TrawlBase presentation

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FAO-APFIC Regional Expert Workshop on Tropical Trawl Fishery Management
30 September – 4 October 2013, Phuket Thailand

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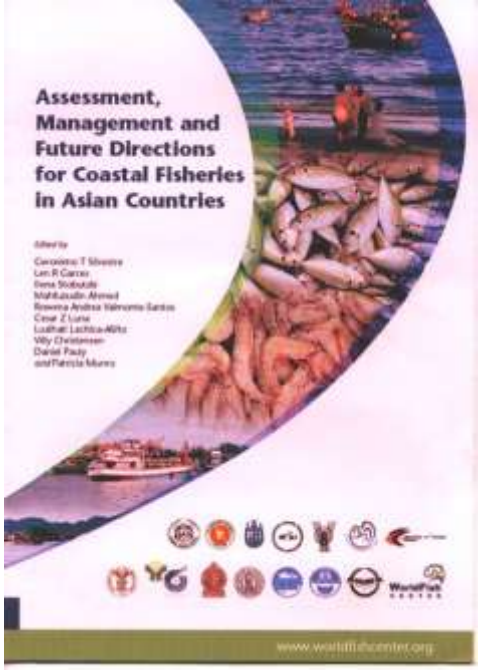
Presentation Outline

- Background
  - "Sustainable Management of Coastal Fish Stocks in Asia" (TrawlBase) Project
- Data Sources and "Analysis Strategy"
- Analyses Results
  - Spatial patterns (assemblage structure)
  - Resource Overlaps (catch composition)

"Sustainable Management of Coastal Fish Stocks in Asia"



FiRST Database: historic research surveys

Tools: summary, visualization, facilitate analyses

Resource Assessment
- ~~Populations~~
- **Assemblages**
- ~~Ecosystems~~

Socioeconomic Assessment
- Fleet dynamics
- Socioeconomic profile
- Bioeconomic modeling

Policy review & National strategies & action plans

Regional strategy & action plan

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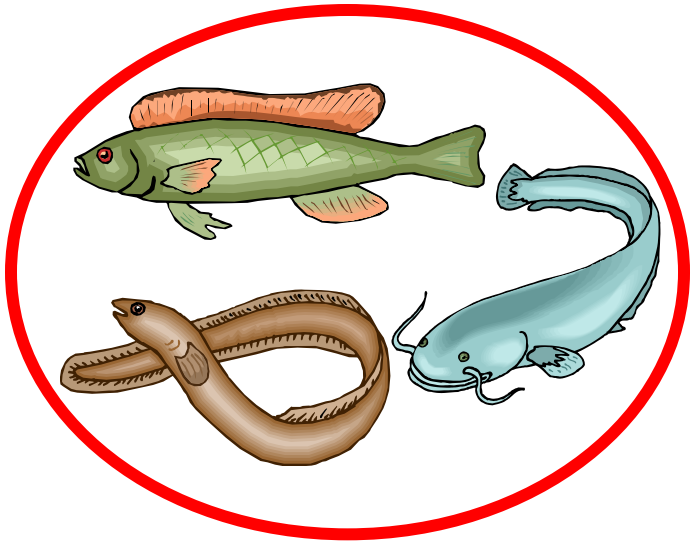
This Presentation:

- Overview of the fish assemblage structure of demersal resources in South and Southeast Asia (provide advise on possible zoning – spatial management)

- Resource (catch composition) overlaps based on a case study of San Miguel Bay, Philippines (management of trawler vs SSF)

Fish Assemblages

- Spatial pattern of species - Where do you find what species?



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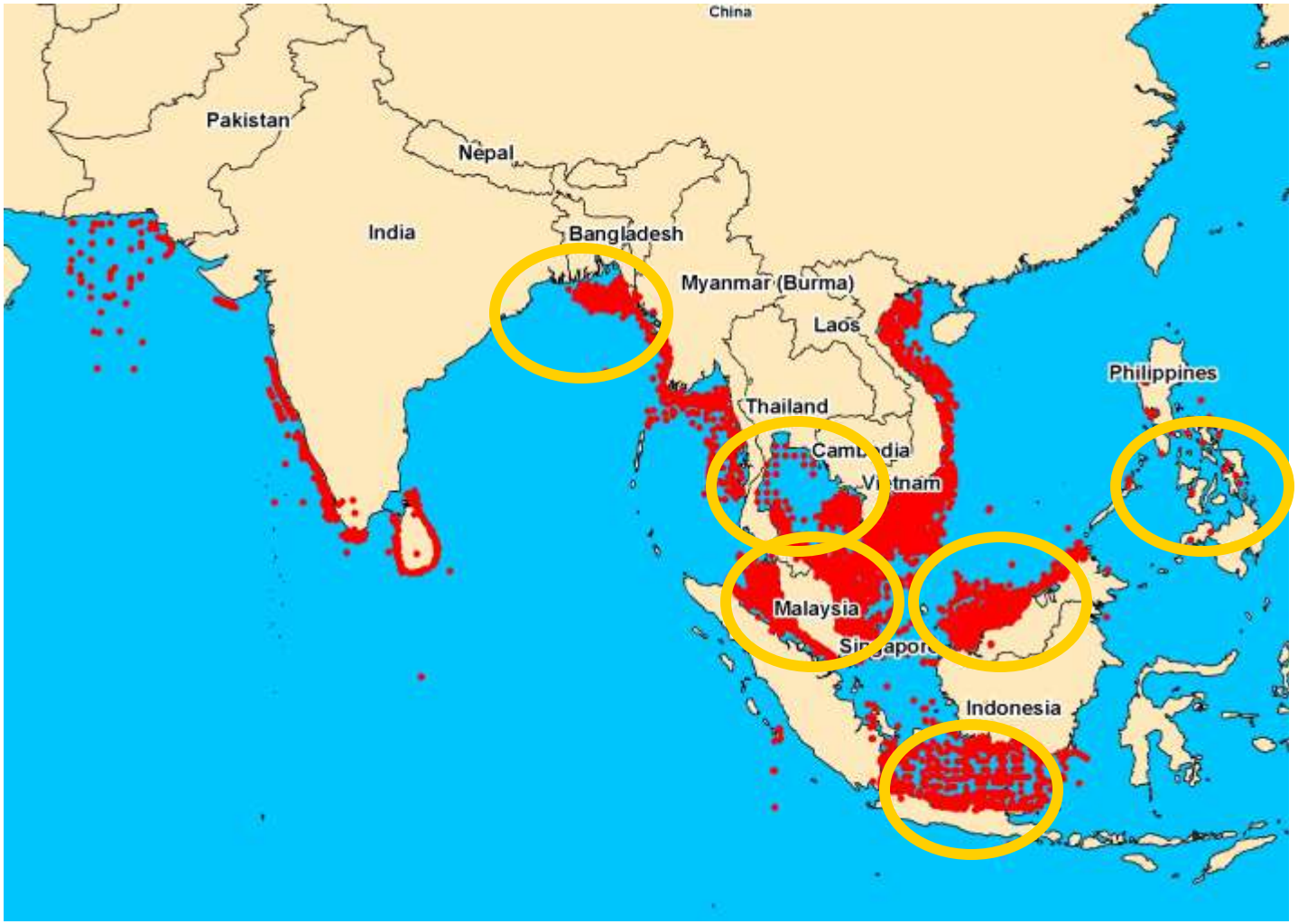
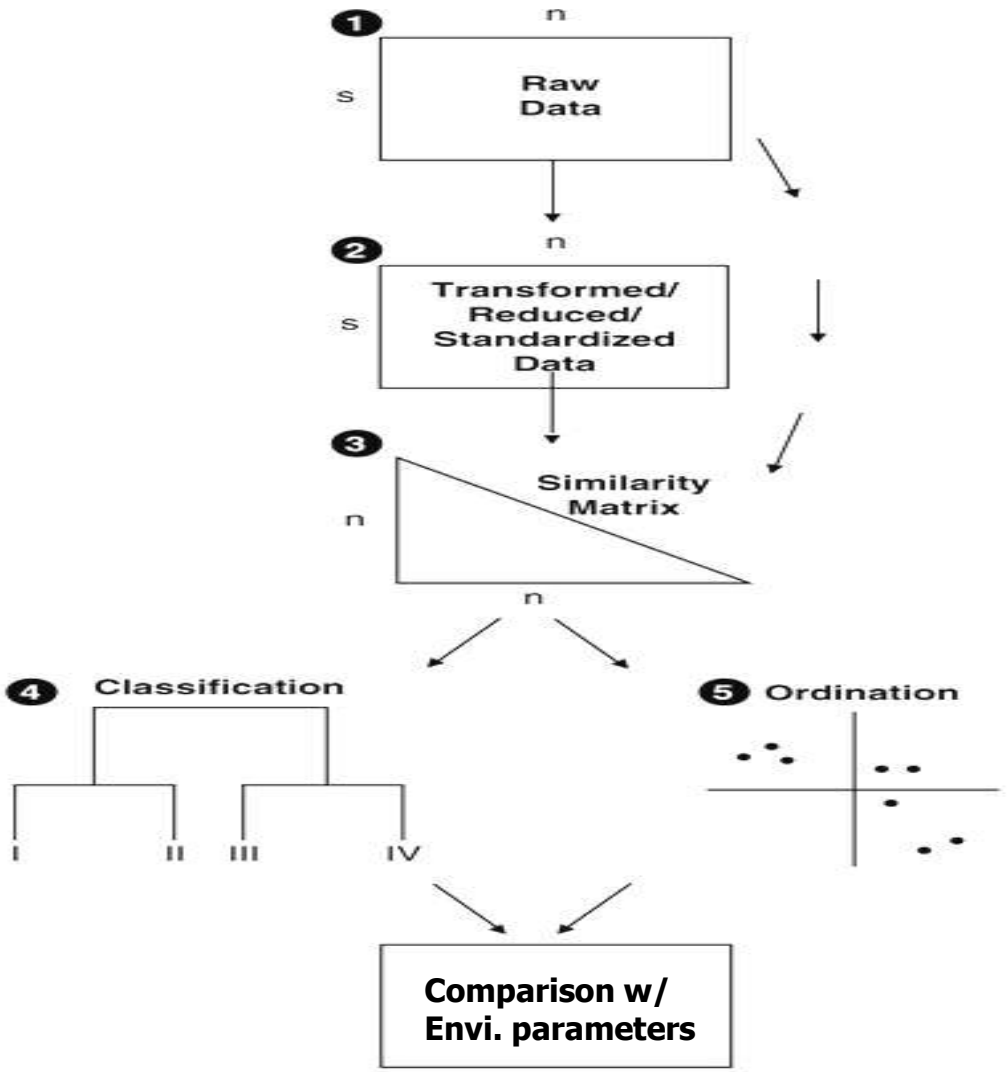
Trawl Survey database: 21,000 stations/hauls



"Analysis Strategy"



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I. Spatial Pattern Analysis

- Define “Fish Assemblages”
- Relation to environmental factors or gradients
- Relate to delineation of fishing zones

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Fisheries Research 78 (2006) 143–157

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Spatial structure of demersal fish assemblages in South and Southeast Asia and implications for fisheries management

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Abstract

We provide a review of the assemblage structure of demersal fish resources in four South and Southeast Asian countries. Multivariate techniques (classification and ordination analysis) were used to analyze scientific trawl survey data from a collaborative project in the region. Analyses covered major coastal fishing areas in Bangladesh, Indonesia, Malaysia, and the Philippines. This represents the first such assessment of fish assemblages for the region using a standard analysis framework. Results indicate that spatial patterns of demersal assemblages are influenced by depth. However, other environmental factors such as salinity and substrate type also appear important. Critical fisheries management implications of the observed assemblage patterns are discussed, particularly in terms of the existing spatial management zones. Existing management zones are based on distance from shore and were found to be largely inconsistent with the assemblage patterns observed. If management is to be effective it must be structured to take into account the underlying pattern of the fish assemblages.

Keywords: Demersal fish assemblages; Experimental trawl surveys; Fisheries management; South and Southeast Asia

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Results – Spatial Patterns

Coastal Areas (Source)	Major assemblages (by depth range - m)									
	<10	20	30	40	50	60	70	80	90	>100
Bangladesh - Bay of Bengal (Mustafa, 2003)										
Indonesia – North coast of Java (Nurhakim, 2003)										
Malaysia - Sabah/Sarawak waters (Alias, 2003)										
Malaysia – Peninsular, West Coast (Alias, 2003)										
Malaysia - Peninsular, East Coast (Alias, 2003)										
Philippines – Manila Bay (Campos, 2003)										
Philippines – San Pedro Bay (Campos, 2003)										
Philippines – Samar Sea (Campos, 2003)										

(Garces et al. 2006)

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Results – Spatial Patterns

Coastal Areas (Source)	Major assemblages (by depth range - m)											
	<10	10	20	30	40	50	60	70	80	90	100	>100
Brunei Darussalam (Silvestre et al., 2003)												
Indonesia - Northwest Coast of Sumatra (Bianchi, 1996)												
Indonesia - Java Sea, including part of southern South China Sea (Bianchi et al., 1996)												
Indonesia – Southwest Shelf (Java) (McManus, 1989)												
Indian Ocean – coast of Bali to mid-Sumatra (McManus, 1996)												
India – West Coast (Srinath et al., 2003)												
Pakistan Shelf (Bianchi, 1992)												
Philippines – Samar Sea (McManus, 1986)												
Philippines – Ragay Gulf (Federizon, 1992)												
Gulf of Thailand – Eastern part off Chanthaburi (Chittima and Wannakiat, 1992)												
Gulf of Thailand (Khongchai et al., 2003)												
South China Sea - northern continental shelf (Qui, 1988)												

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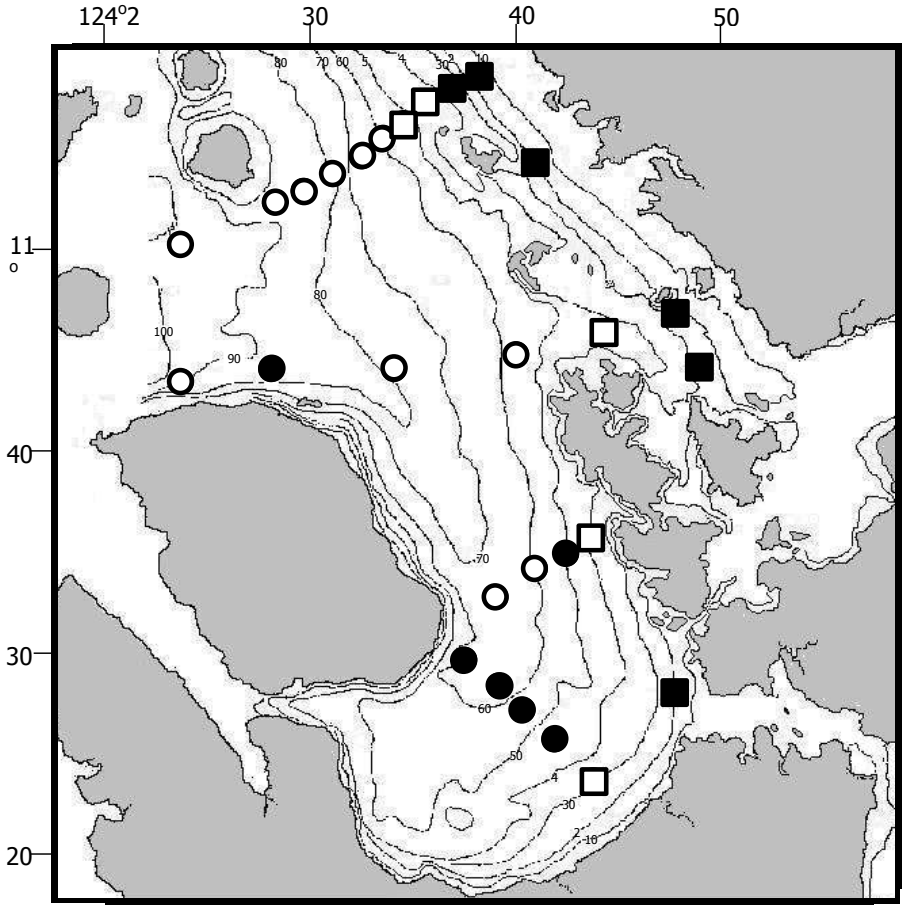
Results - Philippines



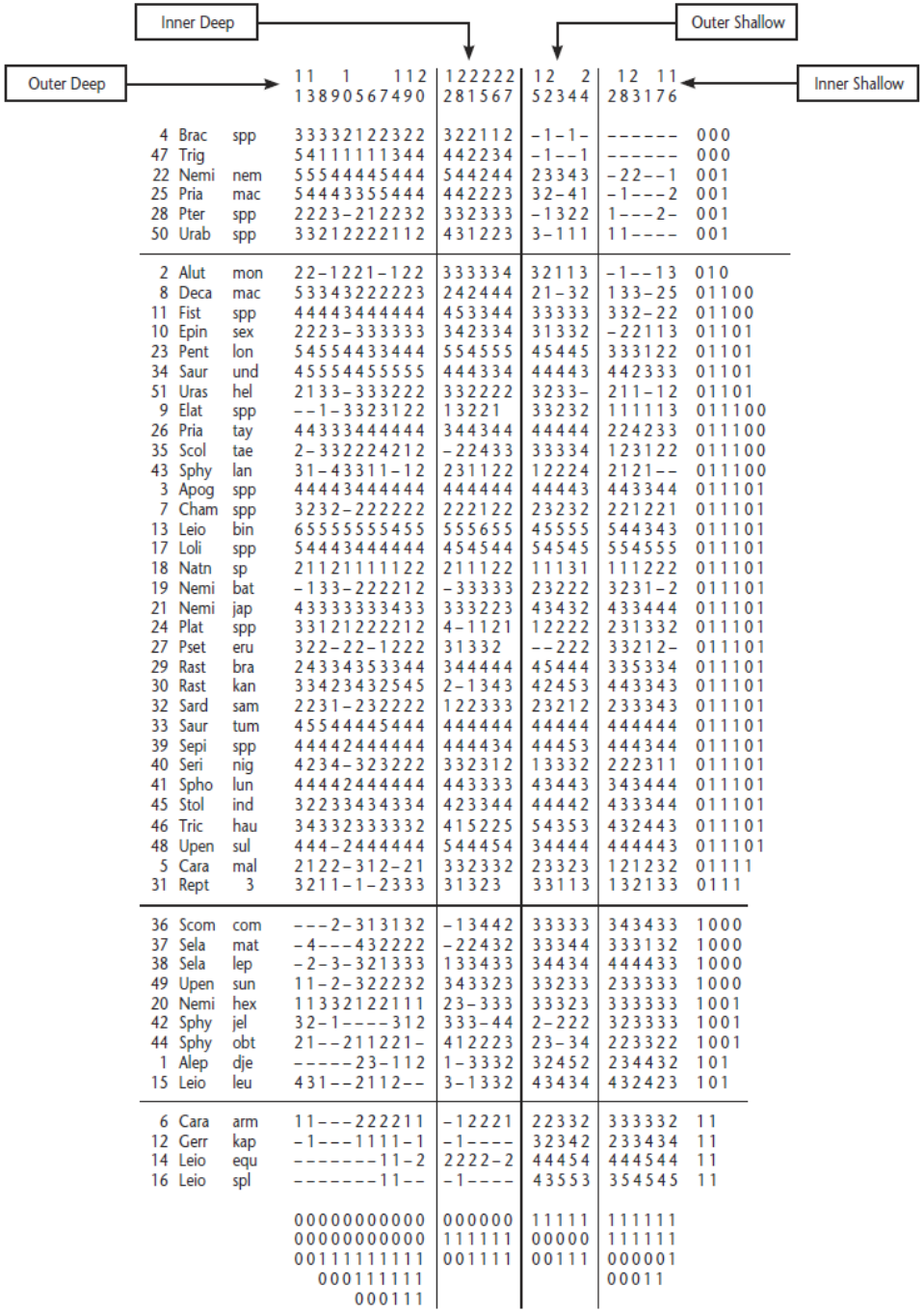
e.g., SAMAR SEA

Delineated by depth:

< 40 m shallow assemblage

50 – 60 m deep assemblage

(Campos 2003)



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22	Nemi	nem	55544445444	544244	23343	-22--1	001
25	Pria	mac	54443355444	442223	32-41	-1---2	001
28	Pter	spp	2223-212232	332333	-1322	1---2-	001
50	Urab	spp	33212222112	431223	3-111	11----	001
2	Alut	mon	22-1221-122	333334	32113	-1--13	010
8	Deca	mac	53343222223	242444	21-32	133-25	01100
11	Fist	spp	44443444444	453344	33333	332-22	01100
10	Epin	sex	2223-333333	342334	31332	-22113	01101
23	Pent	lon	54554433444	554555	45445	333122	01101
34	Saur	und	45554455555	444334	44443	442333	01101
51	Uras	hel	2133-333222	332222	3233-	211-12	01101
9	Elat	spp	--1-3323122	13221	33232	111113	011100
26	Pria	tay	44333444444	344344	44444	224233	011100
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7	Cham	spp	3232-222222	222122	23232	221221	011101
13	Leio	bin	65555555455	555655	45555	544343	011101
17	Loli	spp	54443444444	454544	54545	554555	011101
18	Natn	sp	21121111122	211122	11131	111222	011101
19	Nemi	bat	-133-222212	-33333	23222	3231-2	011101
21	Nemi	jap	43333333433	333223	43432	433444	011101
24	Plat	spp	33121222212	4-1121	12222	231332	011101
27	Pset	eru	322-22-1222	31332	--222	33212-	011101
29	Rast	bra	24334353344	344444	45444	335334	011101
30	Rast	kan	33423432545	2-1343	42453	443343	011101
32	Sard	sam	2231-232222	122333	23212	233343	011101
33	Saur	tum	45544445444	444444	44444	444444	011101
39	Sepi	spp	44442444444	444434	44453	444344	011101
40	Seri	nig	4234-323222	332312	13332	222311	011101
41	Spho	lun	44442444444	443333	43443	343444	011101
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46	Tric	hau	34332333332	415225	54353	432443	011101
48	Upen	sul	444-2444444	544454	34444	444443	011101
5	Cara	mal	2122-312-21	332332	23323	121232	01111
31	Rept	3	3211-1-2333	31323	33113	132133	0111
36	Scom	com	---2-313132	-13442	33333	343433	1000
37	Sela	mat	-4---432222	-22432	33344	333132	1000
38	Sela	lep	-2-3-321333	133433	34434	444433	1000
49	Upen	sun	11-2-322232	343323	33233	233333	1000
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42	Sphy	jel	32-1----312	333-44	2-222	323333	1001
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1	Alep	dje	-----23-112	1-3332	32452	234432	101
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			000111				

Fig. 9. Two-way table output for annual spatial analysis of Samar Sea data.

e.g., SAMAR SEA

Delineated by depth:

< 40 m shallow assemblage

50 – 60 m deep assemblage

(Campos 2003)

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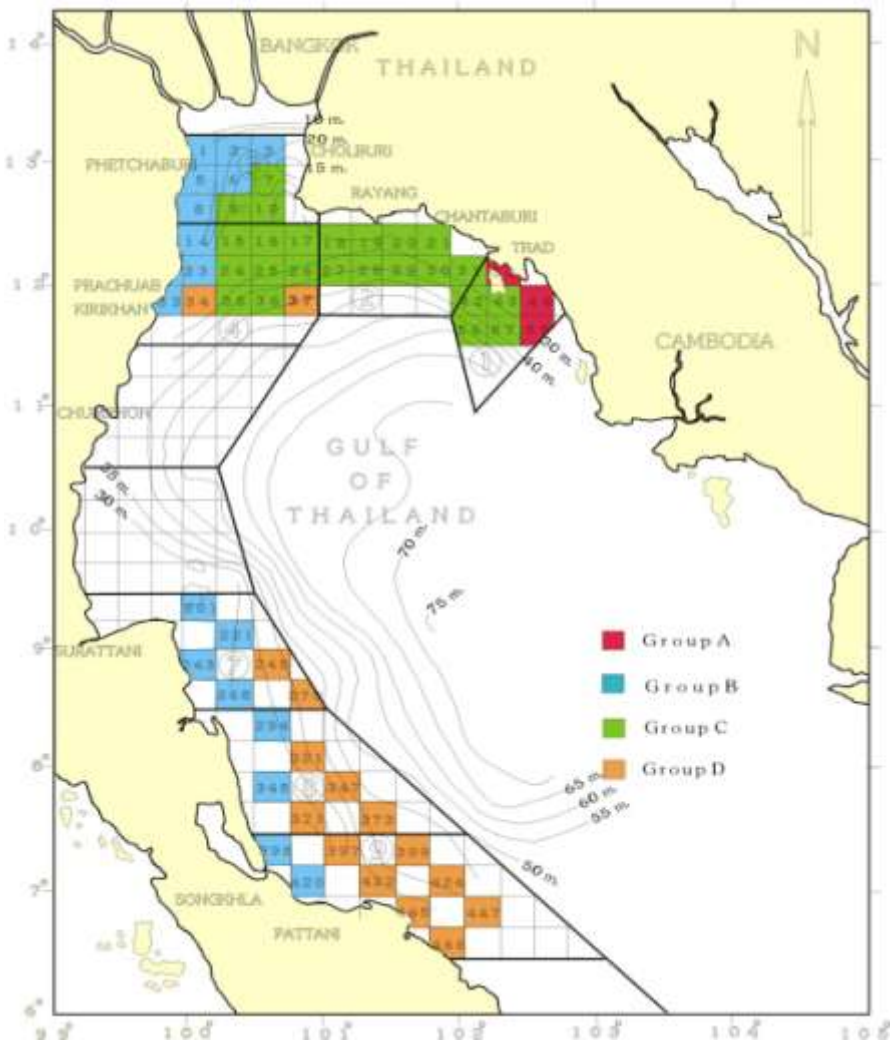
Results - Thailand



e.g., Gulf of Thailand

- Delineated mainly by depth in Southern GOT:
  < 30 m shallow assemblage
  30 - 50 m deep assemblage

- Inner Gulf maybe by salinity or habitat type?

(Khongchai et al. 2003)

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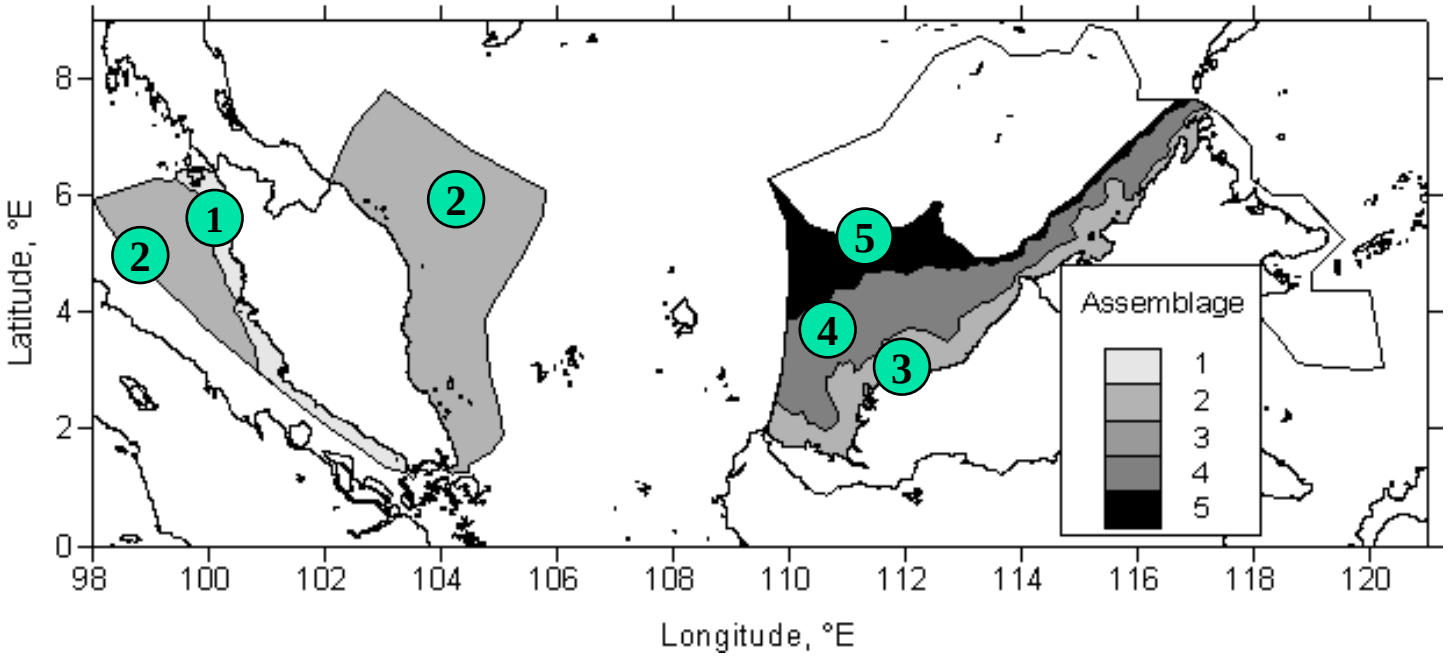
Results - Malaysia



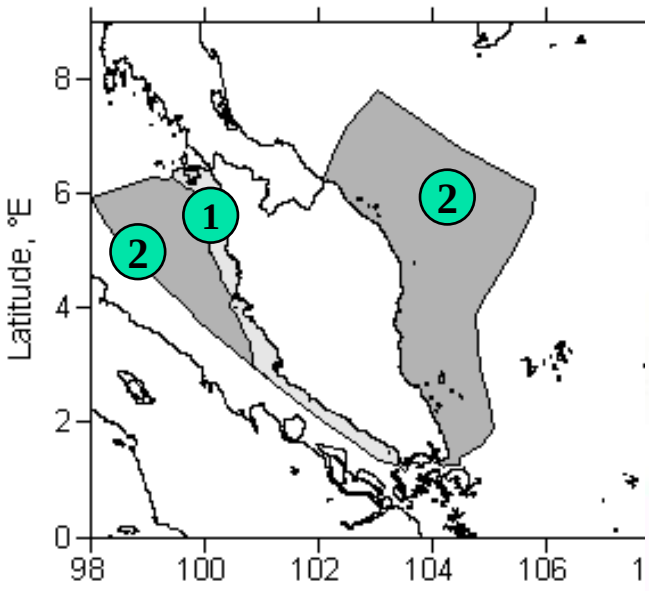
Delineated by mainly by depth & salinity (?)

< 40 m	shallow assemblage (1, 3)
40 – 90 m	intermediate assemblage (2, 4)
> 90 m	deep assemblage (5)

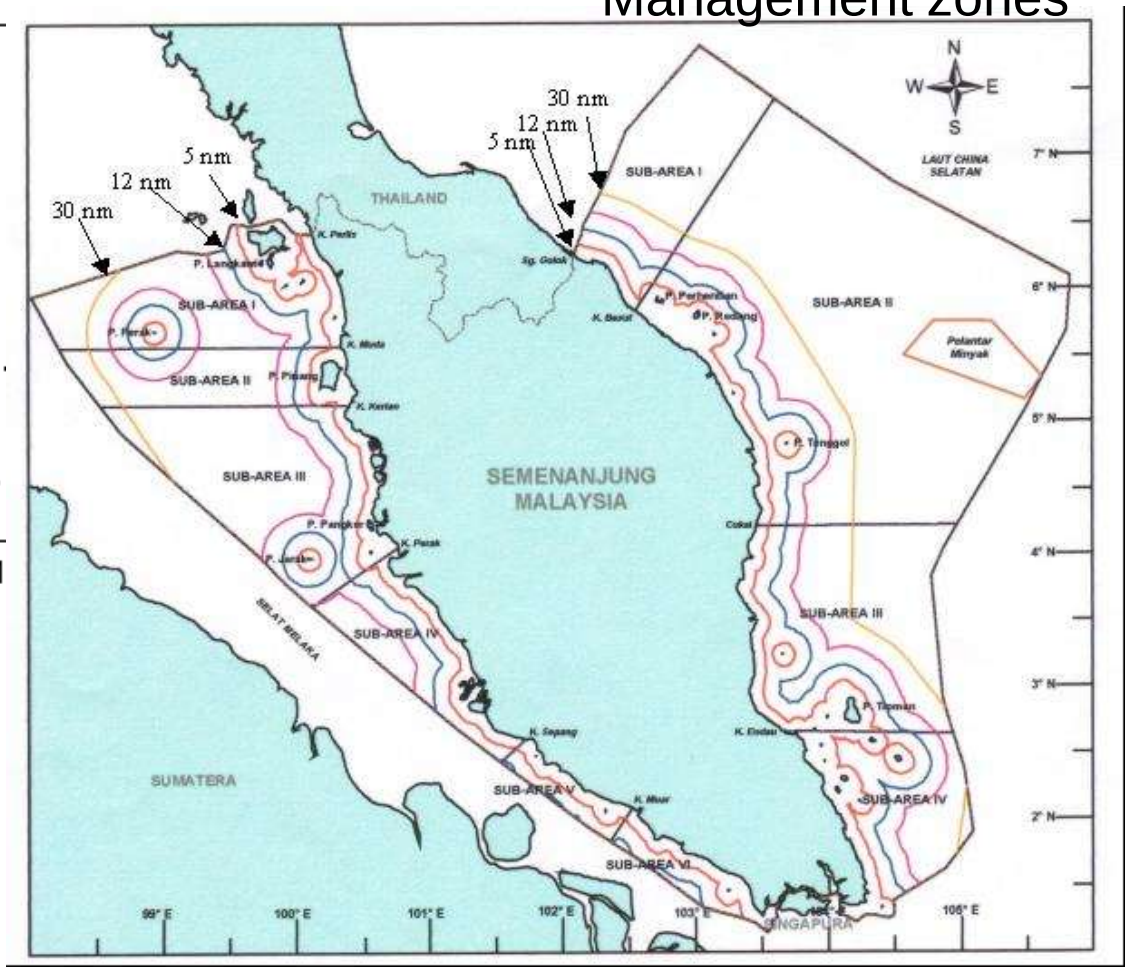
(Alias 2003)

Fish Assemblages

Fisheries management zones do not take into account fish assemblages.



Management zones



Existing Fishing Zones …..

Countries	Fishing Zone I	Fishing Zone II	Fishing Zone III	Fishing Zone IV
	Reference Point: Distance from shoreline			
BRUNEI DARUSSALAM	3nm (Small-scale/ Artisanal fisheries)	3nm to 20nm (Small-scale/ Artisanal fisheries /Industrial fisheries)	20nm to 45nm (Small-scale/ Artisanal fisheries /Industrial fisheries)	45nm to EEZ limit (Small-scale/ Artisanal fisheries /Industrial fisheries)
INDONESIA	3nm (Small-scale fisheries)	7nm (Small-scale fisheries)	12nm (Industrial fisheries)	>12nm (Industrial fisheries)
MALAYSIA	5nm (Traditional Fisheries)	5nm to 12nm (Commercial Fisheries)	12nm to 30nm (Commercial Fisheries)	30nm to EEZ (Commercial Fisheries)
PHILIPPINES	15km (~8nm) (Municipal fisheries)	15km (~8nm) to EEZ limit (Commercial fisheries)		
THAILAND	12nm (Small-scale fisheries)	12nm to EEZ limit (Large-scale fisheries)		
VIET NAM	0 to 30m depth in Northern and Southern areas, to 50m depth in Central area (Small-scale fisheries)	30 to 50m depth to the EEZ limit (Large-scale fisheries)		

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Conclusion

Spatial Patterns:

- Delineation of fish assemblages are mainly influenced by DEPTH, but salinity and substrate (habitat) type maybe also be important
- In most countries fish assemblage structure are not consistent with “fishing zones” or “management zones”

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II. Resource Overlaps

J. Mar. Biol. Ass. India, 52 (1) : 1 - 7, January - June 2010

Invited Paper

An evaluation of resource overlaps among fishing gears in the coastal fisheries using multivariate techniques

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Abstract

Southeast Asian fisheries such as in San Miguel Bay, Philippines operate in a multi-gear and mixed-species situation. Marine capture fisheries in the Philippines are conventionally sub-divided into municipal (small-scale) and commercial (large-scale) based on vessel gross tonnage (GT) and arbitrarily delineated spatially on the basis on area where fishing operations are undertaken. Fisheries management interventions are usually focused on the effort control by fishing gear type or specific fisheries (or species). Catch and effort data have been collected in most of the stock assessment studies, however, there have been limited assessments in differential fishing pressure on various species from available data. The apparent gear interactions and their influence on the high exploitation levels of the major fishery resources have been assessed qualitatively. The approach being illustrated can help management clarify effort reduction or allocation measures and identify which fishing gears should be regulated. Classification (TWINSPAN) and ordination (DCA) techniques commonly used in community structure analysis were utilized to examine the catch composition of 17 dominant fishing gears monitored during 1992 and 1993 and illustrate the extent of competition among the fishing gears in terms of their target species. The results indicate separation of two gear groups i.e., nearshore/coastal and offshore. The fishing gears employed in the nearshore/coastal areas indicate high degree of gear competition due to similarity in target species. The catch composition of the fishing gear group is also presented. Finally, this study provides an example how three fishing gears (*i.e.*, trawl, filter net and gillnet) exploit different size groups of croaker (*Otolithes ruber*), which is one of the dominant species in the Bay.

Keywords: Coastal fisheries management, fishing gear interaction, multivariate analysis, Philippines

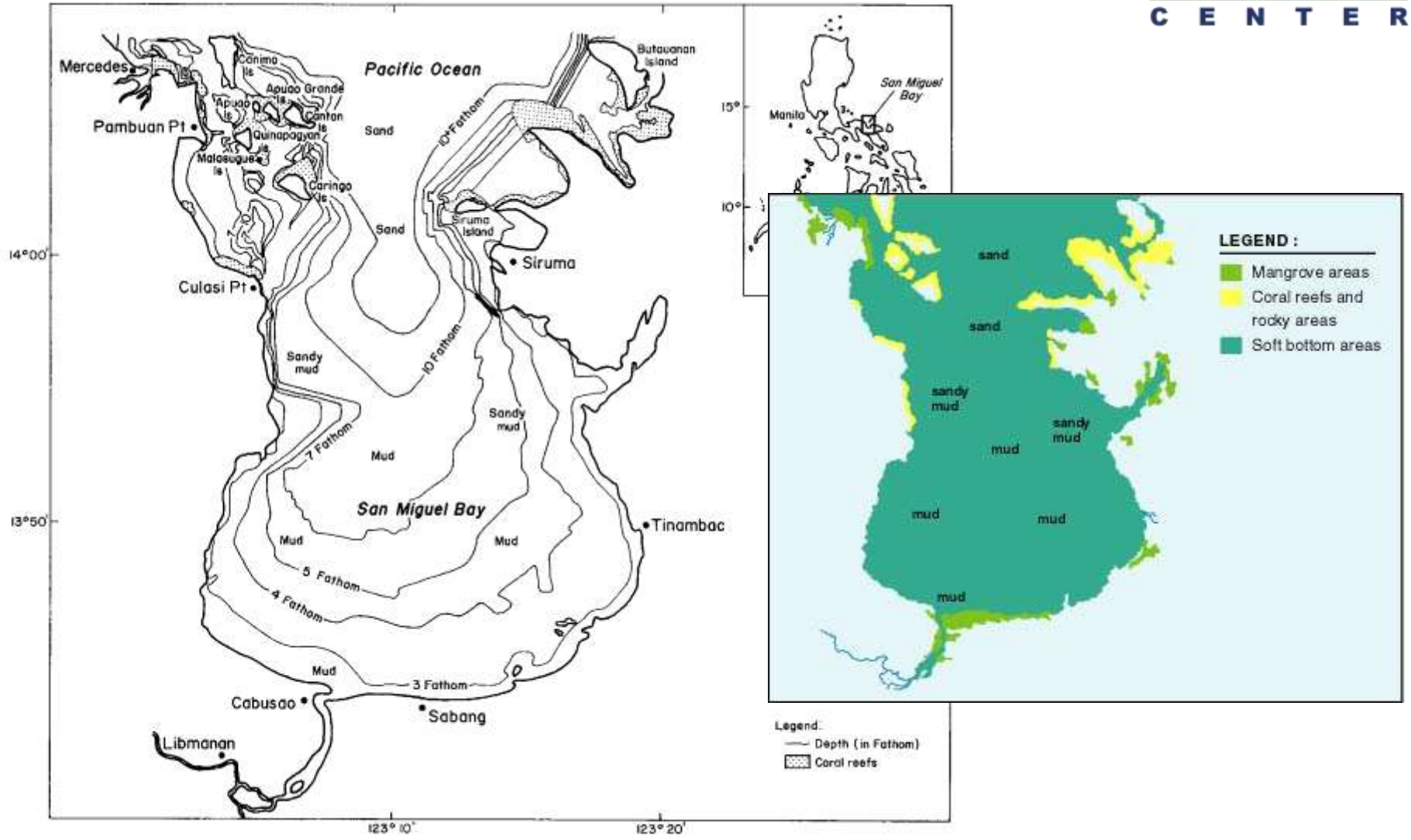
Introduction

Recently, it is recognized that most of the coastal/ nearshore fisheries in southeast Asia are overfished (Silvestre *et al*., 2003; Stobutzki *et al*., 2006). Production from coastal capture fisheries has also been declining in some fishing areas. Silvestre *et al*. (2003) have estimated that overfishing in south and southeast Asia has depleted coastal fish stocks by 5 to 30 per cent of their unexploited levels. The overexploited stocks are coastal demersals and small pelagics in Java Sea, Indonesia and Philippines; and demersals, small pelagics and prawns in the Gulf of Thailand (Stobutzki *et al*., 2006).

Most of the fisheries in tropical coastal fishing grounds such as in San Miguel Bay, Philippines operate in multi-gear, multispecies complex. Overfishing has been identified as a serious problem on the sustainability of the resources in the Bay and that demersal fish biomass declined to about 18.5% of their level in the late 1940's (Cinco *et al*., 1995a). The declines in fish biomass particularly of demersal stocks are presumably due to excessive fishing effort as well as habitat/environmental degradation. The results of the stock assessments in the Bay estimated a mean exploitation rate for the 15 most abundant species in the Bay at 0.65 (Cinco and Silvestre, 1995). This value is above the optimal level prescribed by current theory and suggests very heavy fishing pressure from the mix of fishing methods used in the Bay.

Many Asian countries use "fishing zones" as a spatial management tool to restrict fishing in

Study Site: (San Miguel Bay)



Objectives of the Study:

- To assess extent of gear competition or interaction in terms of species overlaps as exhibited in the catch composition of the various gears

- To examine the effectiveness of gear restrictions currently being implemented to mitigate the overexploitation problems in the coastal fisheries of San Miguel Bay, Philippines.

Methodology: (Data)

- Species composition (numbers & kinds of species) – Fish catch monitoring (REA 1992-93)
- Species abundance by gear (densities, frequencies, biomass, percentage)
- Of the 51 fishing methods identified in the Bay, catch composition data for only 16 gear types with a total of 59 species/taxa were included in the analysis (REA 1992-93)

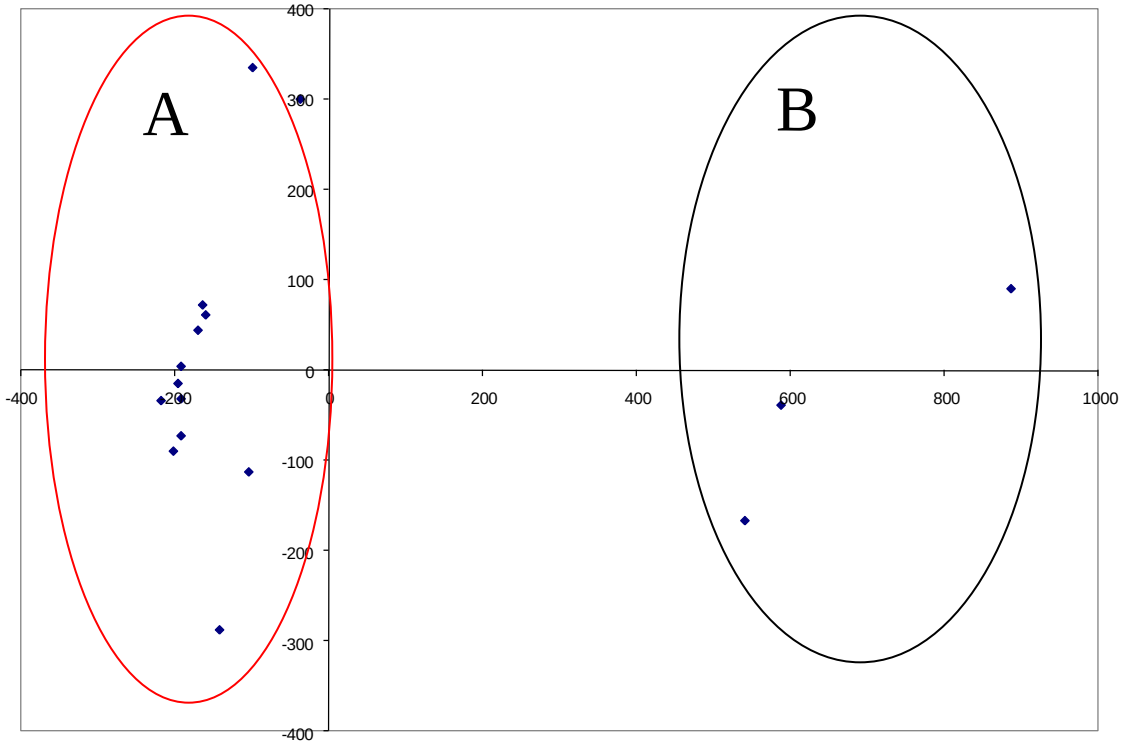
Methodology: Multivariate Techniques

- TWINSPAN –Two-Way Indicator Species Analysis (Hill 1979), divisive clustering method that classifies sites/gear and species

- DCA - Detrended Correspondence Analysis, an ordination method based on the abundance values of the species (CANOCO, Ter Braak 1990)

- MDS – multi dimensional scaling (Primer software, Clake 2006)

Results: DCA/TWINSPAN

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 7 Cara  mal  ------3--------------  00000
34 Plot  ang  ------2--------------  00000
41 Scat  arg  ------2--------------  00000
48 Siga  jav  ------1--------------  00000
19 Gazz  min  --3-1-2--------------  000010
24 Leio  spl  -235313---1----------  000010
 3 Apog  qua  ---2-----------------  000011
45 Secu  ruc  ---2111--------------  000011
47 Serg  est  ----55--------------  000011
49 Siga  sp   -----2--------------  000011
52 Stol  com  -134142--------------  000011
55 Tras  h f  --4343--------------  000011
59 Upen  sul  --23----------------  000011
53 Stol  ind  5522132--------------  0001
57 Trip  blo  -4-----------------  0001
 4 Apog  sp   -1--1-1---1--------  001
21 Lago  sp   -1-21-2---1-1------  001
25 Loli  go   --121----11--------  001
46 Sela  lep  --21-----1---------  001
20 Hemi  geo  -1------1----------  010000
29 Otol  rub  51322-2-25511------  010000
23 Leio  equ  -----1---1---------  010001
30 Pell  dit  ------2--1---------  010001
31 Pena  eid  5143443?-4215------  010001
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51 Sphy  jel  --1-------1--------  010001
56 Tric  hau  --321132153--------  01001
27 Mugi  sp   -12212255211-1-----  0101
11 Chir  dor  --1-----11---------  01100
15 Dend  rus  1-1---3223411------  01100
40 Sard  per  --22---1112-3------  01100
50 Sill  sih  -3------21-1-------  01100
13 Cyno  sp   ----1----1-1-------  01101
35 Port  pel  21122---1255-------  01101
36 Pset  eru  --------1-1--------  011100
54 Thry  set  ----1-2?311-3------  011100
32 Penn  sp   --------12---------  011101
37 Rast  bra  --------1----------  011101
43 Scom  lys  --------1----------  011101
12 Cyno  bil  ----------1--------  01111
33 Plat  ind  ----------1--------  01111
58 Tylo  sto  -1------1---3------  01111
 1 Alec  cil  --------3------2---  10
18 Form  nig  ---1---1-------1---  10
39 Rhyn  dji  --------4------2---  10
 5 Ariu  sp   --------1-1114113-  110
44 Scyl  ser  ----------1-?------  110
28 Mura  cin  ----1121--1-1-14---  1110
16 Drep  pun  ----------1-?2-----  11110
 6 Cara  ign  ----------------45-  11111
 8 Cara  sex  ----------------1---  11111
 9 Cara  sp   ----------1---4---  11111
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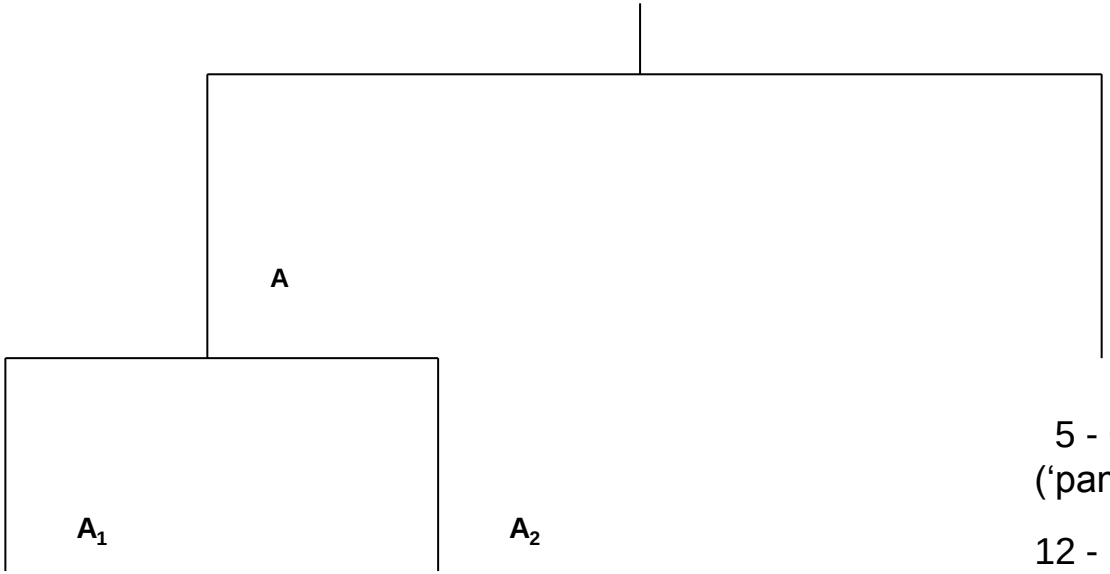
Results: Cluster Analysis



5 - Gillnet ('pamating')

12 - Lonngline

13 - Ringnet

4 – Gillnet (lait)

14 – Pull net

1 – Medium trawl

2 – Small trawl

3 – Mini trawl

15 – Filter nets

16 – Fish corral

6 – Gillnet (drift)

8 – Gillnet (bottom-set)

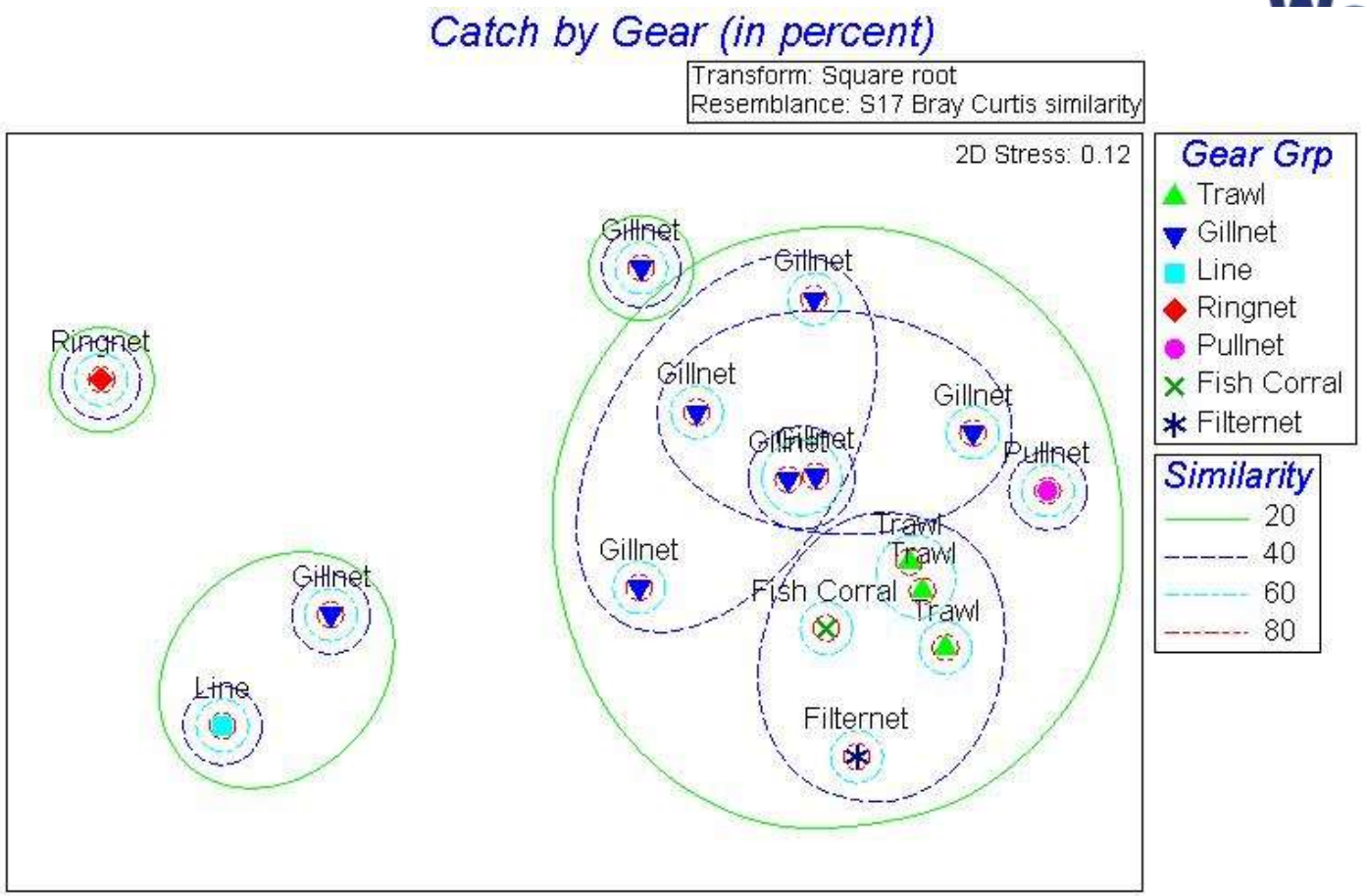
9 – Gillnet (panke)

10 – Gillnet (timbog)

7 – Gillnet (crab)

11 – Gillnet (hila-hila)

Results: MDS


Catch by Gear (in percent)
Transform: Square root
Resemblance: S17 Bray Curtis similarity
2D Stress: 0.12
Gear Grp
Trawl
Gillnet
Line
Ringnet
Pullnet
Fish Corral
Filternet
Similarity
20
40
60
80
Gillnet
Gillnet
Ringnet
Gillnet
Gillnet
Gillnet
Pullnet
Gillnet
Trawl
Trawl
Gillnet
Fish Corral
Trawl
Gillnet
Line
Filternet

Results: Species Composition

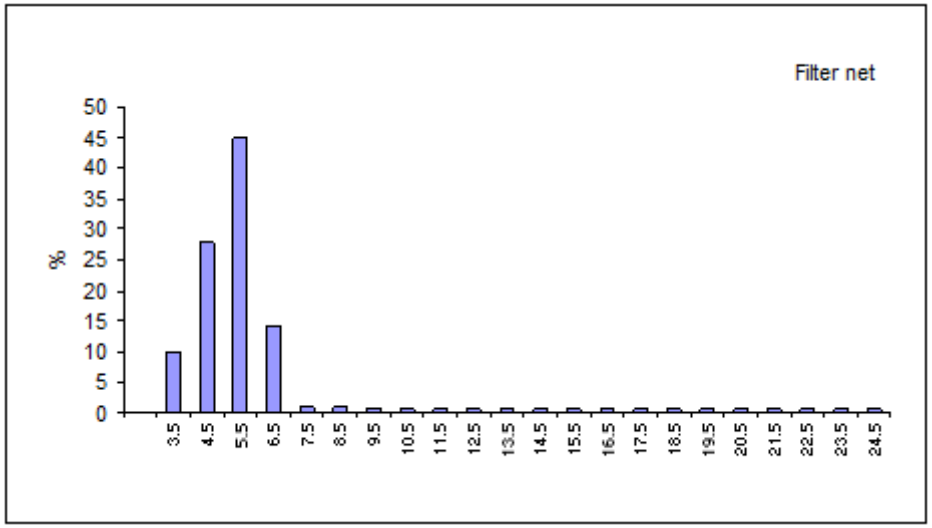
Group A		Group B	
Species/Groups	%	Species/Groups	%
Penaeid shrimp	12.38	*Caranx ignobilis*	35.27
Mugil sp.	11.65	*Carcharinus melanopterus*	16.60
Portunus pelagicus	11.36	*Lates calcalifer*	13.70
Otolithes ruber	9.91	*Arius sp*	8.83
Stolephorus indicus	8.85	*Muraenesox cinerius*	4.93
Sergestid shrimp	7.79	*Drepane punctata*	4.40
Trichiurus haumela	4.21	*Caranx spp*	3.53
Leiognathus splendens	3.44	*Dasyatis kuhlii*	3.37
Trash fish	3.10	*Rays*	2.43
Dendrophysa russelli	2.98	*Rhynchobatus djiddensis*	1.43

Results: Species Composition

Group A1		Group A2	
Species/Groups	%	Species/Groups	%
Stolephorus indicus	16.43	*Mugil sp*	23.25
Sergestid shrimp	14.47	*Portunus pelagicus*	22.26
Penaeid shrimp	13.51	*Otolithes ruber*	14.28
Leiognathus splendens	6.30	Penaeid shrimp	11.07
Otolithes ruber	6.17	*Trichiurus haumela*	6.19
Trash fish	5.76	*Dendrophysa russelli*	4.77
Stolephorus commersonii	5.45	*Thryssa setirostris*	3.51
Trichiurus haumela	2.51	*Arius sp*	2.16
Portunus pelagicus	2.03	*Rhynchobatus djiddensis*	2.07
Tripodichthys blochi	1.89	*Sardinella perforata*	2.01

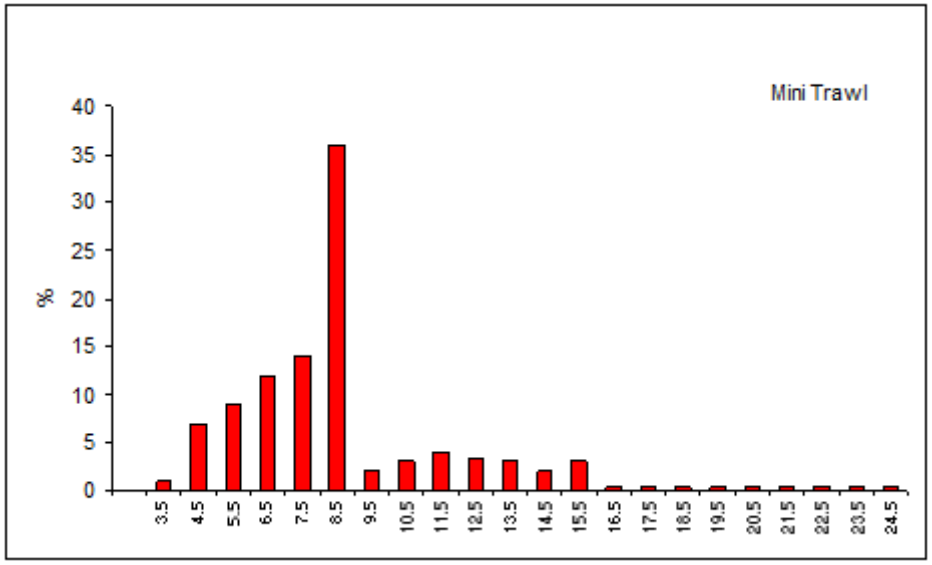
Size Composition by Gear – San Miguel Bay

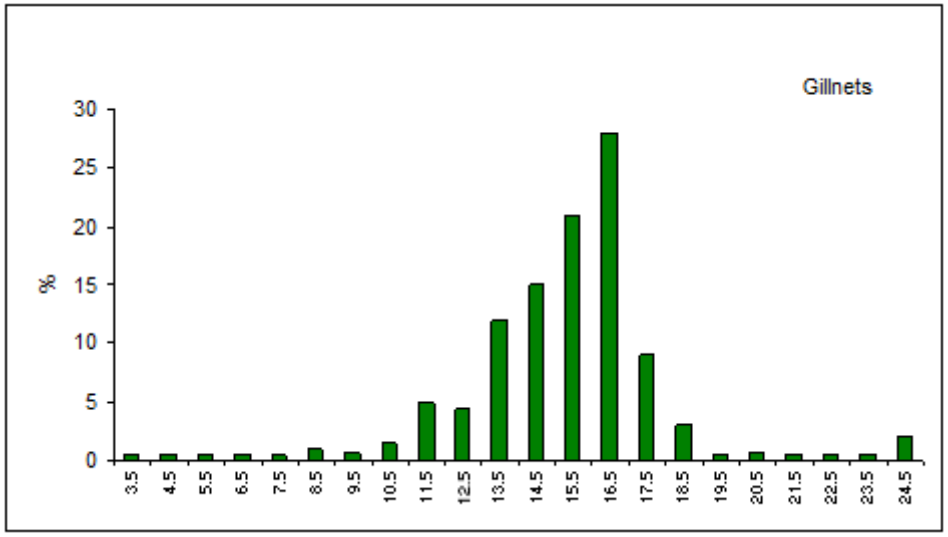
(Silvestre et al. 1995)



Otolithes ruber

(Tiger-toothed croaker)





Conclusion:

- There is a high degree of gear competition due to similarity of catch composition and target species particularly the small-scale (municipal) fisheries sector

- Need to design management interventions to partition different fisheries or gears based on spatial patterns of fish assemblages.

- To refine gear-based management and develop approaches towards fleet configuration rather than single gear regulation (e.g., trawl ban)