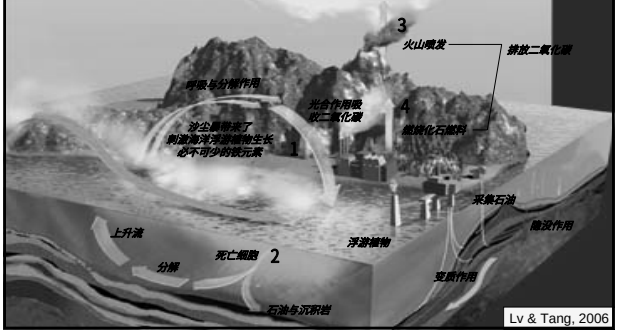
Yearly variation of HAB and dust /sand storm occurrence



Lv & Tang, 2006

Tang DanLing 唐丹玲

沙尘暴参与地球碳循环过程示意图



Lv & Tang, 2006

http://lingzis.51.net

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Sustainable Development