Training Workshop on Identification of Deep-sea Benthic Macroinvertebrate Vulnerable to Fishing Gear

11-15 July 2011, Samutprakarn, Thailand

PART II
Presentations and results of identification

Annex 6: Deep-Sea Resource Exploration in the Southeast Asian Region

By Mrs. Penchan Laongmanee

Deep-Sea Resource Exploration in the Southeast Asian Region

Capture Fishery Technology Division

SEAFDEC/TD

Background

- Depletion of the inshore/coastal fisheries resources in the Southeast Asian Countries
- Search new fishing ground targeting at **deep-sea area**

In serving Member Countries, SEAFDEC /TD, with the active financial and technical support of Japanese Government start the

"Deep Sea Fisheries Resources Exploration in the Southeast Asia" since 2008

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Objectives

1. Provide technical support of exploration of deep-sea resources in the Southeast Asian waters by using M.V. SEAFDEC2 to member countries and/or by other research vessels in collaboration with the member countries;
2. Increase number and capacity of researcher in Member Countries to explore deep-sea fisheries resources as well as its ecosystem (recognized that deep-sea ecosystems are vulnerable to damage)

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Activities

- Activity 1: Meeting/workshop
- Activity 2: Development/Improvement of sampling gear and exploration methodology
- Activity 3: Supporting deep-sea fisheries resources survey of Member Countries
- Activity 4: HRD programs on deep-sea fisheries resources exploration
- Activity 5: Information dissemination

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Activity 1: Meeting/workshop

1. **Workshop on the Standard Operating Procedure (SOP) and Development of Sampling Gears for Deep-Sea Resource Exploration,**
   26-28 May 2009 at SEAFDEC/Training Department,
   22 Participants: SEAFDEC/TD and MFRDMD, Brunei, Japan, Indonesia, Philippine, Malaysia, Myanmar Thailand and Vietnam

- Output
- SOP for Deep-Sea Resources Exploration in Southeast Asian Region
- Suggestion for deep-sea fisheries resource sampling gear
- Network of scientist

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Activity 1: Meeting/workshop

2. **Expert meeting on deep-sea fishing and its impact on ecosystem**
31 August - 2 September 2010, Bangkok, Thailand

21 participants: SEAFDEC/TD,NOAA, Brunei, Japan, Indonesia, Philippine, Malaysia, Myanmar, Thailand and Vietnam

Output : topic and priority of data/info that should be collected for implementing the precautionary approach for deep-sea fisheries
Full report can be download at
http://map.seafdec.org/DeepSea/index.html

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Activity 2: Development/Improvement of sampling gear and exploration methodology

- Beam trawl
- Agassiz trawl (Beam trawl)
- Deep sea trap
- Isaccs-Kidd Midwater trawl (IKMT)
- Under water VDO camera

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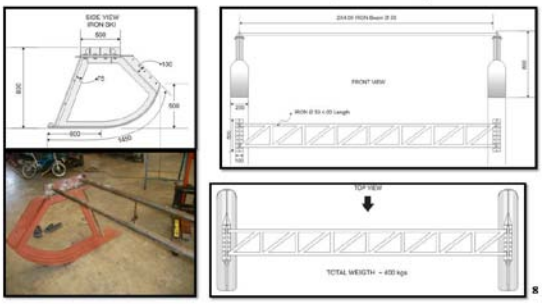
Beam trawl

Beam / Frame diagram



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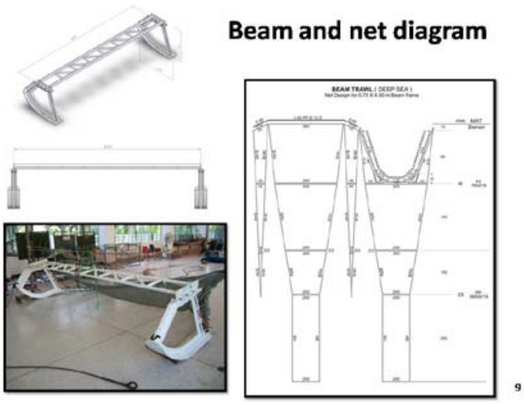
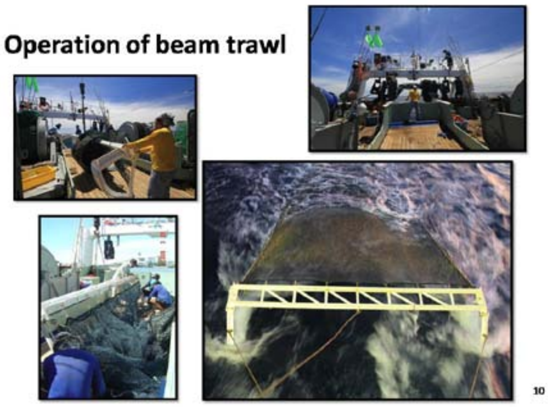
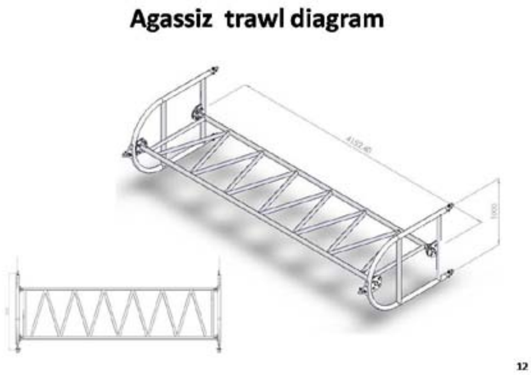

Beam and net diagram
9

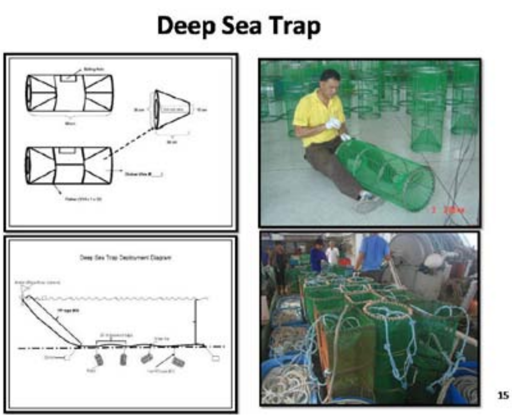

Operation of beam trawl
10


Sample from beam trawl


Agassiz trawl diagram
12

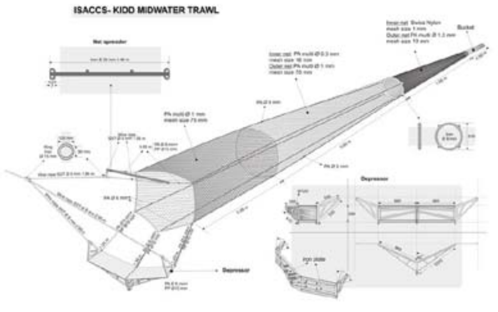

Agassiz trawl operation
13


Sorting of Agassiz trawl catch
14


Deep Sea Trap
15


Operation and sample
16

Isaccs-Kidd Midwater Trawl



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Construction of IKMT at SEAFDEC's workshop

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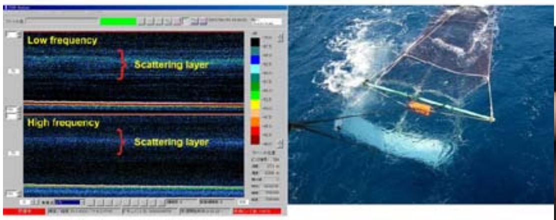
IKMT Operation



Using scientific echo-sounder (Furuno FQ80 onboard M.V. SEAFDEC2) provide a target area

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Sample from IKMT

Mesopelagic fishes, mostly Myctophidae

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Under water VDO camera

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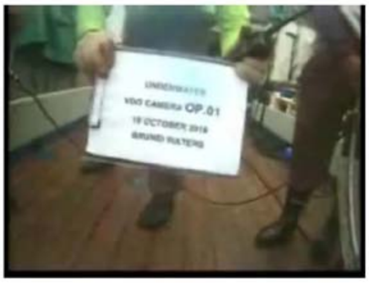
Under water VDO camera clip from Brunei water



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Activity 3: Support deep-sea fisheries resources survey

Support technical staff of SEAFDEC/TD to join the actual survey on M.V.SEAFDEC2 and national research vessel

- -2008 Brunei and Philippine
- -2009 Brunei
- -2010 Brunei and Malaysia
- -2011 Brunei

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M.V.SEAFDEC 2 Cr29-2/2008, Brunei water, 4 June-5 July 2008

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M.V.SEAFDEC 2 Cr31-1/2009, Brunei water, 6 March-11 April 2009

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M.V.SEAFDEC 2 Cr35-3/2010, Sabah-Sarawak water, Malaysia, 28 June-11 August 2010

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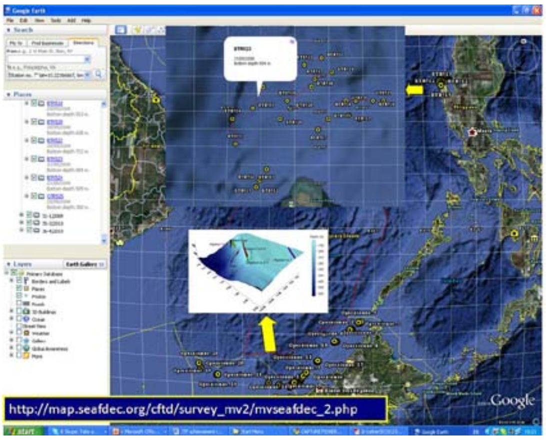

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Activity4: HRD programs on Deep-sea fisheries resources exploration

- 11-25 May 2008, Ship board training on deep sea exploration, R.V.DA BFAR, Philippine
- 7-11 April 2009,On the job training on collection, preservation and digital imaging technique for deep-sea fish, Brunei
- 18-22 January 2010-Training Workshop on Identification of Deep-sea Fish, SEAFDEC/TD
- 2-4 February 2010 - On site training on technique for preparation of deep sea fish pictorial book, Brunei

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Activity4: HRD programs on Deep-sea fisheries resources exploration

- 16-20 October 2010, Training on research methodologies for study on impact of fishing on deep-sea ecosystem, Brunei
- 11-15 July 2011, Training/workshop on identification of deep-sea benthic macroinvertebrate vulnerable to fishing gear, SEAFDEC/TD
- 18-21 July 2011, On-site training on Identification of Deep-sea Fish, Malaysia

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Ship board training on deep sea exploration on M.V.DA-BFAR (Co -organize by Bureau of Fisheries and Aquatic Resources, the Philippine)

Objective: to enhance the human resources capacity on the deep sea resources exploration including
- Methodology for samplings of deep sea fisheries resources,
- Identification of deep-sea fish and larvae

Participants from Member Countries : Brunei (1) , Indonesia (1), Malaysia (2), Philippine (5), Thailand (1) , Vietnam (1) and SEAFDEC staffs (5)
Resource person:
Fish taxonomist : Mr. Montri Sumontha
Invertebrate zoology: Associate Professor Kotaro Tsuchiya, Tokyo University of Marine Science and Technology

Read full report : http://map.seafdec.org/DeepSea/pub03.html

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Ship board training on deep sea exploration on M.V.DA-BFAR

Training Workshop on Identification of Deep-sea Fish

Objective:
- To enhance the human resources capacity on deep-sea fish species identification;
- To encourage the SEAFDEC Member Countries to initiate deep-sea resources exploration ensuring the accurate deep-sea fishes identification

Participants from Member Countries : Brunei (2), Indonesia (1), Malaysia (1), Philippine (1), Thailand (2) , Vietnam (1) and SEAFDEC staffs (2)
Resource persons:
1. Dr. Yoshinobu Konishi, Retire researcher of Fishery Agency, Japan
2. Dr. Fayakun Satria, Research Center for Capture Fisheries, Indonesia
3. Assistant Professor Dr. Toshio Kawai, Fisheries Science Center, The Hokkaido University Museum

Watch: Summary activities VDO at http://map.seafdec.org/DeepSea/
Read: Training report at http://map.seafdec.org/DeepSea/pub01.html

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Training Workshop on Identification of Deep-sea Fish

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Training Workshop on Identification of Deep-sea Fish

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Training Workshop on Research Methodologies for the Study on Impact of Fishing to Deep-Sea Ecosystem (co-organize by Department of Fishery, Brunei Darussalam)

Objective:

- To enhance participants' knowledge on research methodologies on impact of fishing to deep-sea ecosystem
- To build human resources capacity through actual practices on: research planning, topographic survey; sampling gears operating methods; sampling methods (quantitative and qualitative); and data collection methodology from the actual survey.

Participants from Member Countries : Brunei (4), Indonesia (1), Malaysia (1), Philippine (1), Thailand (1) , Vietnam (1)

Resource persons:

1. Dr. Yoshinobu Konishi, Retire researcher of Fishery Agency, Japan
2. Dr. Chittima Aryuthaka, Associate Professor , Kasetsart University
3. Dr. Sumaitt Putchakarn, Senior Scientist, Institute of Marine Science, Burapha University

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Training Workshop on Research Methodologies for the Study on Impact of Fishing to Deep-Sea Ecosystem

Read: Training report at http://map.seafdec.org/DeepSea/pub01.html

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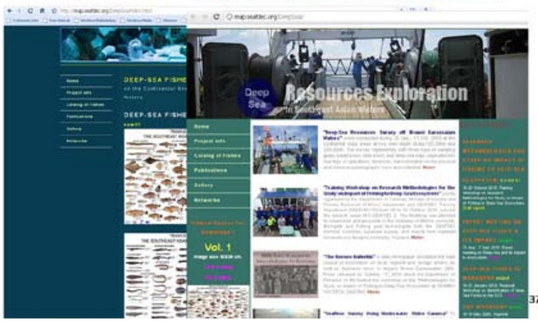
Activity5: Information Dissemination

- Project Website: http://map.seafdec.org/DeepSea/



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Activity5: Information Dissemination

- Guide for Deep-Sea Trap Operation
- Guide for Beam Trawl Operation
- Guide for Isaacs-Kid Mid-water Trawl
- Check lists of the deep-sea fishes in the South China Sea and Adjacent Waters
- Report of Training Workshop on the Deep Sea Fishery Resources Exploration on the Continental Slopes in Southeast Asian Waters, 11-25 May 2008, M/V DA-BFAR, Philippines
- Report of the Regional Training/Workshop on Identification of Deep-Sea Fishes, SEAFDEC/TD, Thailand, 18-22 January 2010
- Report of the Expert Meeting on Deep-Sea Fishing and Its Impact on Ecosystem, 31 August - 2 September 2010, Bangkok, Thailand
- Report of the Training Workshop on Research Methodologies for the Study on Impact of Fishing to Deep-Sea Ecosystem 16-20 October 2010, Brunei Darussalam

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Activity5: Information Dissemination

Series of publication: http://map.seafdec.org/DeepSea/pub01.html

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Activity5: Information Dissemination

Poster presentation in Marine Science Seminar, Phuket, Thailand 28-30 June 2010

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Activity5: Information Dissemination

Poster of trawled fish of the Southeast Asian Water:
I- 100 - 370 m
II - 300- 1,200 m

- 500 pcs./type distribute through networks
- Download at http://map.seafdec.org/DeepSea/

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Activity5: Information Dissemination

Database of Deep-sea fish in SEAFDEC collection at
http://map.seafdec.org/deep_sea/search.php

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Potential fisheries resources

- Deep-sea shrimp : pandalid shrimp species (*Heterocarpus woodmasoni, H. hayashi, H. dorsalis*) found in Brunei ,Philippine, Malaysia and Thailand (Andaman sea)

Philippine : A pilot deep-sea shrimp trap fishery
-Improve efficiency of fishing gear
- Study impact to deep-sea ecosystem
-Cost-benefit study

Aim: to formulate a management plan/policy on deep-sea shrimp trap fishery

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Thank you

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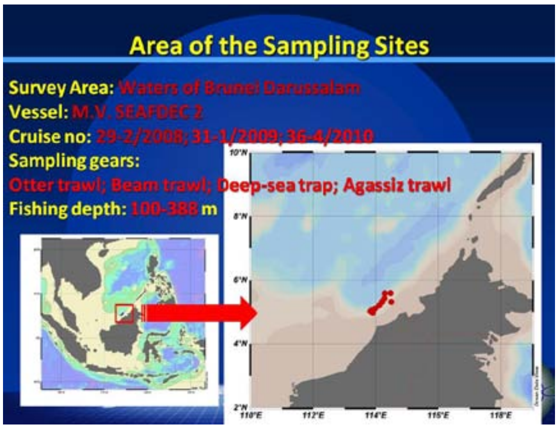
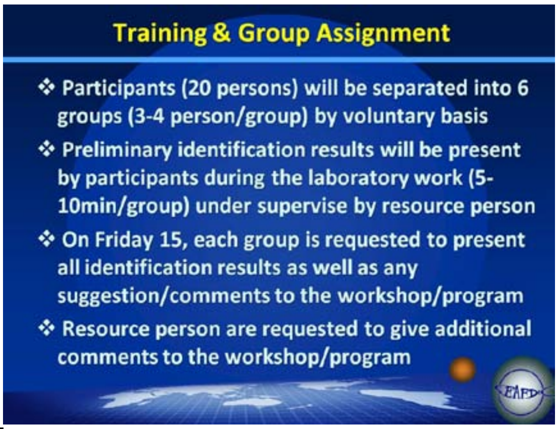
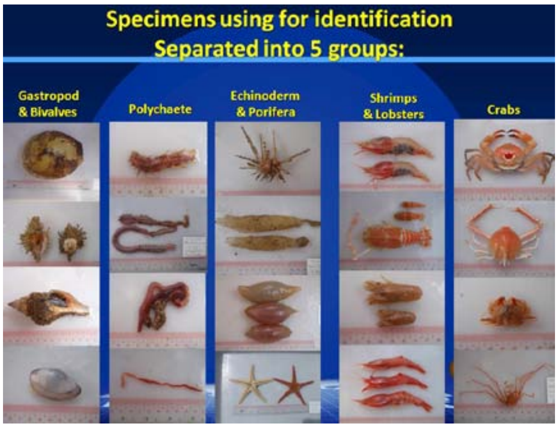
Annex 7: Arrangement of Activities during the workshop

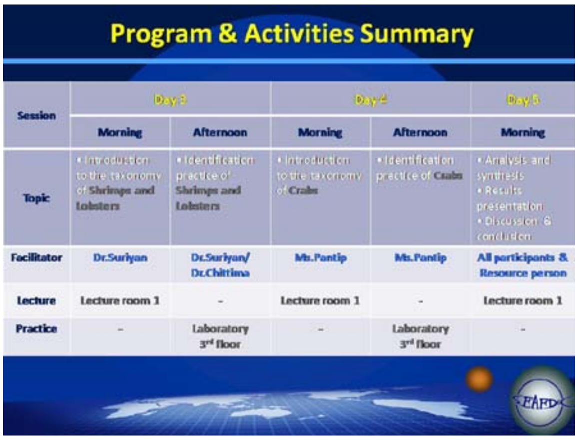
By Dr. Natinee Sukramongkol



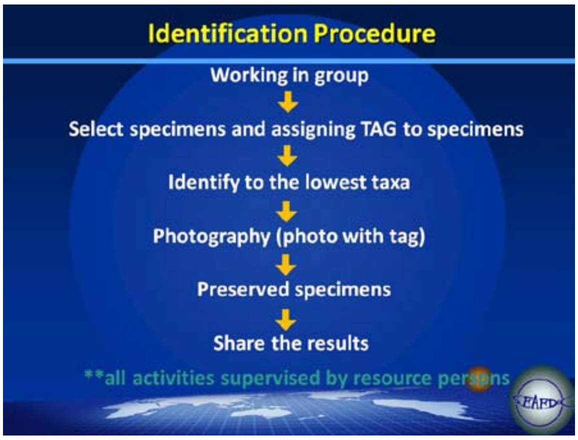


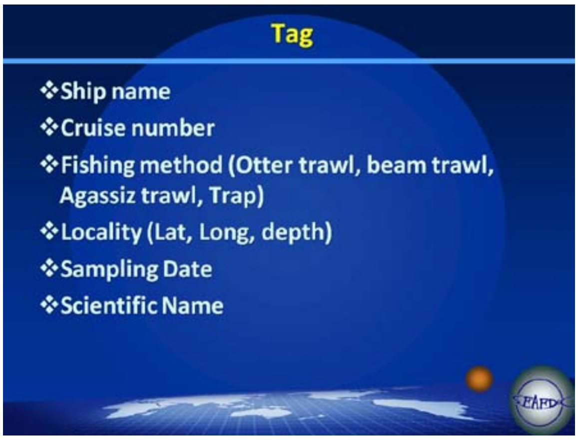


Session	Day 1		Day 2	
	Morning	Afternoon	Morning	Afternoon
Topic	• Distribution and structure of benthic macroinvertebrate assemblages on the continental shelf and slopes • Sampling methodologies	• Introduction to the taxonomy of Gastropods and Bivalves • Identification practice	• Introduction to the taxonomy of Polychaete • Identification practice on Polychaete	• Introduction to the taxonomy of Echinoderm and Porifera • Identification practice on Echinoderm and Porifera
Facilitator	Dr.Mike	Mr.Teerapong	Dr.Mike	Dr.Sumaitt
Lecture	Lecture room 1	Lecture room 1	Lecture room 1	Lecture room 1
Practice	-	Laboratory 3rd floor	Laboratory 3rd floor	Laboratory 3rd floor



Session	Day 3		Day 4		Day 5
	Morning	Afternoon	Morning	Afternoon	Morning
Topic	• Introduction to the taxonomy of Shrimps and Lobsters	• Identification practice of Shrimps and Lobsters	• Introduction to the taxonomy of Crabs	• Identification practice of Crabs	• Analysis and synthesis • Results presentation • Discussion & conclusion
Facilitator	Dr.Suriyan	Dr.Suriyan/ Dr.Chittima	Ms.Pantip	Ms.Pantip	All participants & Resource person
Lecture	Lecture room 1	-	Lecture room 1	-	Lecture room 1
Practice	-	Laboratory 3rd floor	-	Laboratory 3rd floor	-

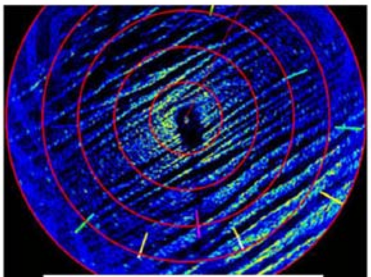




Annex 8: Patterns in the benthos

By Dr. Mike Kendall

Patterns in the benthos



Mike Kendall

Mike Kendall

- Benthic ecologist
  - Soft sediments and rocky shores
  - Research and commercial
  - Basic research interest in broad-scale pattern in diversity and population biology
- Worked worldwide
  - In the tropics: W.Africa, India, Bangladesh, Malaysia, China and Thailand….and in the Arctic
- Just finished EU programme on recovery of biological resources post-tsunami in Thailand
- Until recently I worked for Plymouth Marine Lab; now a consultant for PML Applications

English is my native language and some of the ideas I want to present to you are exciting.

If I start talking too quickly please tell me to slow down!

Summary of lecture

- **Benthic animals**
  - What lives in the benthos
  - How does our sampling influence our view of the biology of the sea floor
- **Broad scale patterns in the distribution of benthic animals**
  - Latitudinal gradients
  - Depth gradients
- **Local patterns**
  - Habitat complexity
  - Sediment grain size

Summary 2

Disturbance and benthic diversity
- Intermediate disturbance hypothesis
- Scales of disturbance
- Physical and biological disturbances

Fishing disturbance
- Examples of impacts on the benthos
- Recovery from fishing

WHAT LIVES IN THE BENTHOS ?


In a research trawl we get species that are
- Large
- Mobile over 100 metres or much more
- Long-lived, often >5 years

This is the megafauna.



In a grab sample we get generally species that are
- Smaller 0.5mm to 10cm
- Mobile over < 1 metre
- Live 1-5 years

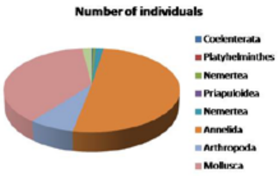
This is the macrofauna.





Typical dataset from Europe

		Number of individuals	% of total
Coelenterata		32	0.26
Platyhelminthes		3	0.02
Nemertea		63	0.51
Priapuloidea		6	0.04
Nemertea		201	1.65
Annelida		6135	50.48
Arthropoda		895	7.36
Mollusca		4575	37.65
Echinodermata		241	1.98
	Total	12151	



In a core sample we get generally species that are
- Smaller to 64 to 0.5mm
- Mobile over < 10cm
- Live <1 year; usually a lot less

This is the meiofauna

Our view of change in the biota of the seafloor is strongly influenced by the sampling gear we use

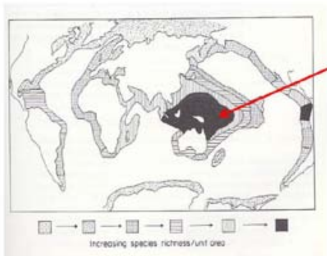
- If sample with a trawl, unless pollution or disturbance is severe, changes in species composition are buffered by longevity and mobility of the species.
- If we use a core, small short lived species may react too quickly for us to be aware of change
- Most pollution/disturbance benthic surveys study the macrofauna; there is a direct impact, limited mobility and a small number of generations/year.
- Its wisest to study all elements but if money is tight prioritise as;
  - Macro
  - Mega
  - Meio

Our ability to monitor the benthos is determined by the availability of specialists and specialist literature

- You need to be able to identify the animas and plants you encounter.
- It isn't always necessary to identify to species…more later
- A formal species name isn't always needed…more later

BROAD-SCALE PATTERNS OF BENTHIC BIODIVERSITY

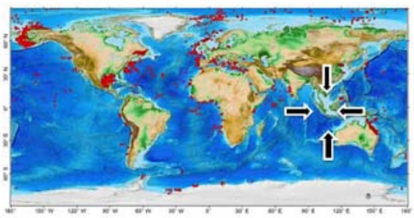
Global patterns of shallow water species richness: Is there a latitudinal gradient ?



There is certainly a global diversity hot-spot; but are all the data available?

Valantine and Moores 1974

Distribution of abundance and biomass records in the "CoML Fresh Biomass Database"

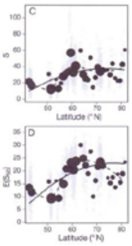


Based on 4872 biomass records, 5511 abundance records, and 4196 records with both biomass and abundance from 175 studies.

Wei C-L, Rowe GT, Escobar-Briones E, Boetius A, Soltwedel T, et al. (2010) Global Patterns and Predictions of Seafloor Biomass Using Random Forests. PLoS ONE 5(12): e15323. doi:10.1371/journal.pone.0015323

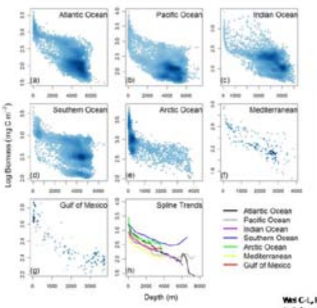
In a **European** study of 43 individual shelf sea datasets (465 354 distribution records, 7481 taxa and 23 113 stations).

- Statistically significant latitudinal trends were small and positive, suggesting **a modest increase in diversity with latitude.**
- These results are consistent regardless of whether subsets of the database were used, replicates were pooled, or component taxonomical groups were evaluated separately.



P. E. Renaud,*, T. J. Webb, A. Bjørgesæter, I. Karakassis, M. Kedra, M. A. Kendall, C. Labrune, N. Lampadariou, P. J. Somerfield, M. Wlodarska-Kowalczuk, E. Vanden Berghe, S. Claus, I. F. Aleffi, J. M. Amouroux, K. H. Bryne, S. J. Cochrane, S. Dahle, S. Degraer, S. G. Denisenko, T. Deprez, C. Dounas, D. Fleischer, J. Gil, A. Grémare, U. Janas, A. S. Y. Mackie, R. Palerud, H. Rumohr, R. Sardá, J. Speybroeck, S. Taboada, G. Van Hoey, J. M. Weslawski, P. Whomersley, M. L. Zettler

Latitudinal trends: Predictions of benthic biomass



Benthic biomass is highest in the polar oceans and lowest in warmer waters

Wei C-L, Rowe GT, Escobar-Briones E, Boetius A, Soltwedel T, et al. (2010) Global Patterns and Predictions of Seafloor Biomass Using Random Forests. PLoS ONE 5(12): e15323. doi:10.1371/journal.pone.0015323

Body size

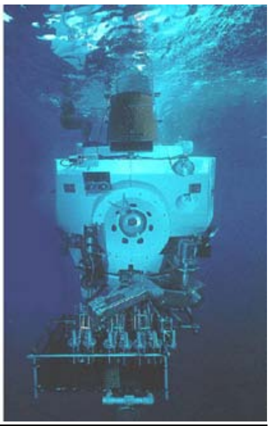
- A latitudinal gradient in body size has been discussed; larger animals in high latitudes.
- There are some large bodied animals in Polar regions but there are also many small bodied species.
- Many methodological difficulties in reaching a conclusion

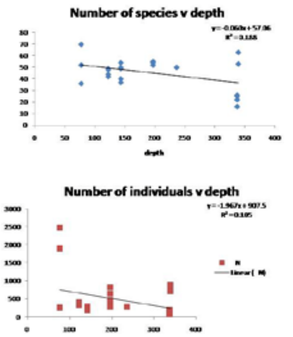
In general

- *On the continental shelf* benthic tropical macrofauna samples from soft sediment:
  - Have fewer individuals.
  - Have smaller individuals.
  - Have more species or a fixed number of individuals.

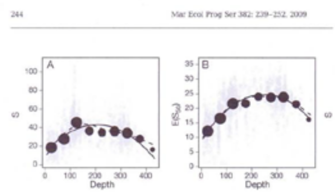
  than temperate or polar samples.

DEPTH



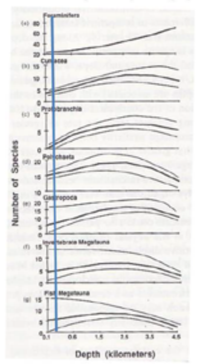


Own data from Polarstern cruise in Arctic.
• R2 small but just significant



European study:
•limited to 350m
•Contains many samples <100m

The shallowest sites are regularly wave-disturbed.
Stability of sediment increases with depth.



Deep Sea study

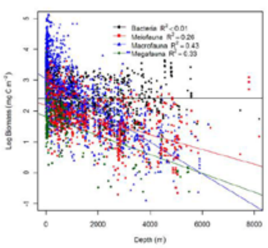
For most taxa the number of species in a sample of 50 individuals increases to 2.5 km and then declines.

BUT

The number of individuals in a sample also declines

From Huston 1994

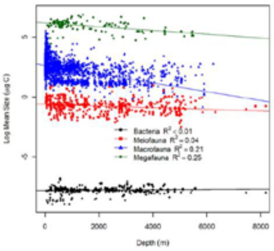
Biomass



Biomass of all elements of biota (except bacteria) declines with depth.

Wei C-L, Rowe GT, Escobar-Briones E, Boetius A, Soltwedel T, et al. (2010) Global Patterns and Predictions of Seafloor Biomass Using Random Forests. PLoS ONE 5(12): e15323. doi:10.1371/journal.pone.0015323

Size of individuals



The body size of mega- and macrofauna declines with depth

Wei C-L, Rowe GT, Escobar-Briones E, Boetius A, Soltwedel T, et al. (2010) Global Patterns and Predictions of Seafloor Biomass Using Random Forests. PLoS ONE 5(12): e15323. doi:10.1371/journal.pone.0015323

Depth effects: Conclusion

- Diversity is moderate at shallow, wave disturbed, depths. It rises towards 200-300m
- In some studies diversity continues to rise until 1000m+ in others it falls away.
- For most taxa biomass decreases with depth
- IN megafauna and macrofauna the size of individuals decreases with depth

LOCAL FACTORS

Sediment granulometry

- The grain size of sediment influences species distribution and abundance.
- Grain size reflects hydrographic conditions and geological history.
- In general, muddy sediments are more physically stable and have a greater surface area for bacterial growth (animal food) then sand.
- Mud tends to deposit with fine organic material...food.
- There is poor oxygen penetration in mud and this may limit the depth of oxygen penetration.
- Where mud is oxygenated it is productive

Sediment granulometry

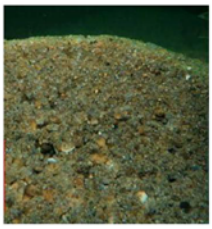
•Sandy sediments tend to be found in shallower water subject to wave action

•Sand is potentially mobile and large particles can cause severe damage to soft bodied animals

•.

•Living and feeding beneath the surface offers protection

•Sand grains have a smaller surface area (constant volume) then mud and hence are less productive



Habitat heterogeneity

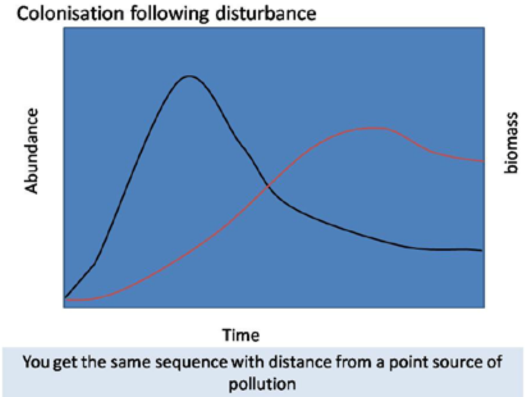
- A complex bottom habitat has more niches and more species.
- In this case benthic sponges provide habitat diversity.
- Habitat diversity can equally result from large stones, coral debris, or burrow structures of megafauna

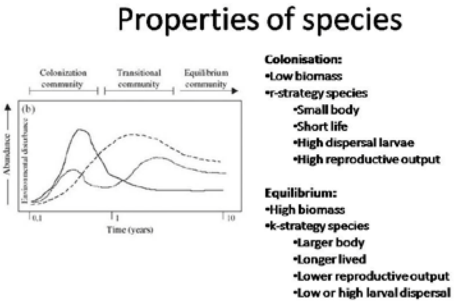
Photographs Julian Gutt AWI

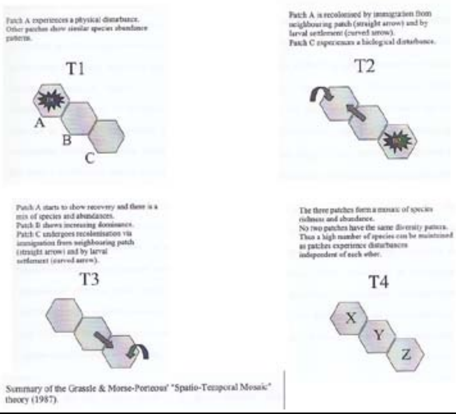
PRODUCTIVITY DISTURBANCE AND BENTHIC DIVERSITY

The seafloor is dynamic

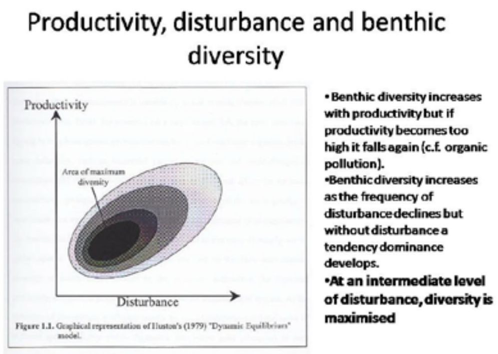
- Every centimetre of the seafloor is either undergoing disturbance or recovering from it.
  - Disturbance can be catastrophic and broad scale (Tsunami) or very local and quick to recover.
- Some species can exploit disturbed environments better than others.
  - Short lived, reproduce young, many offspring high dispersal
- Some species cannot tolerate disturbance
  - Long-lived, slow to reproduce, few offspring, low dispersal.



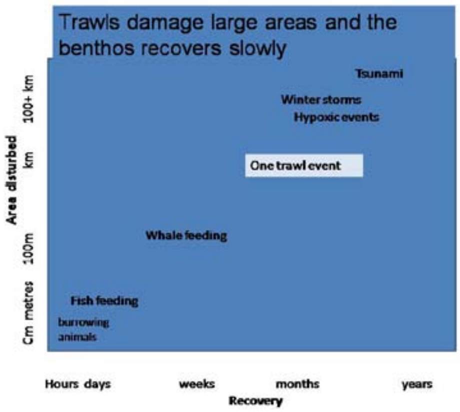


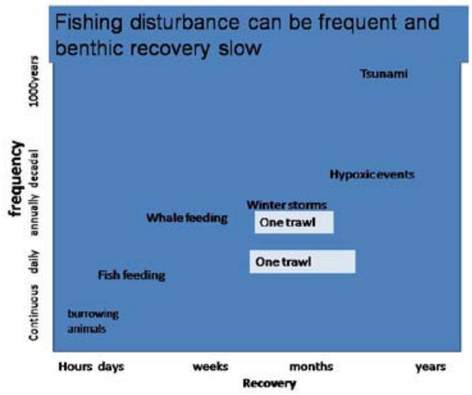


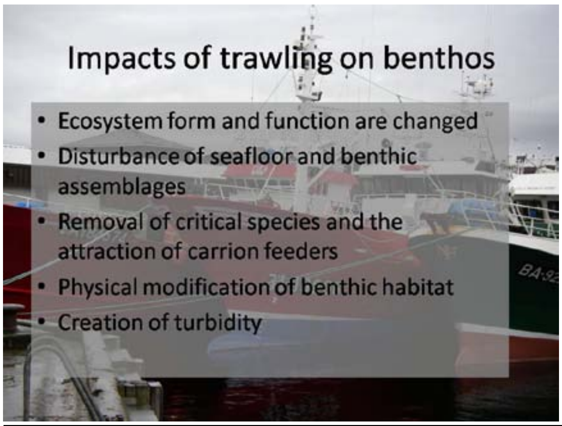
DISTURBANCE PROMOTES DIVERSITY



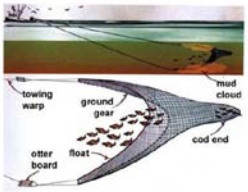
TRAWLING EFFECTS ON BENTHIC COMMUNITIES







Trawl Gear



Foot rope and bobbins

Otter board or trawl door

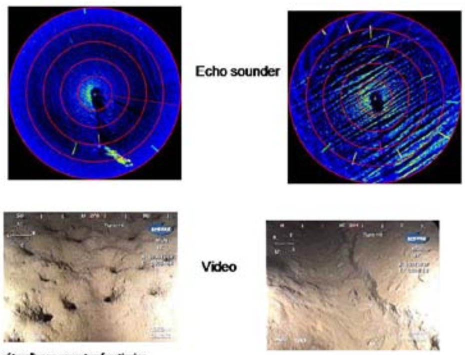
Otter Boards

- Plough the seafloor
- Break fragile animals
- Bury other animals to a depth they cannot recover from.
- Create massive turbidity and inhibit filter feeding

Ground gear

Nets are damaged on rough ground so the ground rope is equipped with rubber rollers that lift it above obstructions.

The rollers (bobbins) can be very large and heavy and will crush animals, remove corals and flatten out the seafloor. They remove habitat heterogeneity



Effects of trawling on ecosystem functioning
Frede Olsgard*, Melanie C. Austen, Morten T. Schaanning, Stephen Widdicombe and Mike A. Kendall

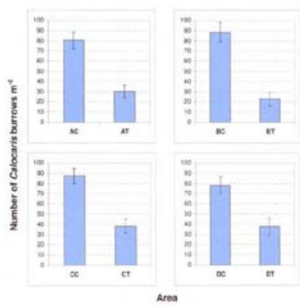
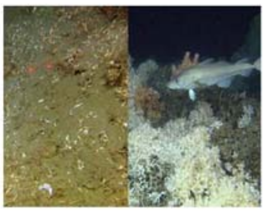


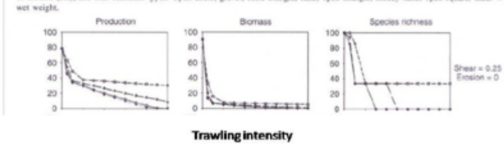
Fig. 54. Number of Calocaris macandrea burrows in non-trawled and trawled areas (mean values and 95% confidence intervals). Data from 41-78 random frames from the video recordings within each area surveyed. Samples from trawled (eg. AT) and non-trawled control sites (e.g. AC) within the four areas A, B, C and D.

Trawling: Before and after



Relationship between trawling intensity, benthic production, biomass and species diversity on four sediments. From Hiddink et al.

Fig. 4. The relation among trawling intensity, production, biomass, and species richness of benthic communities on four sediment ty as calculated by the model. Production, biomass, and relative species richness are given for two levels of shear stress (Pa), two level of erosion (cm), and four sediment types. Open circle, gravel; solid triangle, sand; open triangle, muddy sand; open square, mud. W wet weight.



Trawling
- Decreases productivity
- Decreases benthic biomass
- Decreases diversity
- The scale of damage is dependent on sediment type

Ecosystem effects: effects of trawling extend to ocean chemistry:

Widdicombe et al

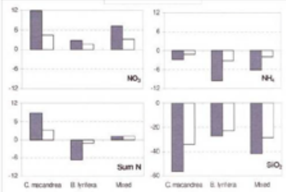


Fig. 2. Calculated effects of trawling on fluxes of silicate and nitrogen nutrients for the observed reduction in abundance for *C. macandrewe* (from 41.5 to 14.5 ind.m^{2} in trawled areas) and for *B. lyrifera*, or a mixed assemblage of the two species.

Reduced faunal abundance leads to changes in nutrient flux from sediments to the overlying water and so impacts pelagic ecosystems

Faunal Changes

- Loss of shelled biota; worms replace molluscs
- Small opportunistic species may replace larger longer-lived animals
- Filter feeders much reduced or lost
- Temporary increases in megafaunal carrion feeders
- There is s substantial shift in benthic community structure following trawling.

Trawling

- Changes biodiversity of benthic ecosystems
- Changes productivity of benthic ecosystems
- Changes the function of benthic ecosystems
- May impact adjacent areas by export of fine sediment or remobilised pollutants.

Annex 9: Sampling the benthos

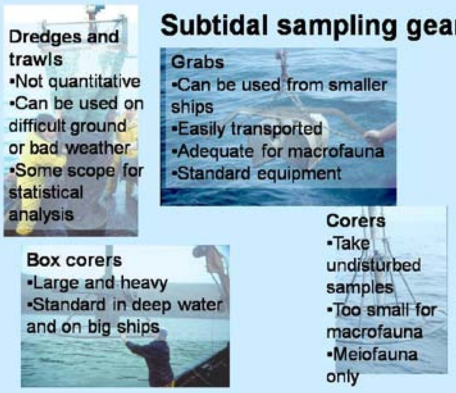
By Dr. Mike Kendall

Sampling the benthos

- Aims:
  - to collect a quantitative sample of the biota of the seafloor
  - To extract the biota from the samples
  - To identify the biota to the lowest possible taxon
  - To use the most appropriate statistical analysis to identify spatial or temporal pattern in the biota
  - To sample cost effectively

- Our impression of the composition of the benthic biota depends on the sampling methods that we use
- Our ability to detect change depends on the number of samples we take and their spatial dispersion

Subtidal sampling gear



Beam Trawl

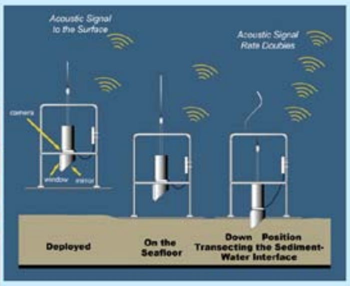
Mini Aggasiz

Van Veen Grab…open

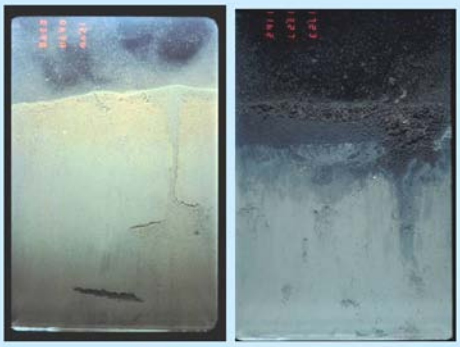
Van Veen closed

Grab photo PML-A

USNEL Box corer deployed



Sediment Profile Imagery....SPI



SPI images

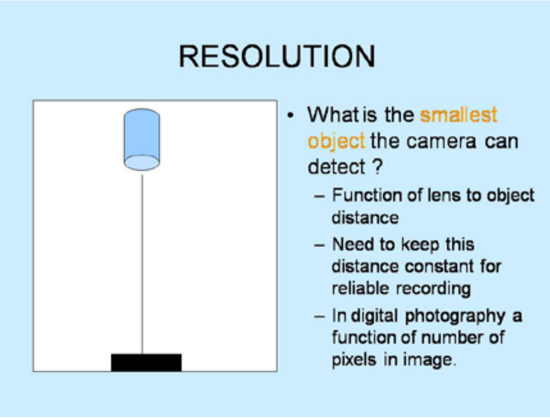
Craib Corer

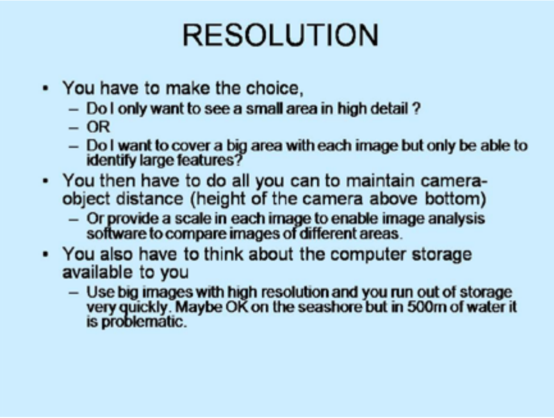
Craib

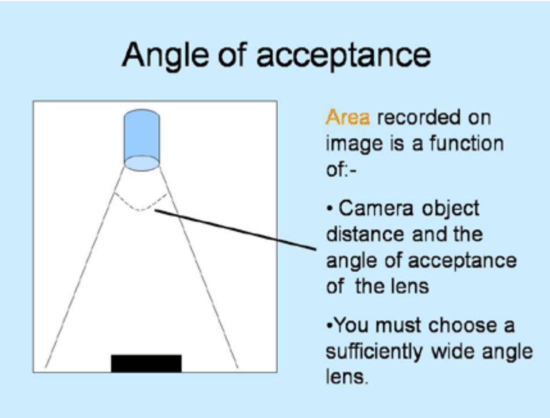
Multicorers

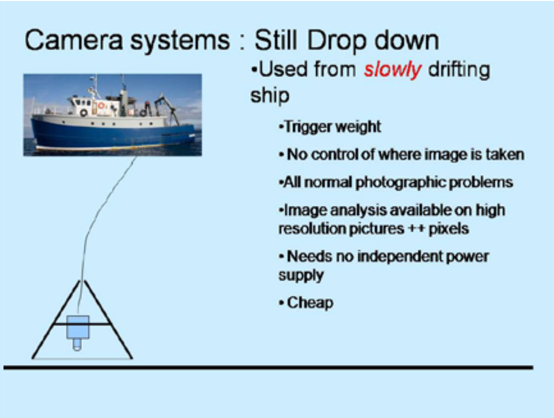
Samples taken by a multicorer are not true replicates
(except at the <1m scale)

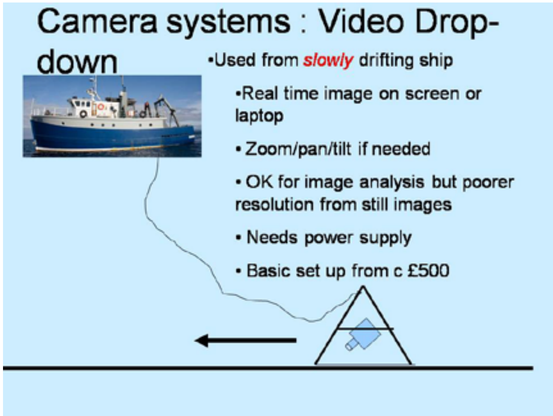
PHOTOGRAPHY

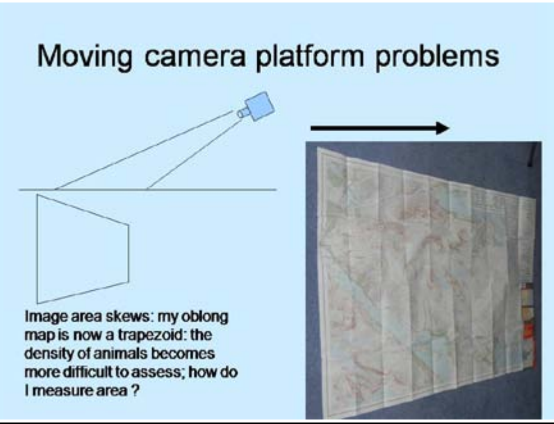

RESOLUTION
What is the smallest object the camera can detect ?
– Function of lens to object distance
– Need to keep this distance constant for reliable recording
– In digital photography a function of number of pixels in image.

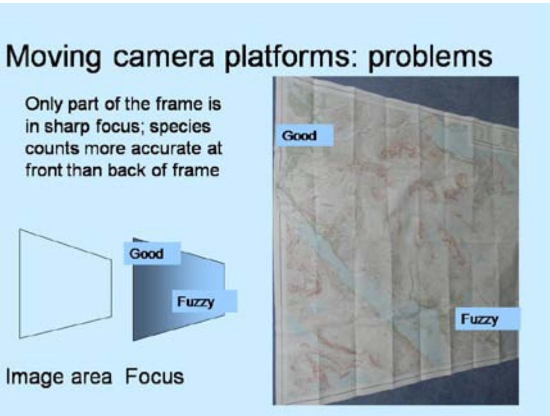

RESOLUTION
You have to make the choice,
– Do I only want to see a small area in high detail ?
– OR
– Do I want to cover a big area with each image but only be able to identify large features?
You then have to do all you can to maintain camera-object distance (height of the camera above bottom)
– Or provide a scale in each image to enable image analysis software to compare images of different areas.
You also have to think about the computer storage available to you
– Use big images with high resolution and you run out of storage very quickly. Maybe OK on the seashore but in 500m of water it is problematic.

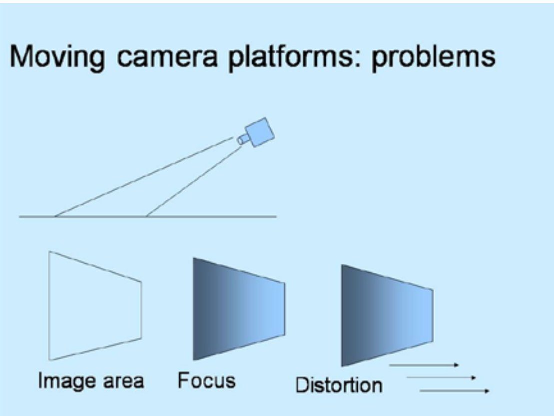

Angle of acceptance
Area recorded on image is a function of:-
• Camera object distance and the angle of acceptance of the lens
•You must choose a sufficiently wide angle lens.

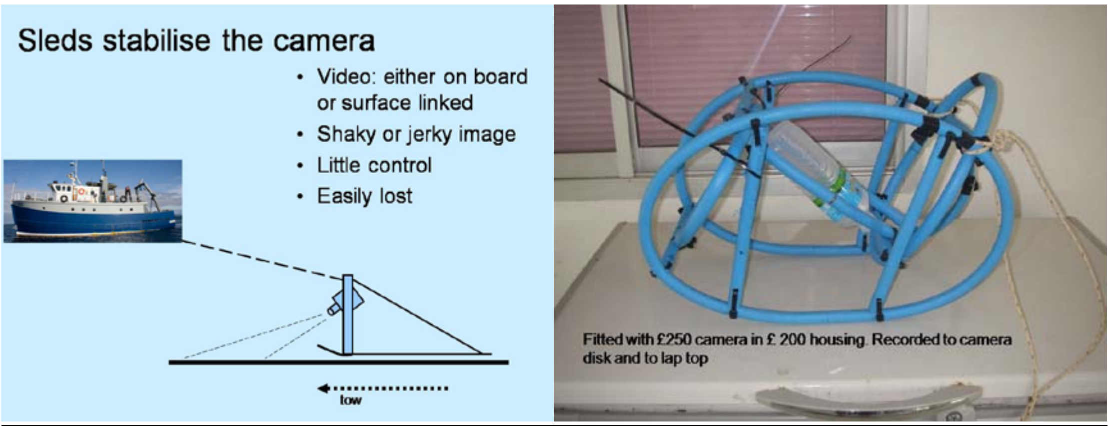

Camera systems : Still Drop down
•Used from slowly drifting ship
•Trigger weight
• No control of where image is taken
•All normal photographic problems
•Image analysis available on high resolution pictures ++ pixels
• Needs no independent power supply
• Cheap

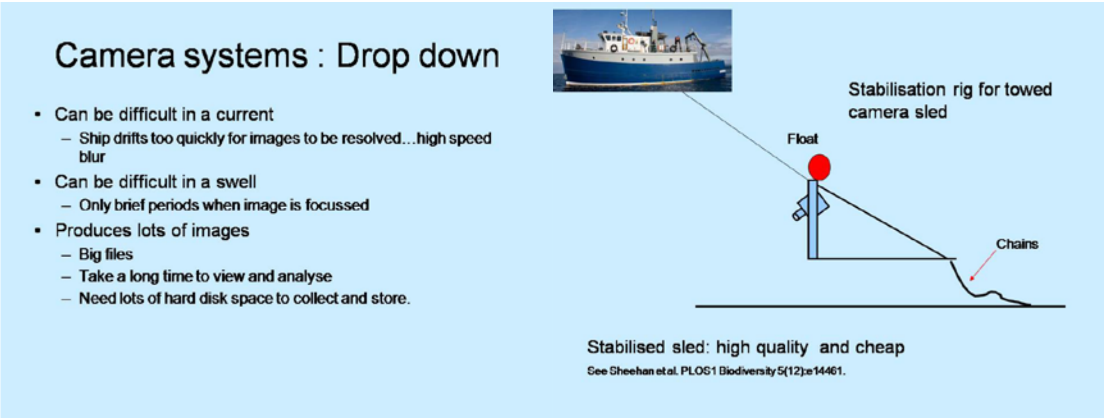

Camera systems : Video Drop-down
•Used from slowly drifting ship
•Real time image on screen or laptop
• Zoom/pan/tilt if needed
• OK for image analysis but poorer resolution from still images
• Needs power supply
• Basic set up from c £500

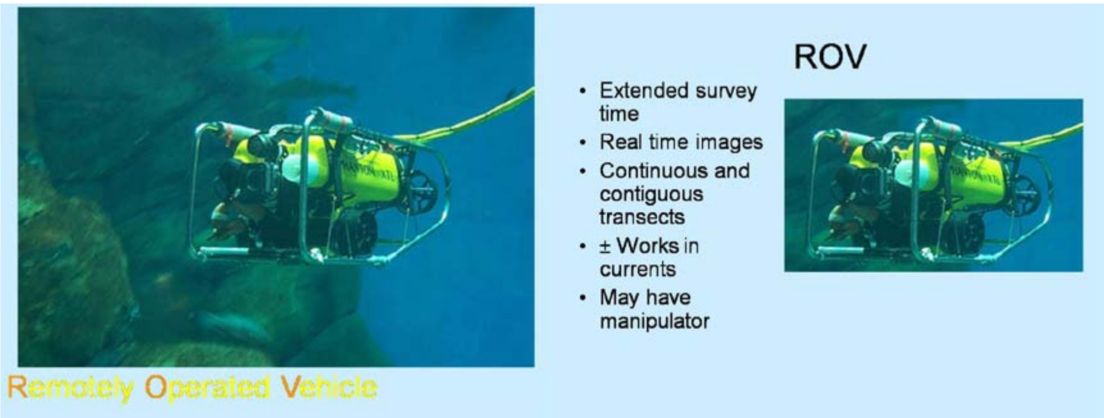

Moving camera platform problems
Image area skews: my oblong map is now a trapezoid: the density of animals becomes more difficult to assess; how do I measure area ?

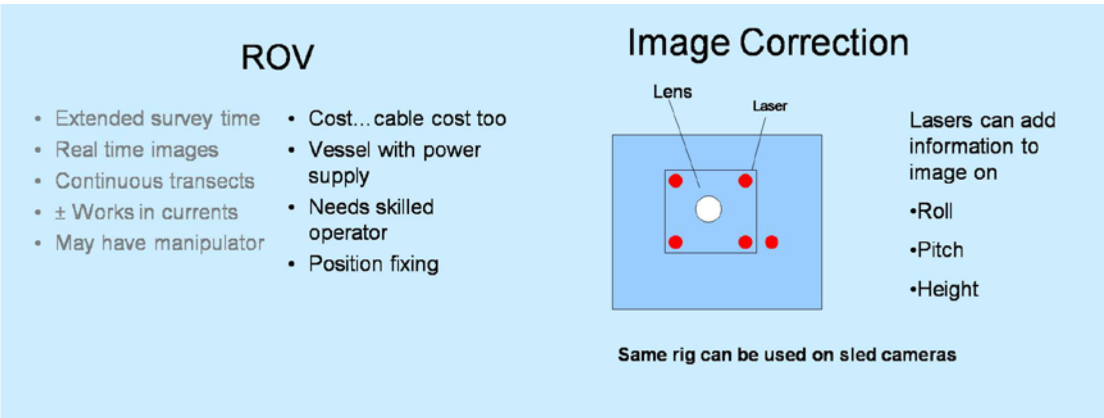

Moving camera platforms: problems
Only part of the frame is in sharp focus; species counts more accurate at front than back of frame
Good
Fuzzy
Image area
Focus
Good
Fuzzy


Moving camera platforms: problems
Image area
Focus
Distortion

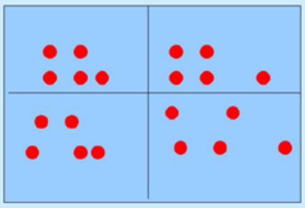

Sleds stabilise the camera
• Video: either on board or surface linked
• Shaky or jerky image
• Little control
• Easily lost
tow
Fitted with £250 camera in £ 200 housing. Recorded to camera disk and to lap top


Camera systems : Drop down
• Can be difficult in a current
– Ship drifts too quickly for images to be resolved…high speed blur
• Can be difficult in a swell
– Only brief periods when image is focussed
• Produces lots of images
– Big files
– Take a long time to view and analyse
– Need lots of hard disk space to collect and store.
Stabilisation rig for towed camera sled
Float
Chains
Stabilised sled: high quality and cheap
See Sheehan et al. PLOS1 Biodiversity 5(12):e14461.

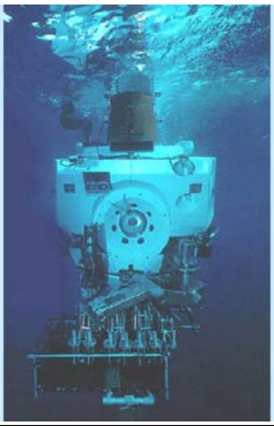

ROV
• Extended survey time
• Real time images
• Continuous and contiguous transects
• ± Works in currents
• May have manipulator
Remotely Operated Vehicle


ROV
• Extended survey time
• Real time images
• Continuous transects
• ± Works in currents
• May have manipulator
• Cost…cable cost too
• Vessel with power supply
• Needs skilled operator
• Position fixing
Image Correction
Lens
Laser
Lasers can add information to image on
•Roll
•Pitch
•Height
Same rig can be used on sled cameras

Laser spots



Calculations of image area, height and all necessary corrections can be done using ABISS software



For the seriously rich

Lessons

- Be realistic: define your limitations
- In tropical settings it can be difficult to find the right boat
  - Towing
  - Power supply
  - Shelter

SAMPLE TREATMENT AND IDENTIFICATION

Quality control is paramount

- Its very easy to collect samples but its equally easy to degrade the information that they provide by poor or careless treatment
- You cant always go back and collect more material
- High levels of quality control are essential

Once sediment samples are collected….

- Preliminary sieving in the field
- Label pots inside and out
- Fix with formalin* for 3-7 days
- Wash out formalin and fix in alcohol

- * Formalin is highly toxic…take precautions.

Careful sample treatment is vital

- The more damage you do to your animals the more difficult it is to get a valid identification
- Poor sample treatment cannot be compensated for by sophisticated statistics.

Faunal extraction: don’t damage the animals

- Sieving
  - Nested sieves cause least damage
  - Treat surface sediment separately
  - Indirect water least damaging
- Flotation/elutriation
  - Water
  - Sugar; for small animals
  - Ludox; for small animals

Sorting

- Pick animals from debris in sieve under low power microscope
- Staining helps picking but can obscure colour patterns that help identification
  - use with discretion

Identifying

- Keys demanded by non-specialists
- ? <1% of the world's ocean has useful keys to the most common taxa
- Those keys that exist are frequently out of date
- Keys give a false sense of security.

When keys can't help

- Draw the specimen
- Make notes concentrating on the taxonomic features of the genus
- Allocate a temporary name (*e.g.Prionospio sp A*)
- Use this throughout all your studies
- Make sure notes and reference specimens are available to other workers
- **The lack of a proper name for a specimen is not a problem to ecologists**

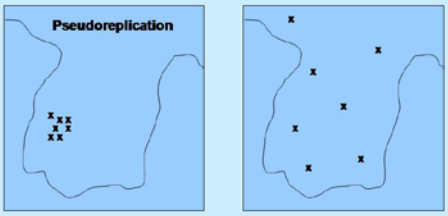
Where do I sample ?

Some Considerations

- Assume you want to detect change in biodiversity in your study area between 2 sampling periods:
  - In comparing the samples you begin with a hypothesis that there is no difference between them.
  - You use statistical tests to determine if the hypothesis is true or false

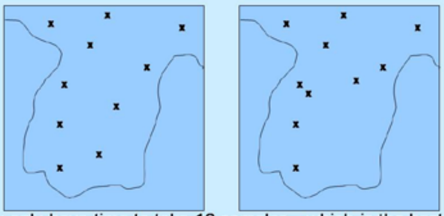
Where do I sample; some considerations.

- Samples should be taken in such a way as to describe the variability of the whole sampling area ….no single station studies please.
- The distribution of samples must match the scale of the scale of the process you are investigating.….go everywhere that fishing occurs not just one place on one trawl track.
- Sample 2 will not be independent of sample 1 if you return to the same spot
  - Non parametric tests assume independence



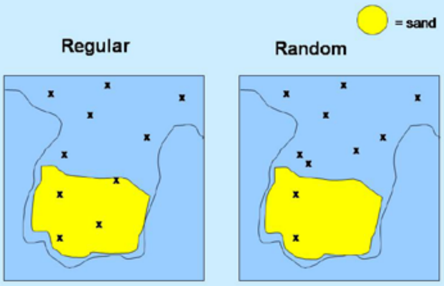
You are sampling biodiversity in this bay; which is the better design?
Pseudoreplication is a very easy way to get your paper rejected

Regular Random



You only have time to take 10 samples…which is the best distribution of stations, random or regular?

Regular distribution produces the best estimate of variance of biodiversity in the whole bay; random would be appropriate if the number of stations was high.



Which layout of sampling stations describes the fauna of the bay best ?

Regular even more appropriate if no preliminary survey

Stratified random is ideal Solution

- **If you have enough replicates !**
- Carry out preliminary survey to identify relative proportion and pattern of distribution of bottom type
- Allocate samples randomly to each sediment type
- Sample

More later………

Replication

- Any realistic study will have funding/manpower only for a fixed number of samples.
- The way you distribute the samples will determine your ability to detect change or pattern.
- Allocate replicates at the scale appropriate to the objective of the survey or the hypothesis being tested.

- **Hypothesis**: Flood water from rivers during the monsoon season impacts the benthos of Phang Na Bay

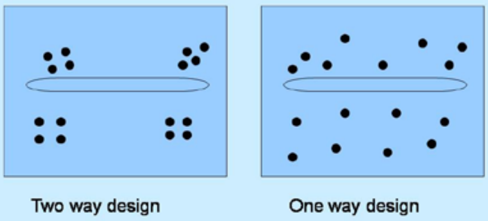
The hypothesis is a generalisation and so you need to sample all rivers.

You can't sample one river and extend the results to the whole bay.

- Hypothesis: Flood water from River XXX during the monsoon season impacts the benthos of Phang Na Bay

The hypothesis is specific so only need to sample around the named river.

Analysis of variance approaches
-a lecture course on its own



Key reference

- A .J.Underwood 1997. Experiments in Ecology. Cambridge University Press

Decisions

- Where do I sample ?
- **How many samples do I take ?**

Questions

- What is the purpose of sampling
- Is formal statistical testing to be used
  - Univariate: species by species
  - Multivariate: whole community
- How much time/money is available

- All methods of estimating the number of samples needed for univariate statistical methods depend on having preliminary data on abundance and variance
  - You might see this as a bit of a circular process.

Power Analysis

- In ***hypothesis testing***, the goal is to see if there is sufficient statistical evidence to reject a presumed ***null hypothesis*** in favor of an ***alternative hypothesis***.
- A *type 2 error* is failing to reject the null hypothesis when it is false…for example by taking too few samples.
- Power analysis tells us the probability of such an error occurring…..but you need preliminary estimates of variance to perform it
- Power analysis tell us how many samples we need. Standard in stats packages. If not available there are other indicative methods

Power analysis

- Gives a strong indication of the size of change that can be detected for a specified amount of effort…and vice versa.
- Needs preliminary data….so unlikely to be perfect.
- Often a sticking point when organisations realise that their complex extensive and expensive sampling programme can only detect changes bordering on obvious

Single species

- Empirical estimate
  - Vezina regression of mean against variance gave the equation

$$n = 1.641\bar{x}^{-0.781}D^{-2}$$

Number of replicates for different levels of precision

Mean number of animals in sample

Precision	0.5	5	10	50	1000
5%	1129	188	110	32	4
10%	283	48	28	9	2
20%	71	13	8	3	<2
40%	19	4	3	<2	<2

Precision: how close the sample mean is to the population mean

Summary

- The smaller the mean abundance the more samples are needed for fixed precision
  - You might want to increase your sampler size
- The more accurate an estimate of the mean you want, and the smaller the change you want to detect the more samples you need to take
  - But how often do you want an estimate within 1% of population mean

For multivariate statistics

- Do I need replication at all
  - Will a gradient study be enough

For multivariate statistics

- Do I need replication at all
  - Will a gradient study be enough
- 4 Samples is the minimum number needed for ANOSIM
  - Taking more samples increases the chance of detecting change

Sampling sediment

- We have covered
  - How
  - where
  - and how many samples
- Sediments are relatively homogeneous over large areas and provide a useful introduction to sampling

Annex 10: Collection and identification of polychaete worms

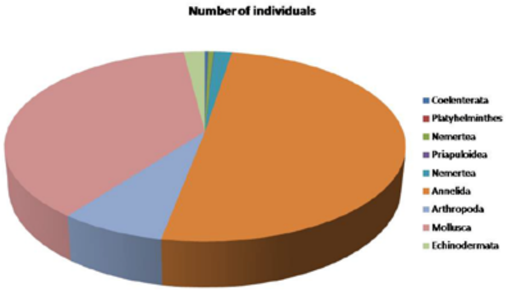
By Dr. Mike Kendall

Collection and identification of polychaete worms

Mike Kendall

"Worms have played a more important part in the history of the world than most persons would at first suppose. - Charles Darwin, 1898"

Polychaetes are the numerical dominants of most benthic assemblages



Phylum Annelida

- Class Oligochaeta
- Class Hirundea
- Class "others"
- Class Polychaeta
  - Segmented
  - Have chaetae (or setae)

Polychaetes

- Around 80 families
- 5122 new annelid names from 1978 to 1998
- 11,000 original polychaete names to 1965
- Reynolds and Cook listed over 7000 original oligochaete names to 1992.
- ***The number of synonyms amongst those names is considerable but unknown***

Sample collection and processing

You can't do good taxonomy on damaged animals

If garbage goes into data analysis garbage comes out from it.

Care during sampling is vital.

- Sieve the sample as gently as possible
- Use up and down motion not side to side
- Back wash carefully into a clean pot
- The pot should be 50% larger than the volume of the sample for effective preservation

Sample preparation

- Label containers inside and out
- Use ***minimum*** 8% formalin
- ***Fix for at least 1 week***
- Wash specimens gently
- Transfer to alcohol for preservation
- Extract worms

Sample extraction

- Pick animals from debris in sieve *under low power microscope*
- Staining helps picking but can obscure colour patterns that help identification
  - use with discretion

Identification

Keys are not always available beyond FAMILY

Around 70% of worms in a coastal study in Thailand couldn't be identified to species

Even when available, keys can't be trusted

- Based on knowledge existing when the key was written
- Quickly become out of date as new species found
- Not always exhaustive: particularly in student level texts

Keys

- Once you have used a key always check your diagnosis against a species description: you may have
  - A species described since the key was written
  - A species that has resulted from taxonomic revision
  - A species new to the area
  - A species new to science.

Identification

- Is it a polychaete at all?
- Is it errant or sedentary
  - Artificial split but necessary to know about if using older keys
- Which family?
- Which genus?
- Which species?

Is it a polychaete ?

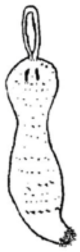
- Many taxa often confused with polychaetes by beginners.
- Some Basic questions
  - Is it segmented ?
  - Does it have chaetae
  - Does it have a coelom

Nemertea

•Nemertine worms have solid bodies, without a central fluid-filled space (coelom). Above the gut is a chamber containing an eversible proboscis.

•Rubbery feel when handled
•No segments
•No chaetae

Echiura: spoon worms



- Have chaetae but no segmentation
- Grooved proboscis or spoon usually lost in collection
- From a few cm in length to 1 metre +

Priapulida

- Usually 3 parts to body: introvert, trunk and caudal appendage
- Mouth surrounded by spines
- Introvert and trunk may also have spines
- Trunk annulate but no internal segmentation
- Caudal appendage may be lost

Phoronida

- Long and thin
- Easily damaged and lophophore lost
- Live in tough sandy tubes
- Unsegmented
- No chaetae

Dissect tube

Sipuncula

- Unsegmented
- There are no chaetae although small chitinous teeth can occur on the introvert and around the posterior.
- Introvert usually withdrawn in preserved material
- Characteristic anatomy on dissection

Annelids

- Is it a Polychaete or Oligochaete
- Difficult
  - ***Oligochaetes*** usually have
    - No structures on/around head
    - Few chaetae in each bundle
    - A restricted range of chaetal types
    - Similar size/shape of segments all along body (except in region 6-12 where reproductive organs are)

Identifying Polychaetes

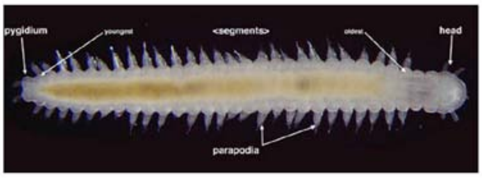
Useful Literature: general identification

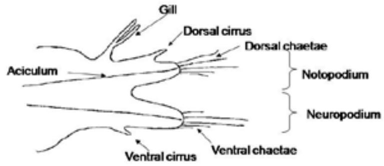
- Fauchald: 1977.The Polychaete Worms: Definitions and keys to the orders families and genera
  - *Out of date but invaluable*
- Hartman: Hartman, O Year: 1959 Title: Catalogue of the Polychaetous Annelids of the World *Occasional Papers of the Allan Hancock Foundation* 23 : 628pp
- Linnean Society Keys.
  - Modern keys to a limited number of families in UK and nearby waters. Useful family key
- Day. J. Polychaetes of South Africa. NHM London
- DELTA/INTKEY National Museum of Australia
- Taxinf keys NHM.AC.UK/Zoology

Literature

- Need to build a modern reference collection
  - Fauchald and Ward is good up to 1997.
  - Online at : http://134.60.85.50:591/PolyDB/PolyDBN_su.html

Polychaetes: Some Basic anatomy

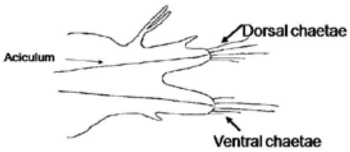




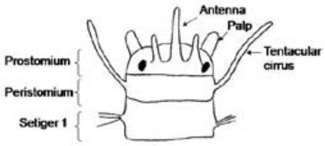
Parapodium

Setae /Chaetae

- These terms are used interchangeably in the literature: Don't worry



Structures on the head



Segment counts

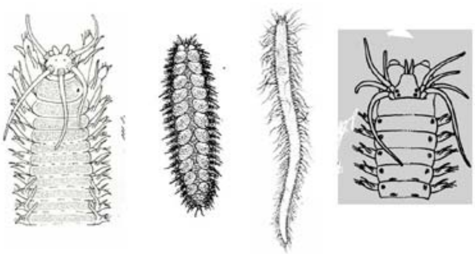
- Peristomial segments often difficult to identify
- Many choices in keys depend on identifying on which segment features start or finish
- In modern keys/descriptions we count segments with chaetae for simplicity
  - Usually setigers
  - Sometimes chaetigers
  - E.g. Gills present from setiger 8-20
- Old keys use segment number : beware

Errant or sedentary

An artificial but often used split

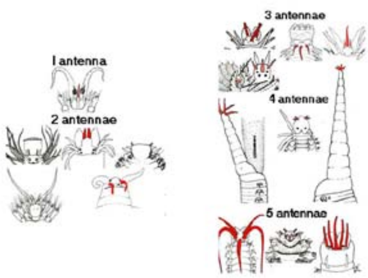
- Errant
  - Well developed head which may have large eyes, antennae, senso ry palps, jaws
  - Parapodia well developed
  - Segments much the same along body
  - Free living

Picture: H.Tsutsumi



Typical errant worms

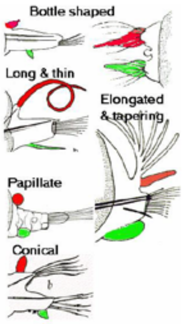
Antennae



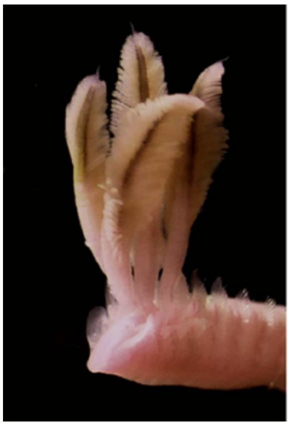
Palps

- Simple
- Bi-articulate

Jaws



Dorsal and Ventral cirri

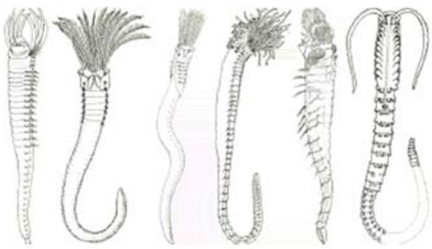


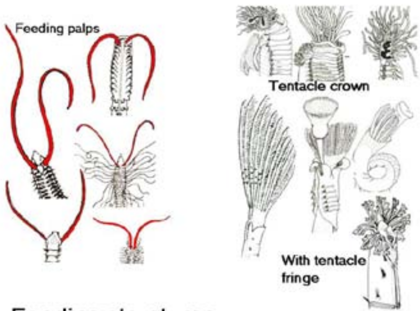
Sedentary

- Head may have feeding structures, feeding palps, branchial crown
- Parapodia weakly developed
- Body divided into 2 or more regions
- Lives in a tube or permanent burrow

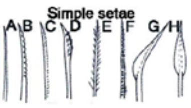
Picture: H.Tsutsumi

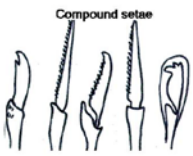
Typical sedentary worms





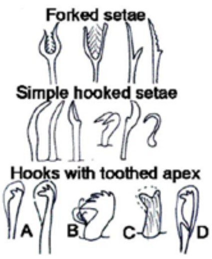
Feeding structures





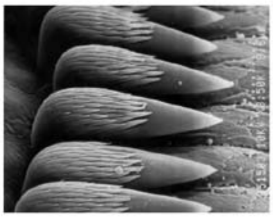
Chaetae

Chaetae



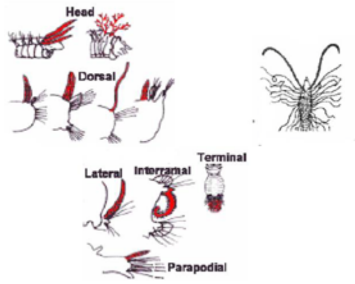
Uncini

- Usually very small
- Embedded in body wall
- Long rows
- May need dissection to see shaft



Gills = Branchae

- Terms used interchangeably



When keys don't work

- For community studies
- Or for biodiversity studies
  - It will be necessary to give an un-described animal a temporary name that can be used consistently

Temporary names

- Draw, describe and record using the features that make up existing species descriptions for the family concerned.

Temporary names

- Draw, describe and record.
- Allocate temporary name e.g. *Prionospio Ranong sp1*

Temporary names

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- Use this name throughout all studies in the future

Temporary names

- Draw, describe and record.
- Allocate temporary name e.g. *Prionospio Ranong sp1*
- Use this name throughout all studies in the future
- Distribute name and description as widely as possible; get others to use the name
  - Don't wait for formal taxonomy

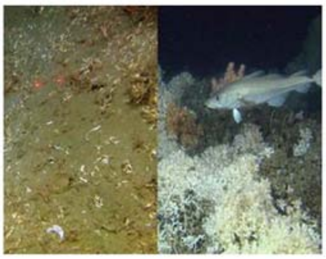
Temporary Names

The lack of a proper name for a specimen is not a problem to ecologists but temporary names must be used consistently.


Thank you

Annex 11: Detecting change due to fishing

By Dr. Mike Kendall



Detecting change due to fishing

Biological Decisions

- Consult at the policy level; what do the funders want you to do. If they are not sure you can help them.
- Define the hypothesis (hypotheses) you want to test
  - Is there an ecosystem impact?
  - Is there an impact on the benthos?
  - Is the impact on all elements of the benthos?
- Define the spatial scope of your study
  - One location or many; impacts at one site in Thailand or impacts across SEAFDEC
  - Independent studies or a large integrated study

Review

- Review the funding available to you
- Review the staff expertise available to you
- Review the amount of time you have to do the study

- **Go back and revise your plans according to resources**

Go and talk to a statistician

- A proper statistician not a biological colleague who is "good at stats".
- Agree a statistical approach (or approaches) to address ***clearly defined*** hypotheses.
- Produce a sampling design.
- Evaluate the cost of your sampling design and the time it will take. Compare with budget and deadlines
- Re-evaluate design if necessary.

Analysis Decisions

In consultation with the statistician decide on the size of effect you want to be able to detect
- The smaller the effect the greater the sampling effort needed.

In consultation with the statistician

- Re-evaluate the design of sampling (control, treatment replication etc.)
- Decide the spacing of sample
- Decide if the sampling will need repeating
- RE-evaluate against time and budget

Decisions are easily made in front of a computer

BUT

Its different in the field
- Nothing works perfectly, everything takes more time than you planned.
- Allow time and budget for things to go wrong
- Never produce a design that needs every sample, every day at sea or every hour in the lab that the most efficient statistical design indicates.

Multivariate or univariate statistical approaches

- Right at the very start you will have to decide the statistical methods that will direct your data collection.
- Many sampling designs are driven by parametric analysis based on the various Analysis of Variance (ANOVA) models. These techniques are very powerful but do fully exploit all the information collected in a benthic survey as they cannot consider the identity of individual species. There are lots of statistical rules that must be adhered to.
- Typically ANOVA based analysis will consider changes in
  - Number of individuals
  - Number of species
  - Abundance of dominant species

Multivariate approaches

- Less dependent on statistical rules on normality, homogeneity of variance, independence of samples etc.
- Use all the data
- Are sensitive to changes in species composition
- Are vastly powerful due to massive redundancy within the data matrix (see later)

Most people combine methods

A general recommendation is to design on the basis of multivariate methods and carry out parametric methods on the resulting data

---

Before-after–control impact: BACI

- It is not sufficient simply to sample the benthos, go out and trawl over the area and then return a few months later to see what the changes are.
- The seafloor undergoes natural change (e.g. pre- or -post-monsoon) and these could confound a simple before and after design. Control areas are needed
- There may be a need to undertake sequential sampling to capture (or eliminate) effects of annual cycles

If things need to change

The next part of the lecture will look at some ways to cut costs or increase scope in macro-benthic surveys

---

For a benthic sampling programme

Mobilisation	Costs
–finding staff –Buying kit –Packing/transport	± fixed
Sampling Ship costs	Some saving possible
Work up –Sample processing –Analysis –Write up	Some saving possible

Ship Costs

- How many days do I need a ship for
  - Contingency
  - Mechanical problems
  - Weather
- No right or wrong answers
  - Trade off between not completing survey and excessive costs

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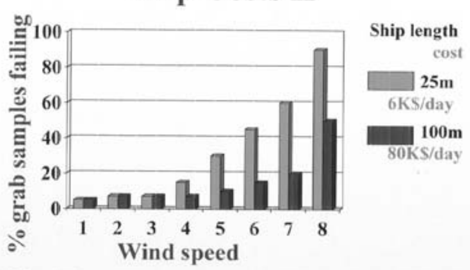
Ship Costs II



A big ship samples better in bad weather *but can you afford the cost ?*

Benthic sample processing

- ONE sample can take 1-3 days for a trained worker to sort/identify
- In an area where the fauna is known about 130 samples can be processed in a year

Benthic sample processing

- ONE sample can take 1-3 days for a trained worker to sort/identify
- In an area where the fauna is known about 130 samples can be processed in a year
- **Lab processing time is a major limiting factor**

In the tropics

- Poor faunal knowledge increases processing time
- Numbers of individuals /sample might be lower
- ? Plan on 1 person dealing with 100 samples/year...or fewer.

How do costs in the lab compare with ship costs ?

- 1day at sea in a small inshore vessel
  - Costs £1200
  - Takes at least 40 samples
- 40 samples will cost £20-30,000 to process

How do costs in the lab compare with ship costs ?

- 1day at sea in a small inshore vessel
  - Costs £1200
  - Takes at least 40 samples
- 40 samples will cost £20-30,000 to process
- So cut down on lab costs if you can

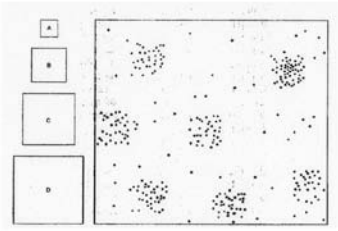
Reducing lab costs: overview

- Take fewer samples
  - Reduce spatial extent
  - Cut down replication
- Take smaller samples
  - Could be a problem in the tropics where numbers are already low
- Use a coarser sieve
- Consider less taxonomic rigour

Take fewer samples

- How does this change the statistical design?
- For most surveys having resources to take the samples isn't a problem
- Its always better to collect extra samples and then choose which to work up rather than wishing you'd taken more.

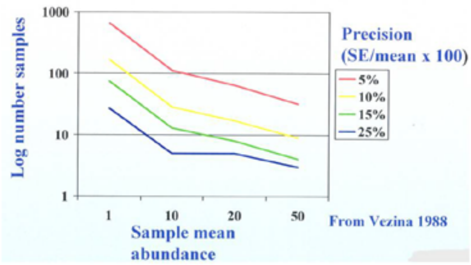
Changing sample size



Changing sample size impacts

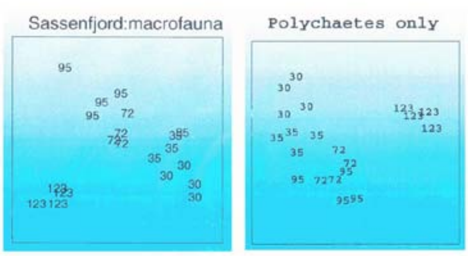
1) Impression of dispersion
2) Sample mean
3) Sample variance

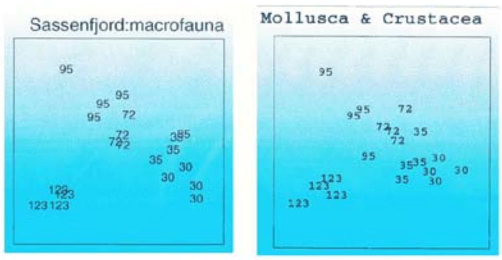
More samples are needed for a fixed precision of mean as abundance decreases

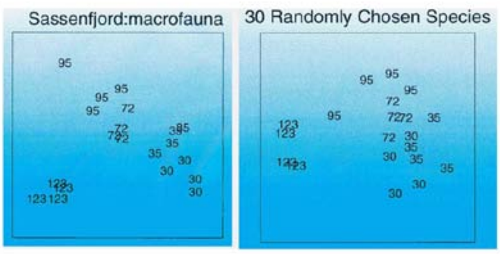


Multivariate

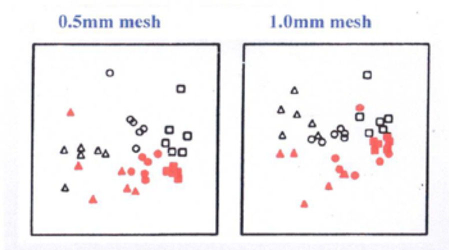
- Multivariate data sets are data rich
  - this gives massive scope for changing elements of the sampling design without compromising the outcome of the study







Changing Mesh Size



From James and Fairweather 1995

Increasing mesh size

- Fewer animals so samples are faster to process
- Patterns of distribution conserved

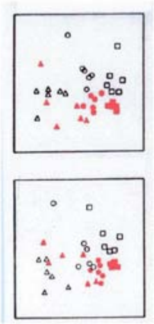
Increasing mesh size

- Fewer animals so samples are faster to process
- Patterns of distribution conserved

BUT

- Small bodied species are underestimated
  - Implications for some diversity/pollution methods
  - Diversity loss
  - Loss of ability to compare

Decreasing taxonomic level



Decreasing taxonomic resolution

- May be useful in tropics to address monitoring etc
- Some genera are speciose and differences can be difficult to find.
- Many taxa are undescribed

Conclusion

- Every sampling programme is different
- Each must be designed individually
  - THERE IS NO COOK BOOK

Annex 12: Introduction to the taxonomy of Gastropods and Bivalves

By Assist. Prof. Teerapong Duangdee

Training Workshop on Identification of Deep-sea Benthic Macroinvertebrate Vulnerable to Fishing Gear

Introduction to the taxonomy of **Gastropods and Bivalves**

Teerapong Duangdee
Department of Marine Science, Faculty of Fisheries, Kasetsart University

Outline

- Introduction
- Phylogeny of Mollusca
- A study on the molluscan fauna in Thailand
- Mollusc identification references
- Introduction to the taxonomy of Gastropods and Bivalves

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Phylum mollusca

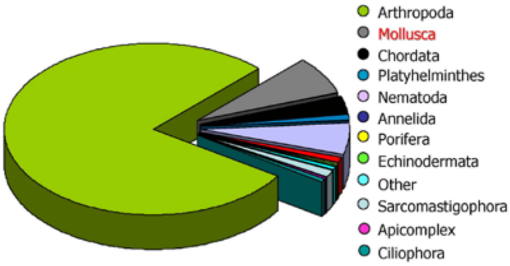
Phylum Mollusca includes snails and slugs, oysters and clams, and octopuses and squids.

Molluscs evolved in the sea and most molluscs are still marine.

Some gastropods and bivalves inhabit freshwater.

A few gastropods (slugs & snails) are terrestrial.

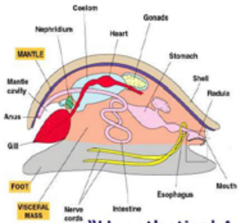
Numbers of species



Second largest animal phylum; 100,000 living species

Characteristics

1. Body Plan: All molluscs have a similar body plan with three main parts: head-foot, visceral mass and mantle (A thick epidermis that covers the dorsal side of the body)



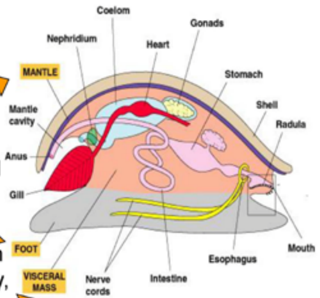
"Hypothetical Ancestral Mollusc"

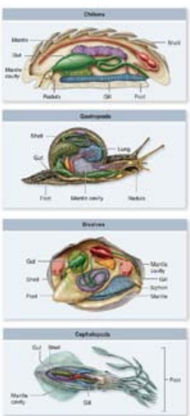
Characteristics

The mantle, which functions in shell production and respiration

A head-foot region with locomotors and sensory functions

A visceral mass with digestive, circulatory, reproductive, and excretory functions





Hypothetical Ancestral Mollusc

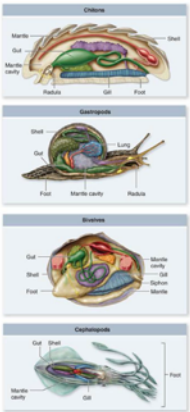
Characteristics

1. Body Plan: All molluscs have a similar body plan with three main parts: **head-foot, visceral mass and mantle**
2. Bilateral symmetrical, body is without true segments
3. Mantle (specialized tissue, secretes shell, may be involved in feeding, reproduction and respiration) – mantle cavity

Mantle cavity

The space between the mantle and the visceral mass is called the mantle cavity.

The respiratory organs (gills or lungs) are generally housed here.



Characteristics

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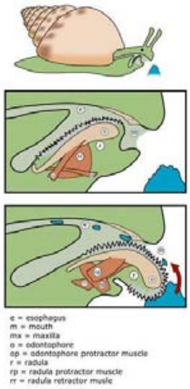
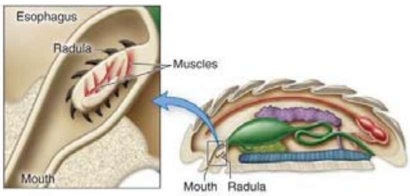
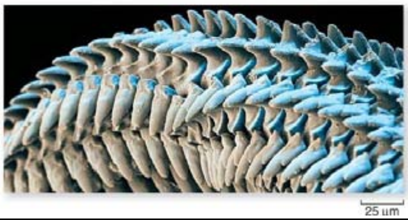
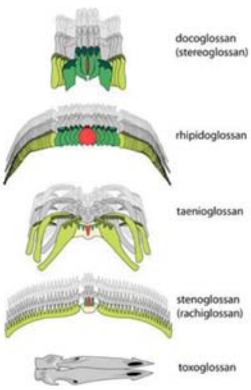
4. Radula : a rasping, protrusible feeding structure found in most molluscs (not bivalves).
5. Open circulatory system (Cepalopods-Closed)
6. Respiratory System - gills, lungs, mantle, epidermis

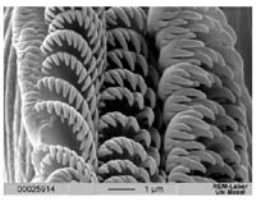


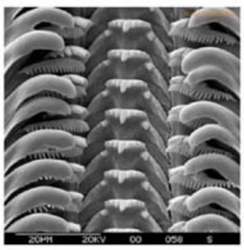






Ptenoglossa





Rachiglossa

Characteristics

1. Body Plan: All molluscs have a similar body plan with three main parts: **head-foot, visceral mass and mantle**
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3. **Mantle** (specialized tissue, secretes shell, may be involved in feeding, reproduction and respiration) – **mantle cavity**
4. **Radula** : a rasping, protrusible feeding structure found in most molluscs (not bivalves).
5. Open circulatory system (Cepalopods-Closed)
6. Respiratory System - gills, lungs, mantle, epidermis

Shells

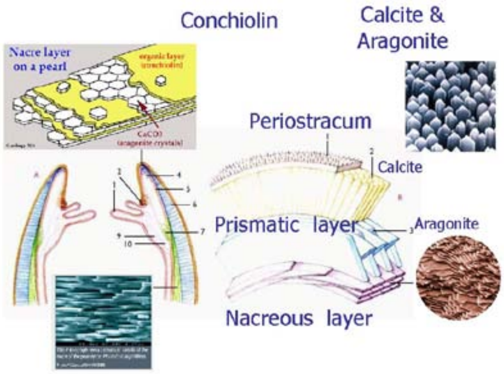
Most molluscs produce an external calcium carbonate-rich shell - Used for protection.
Some species have internalized or reduced shells.

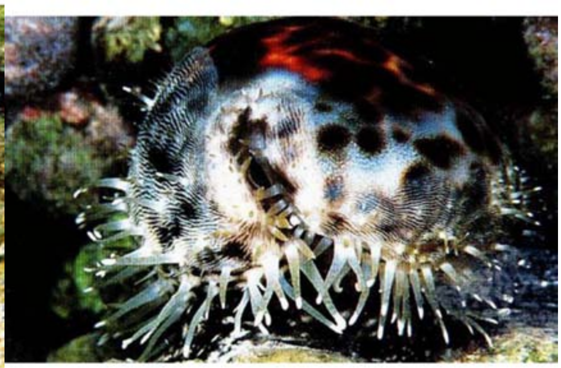
When present, the calcareous shell is secreted by the mantle and is lined by it. It has 3 layers:

Periostracum – outer organic layer helps to protect inner layers from boring organisms.

Prismatic layer – densely packed prisms of calcium carbonate.

Nacreous layer – iridescent lining secreted continuously by the mantle.





Outline

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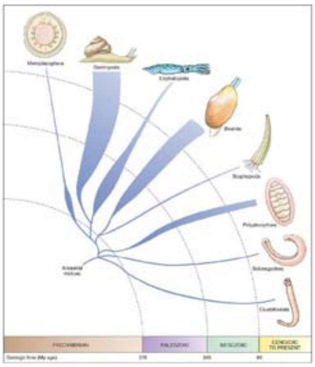
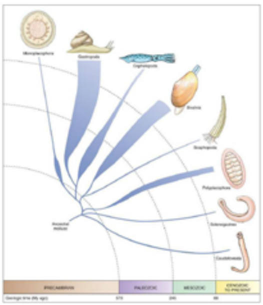


Fossil records from precambrian period

Phylogeny of Molluscs



SUBPHYLUM AMPHINEURA
- CLASS APLACOPHORA
- CLASS POLYPLACOPHORA

SUBPHYLUM CONCHIFERA
- CLASS MONOPLACOPHORA
- CLASS GASTROPODA
- CLASS BIVALVIA
- CLASS SCAPHOPODA
- CLASS CEPHALOPODA

Polyplacophora

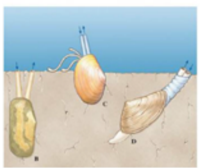
Chitons
- Segmented shell – 8 plates
- Multiple gills down side of body
- Rock dwellers that use radula to scrape algae off rocks

Gastropoda

Largest class (80,000 species)
- Single shell (univalves) may be coiled or uncoiled
- Many snails can withdraw into the shell and close it off with a horny operculum
- Most gastropods are herbivores and feed by scraping algae off hard surfaces using the radula
- Some are scavengers of dead organisms, again tearing off pieces with radular teeth
- Some are carnivores and have a radula modified into a drill to bore through the shells of other molluscs. They use chemicals to soften the shell.

Bivalvia

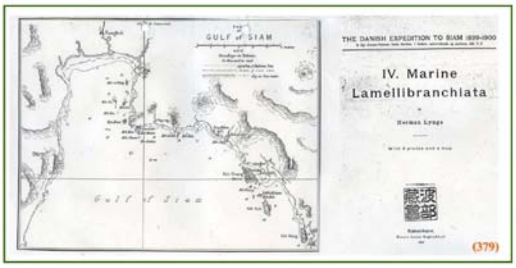
- Have two shells (valves), shell is closed by adductor muscles
- No head or radula
- Complex sheet of gill derived tissue for filter feeding and respiration
- Part of the mantle is modified to form incurrent and excurrent siphons



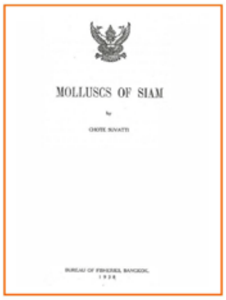
Outline

- Introduction
- Phylogeny of Mollusca
- A study on the molluscan fauna in Thailand
- Mollusc identification references
- Introduction to the taxonomy of Gastropods and Bivalves

Martens, E.C. von. 1860. On the Mollusca of Siam. *Proc. Zool. Soc. Lond.* 1860(28): 17 7



Suvatti, C. 1937. A Check-List of Aquatic Fauna in Siam. Bureau of Fisheries, Bangkok. 372



Suvatti, C. 1938. Molluscs of Siam. Bureau of Fisheries, Bangkok. 533

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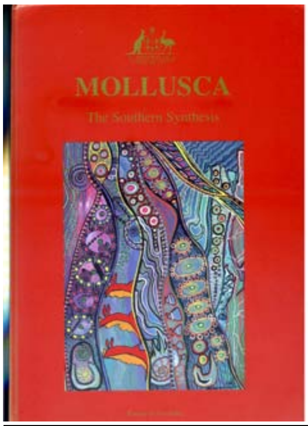

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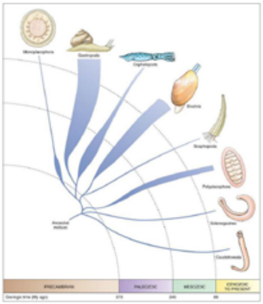
Classification of Molluscs



SUBPHYLUM AMPHINEURA
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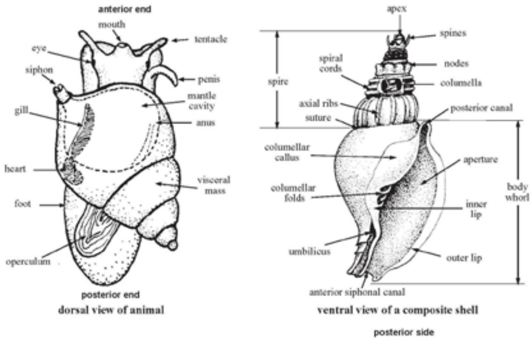
SUBPHYLUM CONCHIFERA
- CLASS MONOPLACOPHORA
- CLASS GASTROPODA
- CLASS BIVALVIA
- CLASS SCAPHOPODA
- CLASS CEPHALOPODA

Gastropods:



Callus

Columella

Cancellate

Lirae

Posterior canal

Operculum

Operculum

Umbilicus

Varix

Key to families

1a. Shell reduced, internal or nearly so, permanently covered by the mantle . . . . .Figure A
1b. Shell well developed, exposed, although it may be temporarily covered by mantle lobes which are withdrawn when touched . . . . → 2

Figure A.

Key to families

2a. Shell permanently cemented to a substrate, loosely or irregularly coiled and generally twisted, resembling the calcareous tube of a polychaete worm . . . . Figure B
2b. Shell not permanently cemented to a substrate, tightly coiled or not coiled and conical, cap-shaped or slipper-shaped, but never resembling a worm tube . . . . → 3

Figure B.

Key to families

3a. Shell ear-shaped or conical and not coiled, with a marginal indentation or slit anteriorly, or with one to several holes in addition to the aperture. .Figure C
3b. Shell not of these shapes, or without holes, anterior indentation or slit, apart from the aperture . . . . → 4

Figure C.

Key to families

4a. Shell cap-shaped, slipper-shaped or conical, without obvious coiling; spire, if visible, not prominent . . . . Figure D
4b. Shell not of these shapes, conspicuously coiled . . . . → 5

Figure D.

Key to families

5a. Outer lip of the aperture with a distinct notch anteriorly. .Figure E
5b. Outer lip of the aperture without an anterior notch . . . . → 6

Figure E.

Strombidae

Key to families

6a. Aperture stretching along the whole shell length; spire concealed under body whorl, or reduced and not protruding . . . . .Figure F
6b. Aperture not stretching along the whole shell length, or spire not concealed under body whorl, more or less developed and protruding . . . . → 7

Figure F.

Key to families

7a. Shell without an anterior siphonal canal . . . . → *8*
7b. Shell with an anterior siphonal canal . . . . → *10*

8a. Interior of shell pearly . . . . Figure G
8b. Interior of shell not pearly . . . . → *9*

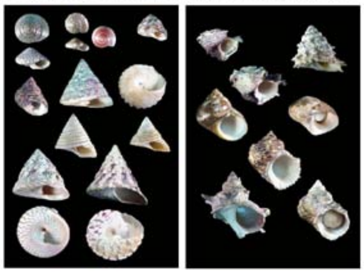


Figure G.

Key to families

9a. Length of the shell much smaller than the width . . . . Figure H
9b. Length of the shell about equal to the width, or decidely larger . . . . Figure I

Figure H.

Figure I.

Key to families

7a. Shell without an anterior siphonal canal . . . . → *8*
7b. Shell with an anterior siphonal canal . . . . → *10*

8a. Interior of shell pearly . . . . Figure G
8b. Interior of shell not pearly . . . . → *9*

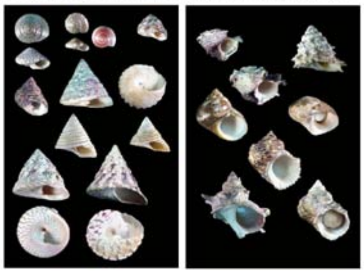


Figure G.

Key to families

10a. Outer sculpture with axial varices . . . . Figure J
10b. Outer sculpture without axial varices . . . . → *11*

Figure J.

Key to families

11a. Columella with strong spiral folds . . . . Figure K
11b. Columella without strong spiral folds (low threads or grooves may be present) . . . . → *12*

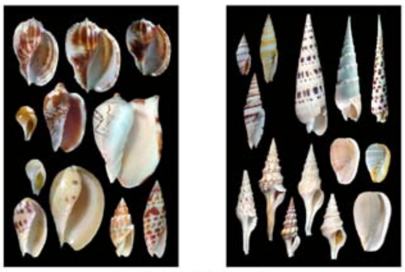


Figure K.

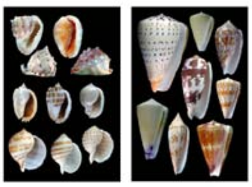
Key to families

12a. Siphonal canal relatively long . . . . Figure L
12b. Siphonal canal relatively short . . . . → *13*

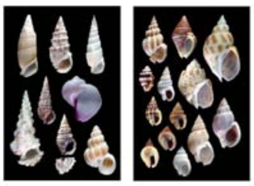
Figure L.

Key to families

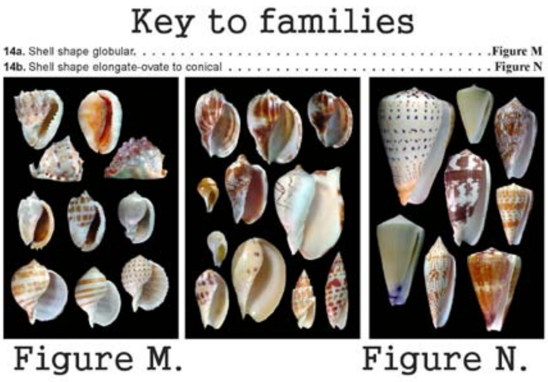
13a. Spire short . . . . → *14*
13b. Spire well developed . . . . → *15*

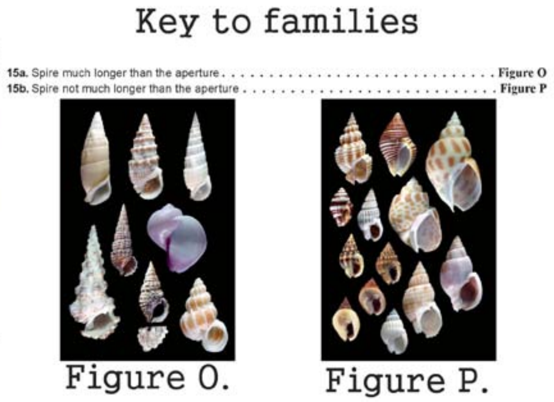


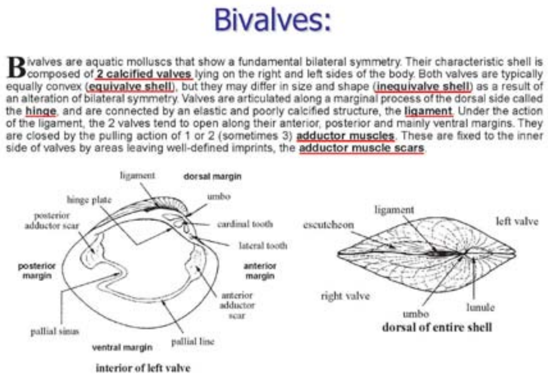
14.

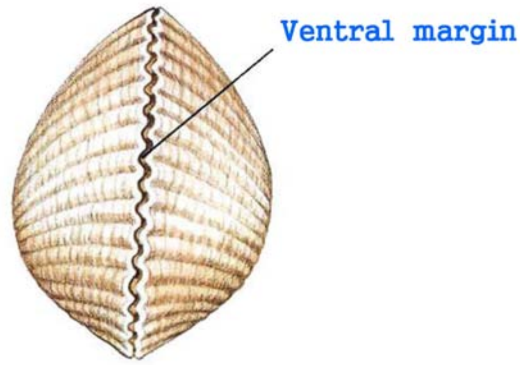


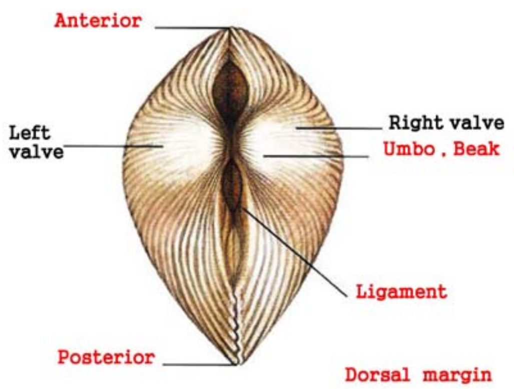
15.

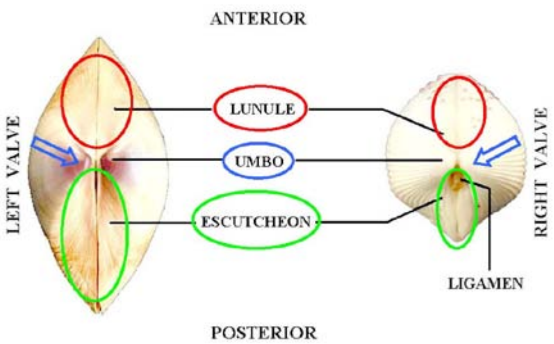

Key to families
14a. Shell shape globular. . . . . Figure M
14b. Shell shape elongate-ovate to conical . . . . Figure N
Figure M.
Figure N.

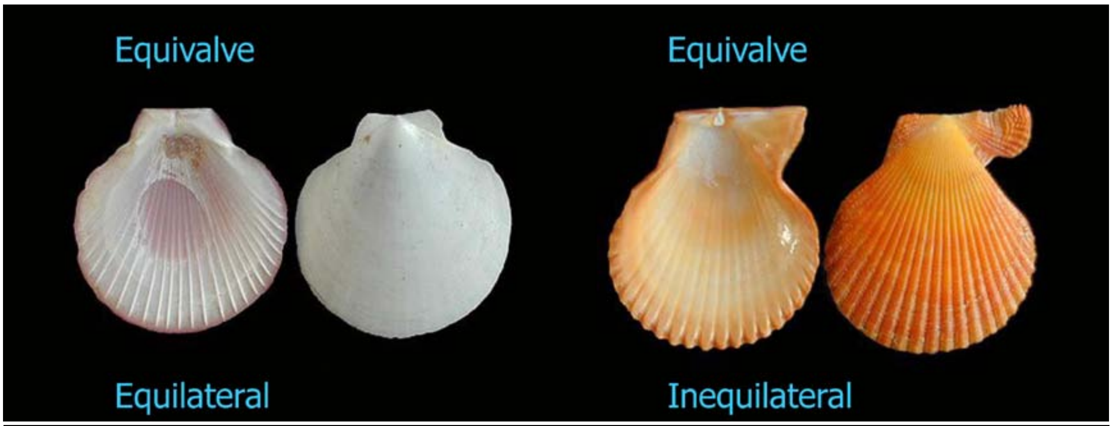

Key to families
15a. Spire much longer than the aperture . . . . Figure O
15b. Spire not much longer than the aperture . . . . Figure P
Figure O.
Figure P.

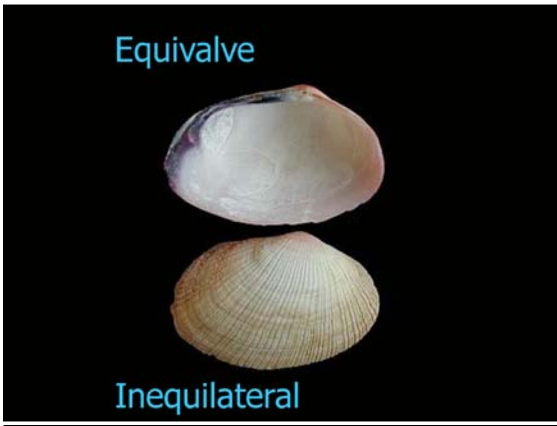

Bivalves:
Bivalves are aquatic molluscs that show a fundamental bilateral symmetry. Their characteristic shell is composed of 2 calcified valves lying on the right and left sides of the body. Both valves are typically equally convex (equivalve shell), but they may differ in size and shape (inequivalve shell) as a result of an alteration of bilateral symmetry. Valves are articulated along a marginal process of the dorsal side called the hinge, and are connected by an elastic and poorly calcified structure, the ligament. Under the action of the ligament, the 2 valves tend to open along their anterior, posterior and mainly ventral margins. They are closed by the pulling action of 1 or 2 (sometimes 3) adductor muscles. These are fixed to the inner side of valves by areas leaving well-defined imprints, the adductor muscle scars.
ligament
dorsal margin
hinge plate
umbo
posterior adductor scar
cardinal tooth
lateral tooth
posterior margin
anterior margin
anterior adductor scar
pallial sinus
pallial line
ventral margin
interior of left valve
ligament
escutcheon
left valve
right valve
umbo
lunule
dorsal of entire shell

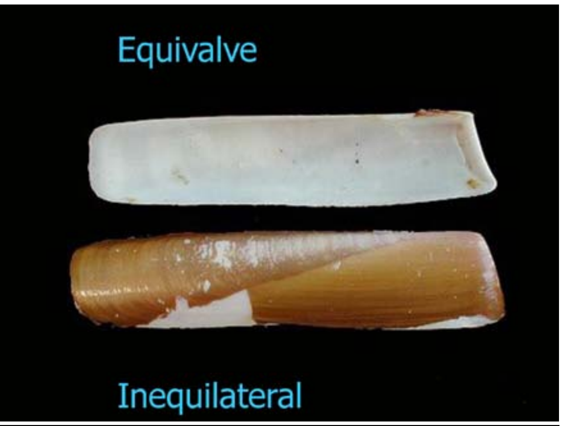

Ventral margin

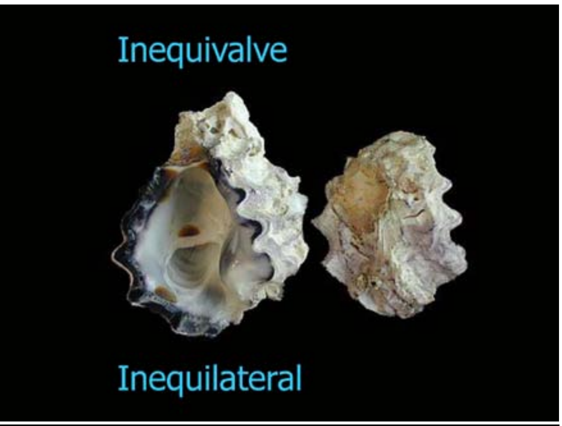

Anterior
Left valve
Right valve
Umbo , Beak
Ligament
Posterior
Dorsal margin

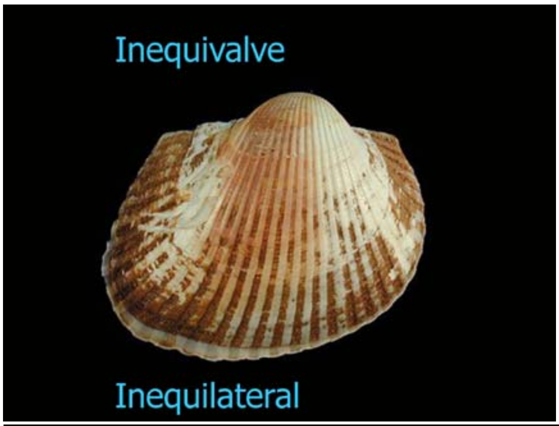

ANTERIOR
LUNULE
UMBO
ESCUTCHEON
LEFT VALVE
RIGHT VALVE
LIGAMEN
POSTERIOR


Equivalve
Equivalve
Equilateral
Inequilateral









Glossary of Technical terms

Accessory plate - calcareous and periostracal structure covering the soft parts in the Pholadidae, in addition to the shell valves.

Adductor muscle - muscle connecting the 2 valves of a shell, tending to draw them together.

Apophysis - finger-like shelly structure to which the foot muscles are attached in the Pholadidae and Teredinidae.

Branchial - pertaining to the gills.

Branchial lamella - (see gill).

Byssus - clump of horny threads spun by the foot, by which a bivalve can anchor to a hard substrate.

Cardinal area - surface of the shell extending between umbo and hinge margin.

Cardinal tooth - (see tooth).

Chomata - marginal crenulations in Ostreidae and Gryphaeidae, occuring all around the inner side of valves or only near the hinge, composed of small tubercles or ridgelets on the right valve, and corresponding pits on the left valve.

Commissure - line of junction of the valves.

Concentric - parallel to lines of growth.

Cruciform muscles - crossed muscles connecting valves and serving to retract the siphons, leaving 2 small scars near the posteroventral end of pallial line in some bivalves (e.g., Tellinidae).

Ctenidial axis - (see gill).

Ctenolium - a row of small teeth on lower side of byssal notch in some Pectinidae.

Demibranch - (see gill).

Denticle - a small tooth.

Ear - lateral expansion of the dorsal part of a shell.

Equilateral - the condition of a valve when growth on either side of umbo is symmetrical.

Equivalve - the condition of a shell when valves are of the same shape and size.

Escutcheon - differenciated area extending along dorsal margin of valves, behind the umbones.

Eulamellibranchiate type - gill demibranchs composed of 2 lamellae. Branchial filaments and lamellae always connected by tissular junctions (e.g., Veneridae).

Filibranchiate type - gill demibranchs composed of 2 lamellae. In addition to the ciliary junctions between branchial filaments, anastomosed tissular junctions may unite lamellae of each demibranch (e.g., Mytilidae, Pectinidae).

Foot - mobile and extensible muscular organ, used for locomotion or for attachment to substrate by means of byssal threads.

Gape - opening or gap remaining between margins of valves, when shell is closed.

Gill - respiratory organ generally composed of 2 thin leaf-like structures (demibranches) suspended to a dorsal axis (ctenidial axis); each demibranch may be either simple or bent back upon itself and then formed of 2 sheets (branchial lamellae). A lamella is constituted of many ciliated filaments parallel to each other and interconnected by more or less complex junctions. Four main types of gill structures are currently recognized among bivalves: the protobranchiate, filibranchiate, eulamellibranchiate, and septibranchiate types (see these terms).

Growth marks - (see sculpture).

Hinge - structures in the dorsal region of the shell, along which the valves meet, and that function in the opening and closing of the shell.

Hinge line - shell margin adjacent to the hinge.

Hinge plate - infolding of dorsal shell margin bearing hinge teeth and sockets, and lying in each valve in a plane parallel to that of junction of valves.

Imbricate - overlapping like tiles or shingles on a roof.

Inequilateral - the condition of a valve when growth on either side of umbo is assymmetrical.

Inequivalve - the condition of a shell when valves are not alike in shape or size.

Keel - a prominent, angular ridge.

Lamellate - with thin, flattened plates.

Lateral tooth - (see tooth).

Lenticular - shaped like a biconvex lens.

Ligament - horny, elastic structure joining the 2 valves dorsally.

Ligamental area - part of cardinal area occupied by the ligament.

Lunule - differentiated area extending along dorsal margin of valves, just in front of umbones.

Mantle - fleshy sheet surrounding vital organs and composed of 2 lobes, one lining and secreting each valve.

Muscle scar - impression marking the place of attachment of a muscle inside the shell.

Nacreous - pearly, often with multi-coloured hues, as in mother-of-pearl.

Nymph - narrow plateform extending behind umbo along dorsal margin, to which the external ligament is attached.

Opisthogyrate - the condition of a shell when umbones are directed posteriorly.

Orbicular - disk-shaped, nearly circular.

Orthogyrate - the condition of a shell when umbones are perpendicular to the hinge line (directed neither anteriorly nor posteriorly).

Pallet - small paddle-shaped or feather-like calcareous and periostracal structure, a pair of which closes the burrow opening when siphons are retracted in the Teredinidae.

Pallial - pertaining to the mantle.

Pallial line - a line near internal margin of valve, marking the site of attachment of the mantle edge.

Pallial sinus - posterior indentation of pallial line, marking the site of attachment of muscles allowing siphons to retract within the shell.

Pedal - pertaining to the foot.

Periostracum - layer of horny material covering the shell.

Plicate - folded or ridged.

Porcelaneous - with translucent, porcelain-like appearance.

Prosogyrate - the condition of a shell when umbones are directed anteriorly.

Protobranchiate type - gill demibranchs simple, formed of leaf-like filaments loosely connected by sparse ciliary junctions.

Radial - diverging from umbo, like the spokes of a wheel.

Rostrate - with a beak-like projection (rostrum).

Sculpture - relief pattern developed on the outer surface of the shell; sculpture is overlain by concentric growth marks corresponding to various positions of shell margins during growth.

Scabrous - rough, file-like.

Scale - localized projection on the outer surface of shell, commonly situated on a rib.

Septibranchiate type - gills absent, replaced by a muscular horizontal partition (the "septum") pierced by small pores. This structure enables a carnivorous nutrition and is encountered in a group of predominantly deep-sea bivalves (e.g., Cuspidariidae).

Siphons - extensible, tube-like projections of the posterior marginal region of mantle, forming 2 openings for water inflow (inhalant siphon) and outflow (exhalant siphon).

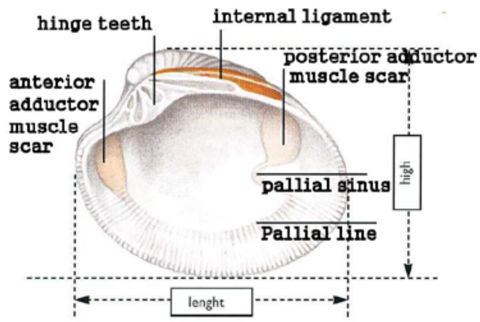
Socket - recess of the hinge plate, for reception of a tooth of opposite valve.

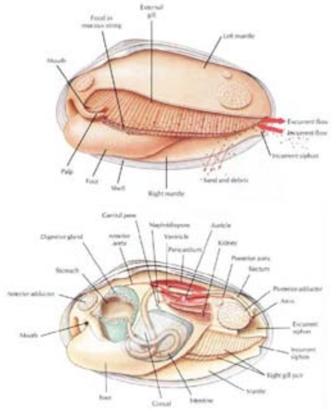
Tooth - shelly projection from the hinge, received in socket of opposite valve; cardinal teeth are close to umbo, whereas lateral teeth are set apart from these, anteriorly or posteriorly.

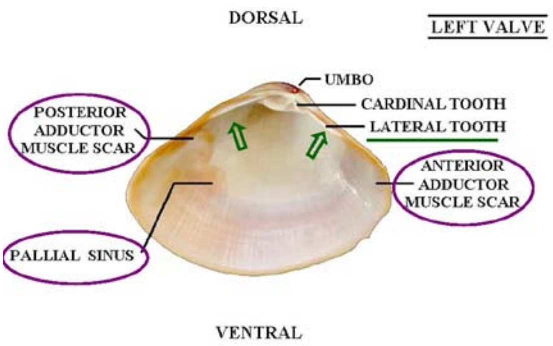
Umbo (pl. umbones) - the first formed part of a valve, usually above the hinge.

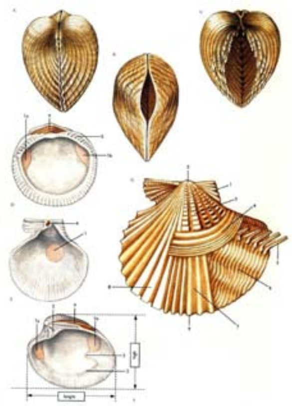
Umbonal reflection - expansion of the internal dorsal margin which is folded over the umbones in Pholadidae and Teredinidae.

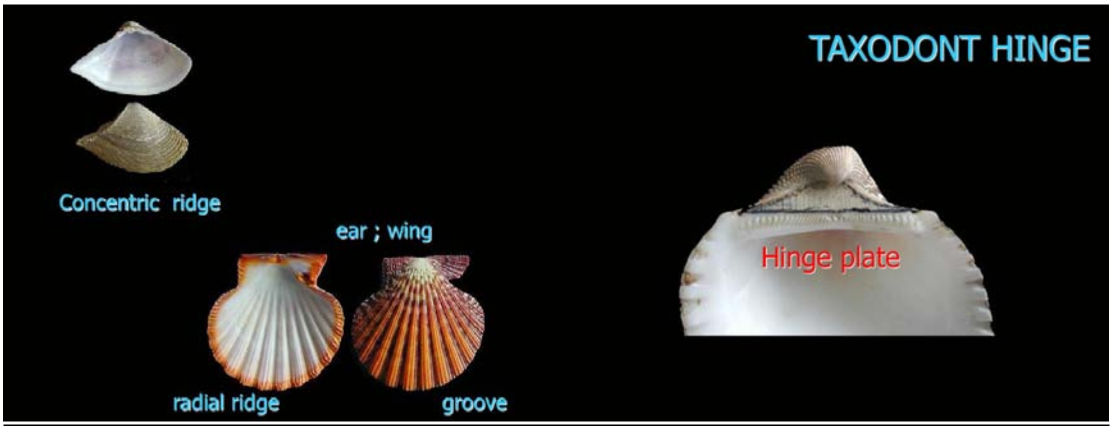
Valve - one of the main shelly halves of a bivalve.











IDENTIFICATION NOTE

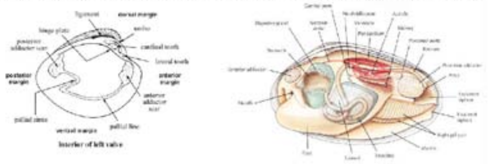
An illustrated key to families of those species included in this guide is included here. After a family is determined by using this key, the user should turn to the descriptive accounts of families and species. Each section on a family includes, in addition to a diagnosis of the family, a key to the species. Furthermore, there are detailed accounts for the most important species given, and abbreviated accounts for species of secondary interest.

For a correct identification of a bivalve species, it is necessary to orientate the shell properly and to distinguish the right valve from the left valve. The area where the mantle lobes are fused together with the visceral mass is considered as dorsal. It is about the same to consider that the hinge and umbones occupy a dorsal position. The anterior margin is then relatively close to the mouth, and the posterior margin close to the anus (see also figures on page 124).

In a bivalve shell it is useful to remember that:

- the pallial sinus, when present, is posterior;
- the centre of adductor scar is posterior in species with only one adductor muscle;
- the external ligament, when stretching along one side of the umbones, is posterior to them.

However, these simple rules do not apply to all species, and sometimes other criteria must be used. In such cases, appropriate features of orientation are depicted in the family or species accounts of this guide.



Key to Families

1a. Only 1 adductor muscle scar in each valve . . . . → 2
1b. Two (sometimes 3) adductor muscle scars in each valve . . . . → 6

2a. Interior of shell partly nacreous, with a non-nacreous border developed at least ventrally . . **Figure A**
2a. Interior of shell, if nacreous, without a non-nacreous border . . . . → 3

3a. Dorsal margin drawn out into ear-shaped or wing-shaped lateral expansions . . . . **Figure B**
3b. Dorsal margin not drawn out into such expansions . . . . → 4

4a. Ligament mainly internal . . . . **Figure C**
4b. Ligament only external . . . . → 5

5a. Hinge with teeth . . . . **Figure D**
5b. Hinge without teeth . . . . **Figure E**

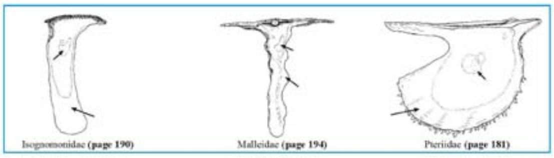


Figure A

Figure A:

Isognomonidae: shell compressed, with a straight dorsal margin, slightly inequivalve. Ligament external, set in a series of transverse grooves along the dorsal margin. Hinge without teeth. Interior partly nacreous. Only 1 adductor muscle scar, with a well-developed pedal retractor scar. Pallial line without a sinus.

Malleidae: shell compressed, irregular in form, more or less elongate dorsoventrally. Dorsal margin often produced at both ends into long, wing-like ears. Ligament set on a transverse median groove. Hinge without teeth. Interior partly nacreous. Only 1 adductor muscle scar, usually with a well-developed pedal retractor scar. Pallial line without a sinus.

Pteriidae: dorsal margin often produced at each end into a wing-like ear, sometimes very long behind. Shell slightly inequivalve. Right valve with a byssal notch anteriorly. Hinge toothless or with denticles. Interior brilliantly nacreous. Only one adductor muscle scar. Pallial line without a sinus.

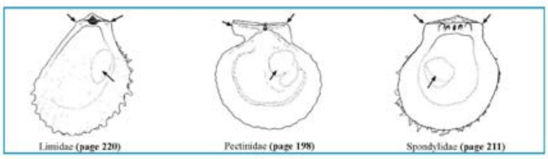


Figure B

Figure B:

Limidae: shell equivalve, higher than long, inequilateral, extended obliquely in an anteroventral direction. Dorsal margin with 2 small ears. Trigonal cardinal area with a median ligamental groove. Hinge toothless. A single adductor muscle scar. Pallial line without a sinus.

Pectinidae: shell more or less inequivalve, ovate to subcircular with a straight dorsal margin forming wing-like ears. A byssal notch and a ctenolium at right valve. Ligament internal, in a small trigonal pit pointing under the umbones. Hinge without teeth. A single adductor muscle scar. Pallial line without a sinus.

Spondylidae: shell stout, usually inequivalve and cemented to substrate by the right valve. Hinge line straight. A trigonal cardinal area, higher in the right valve than in the left. Ligament internal. Hinge with 2 strong teeth and 2 deep sockets in each valve, symmetrically arranged in relation to the internal ligament. A single adductor muscle scar. Pallial line without a sinus.

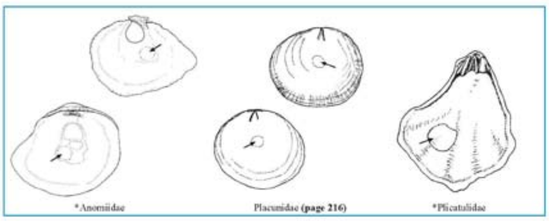


Figure C

Figure C:

*Anomiidae: shell inequivalve, often irregular, adhering to substrate by means of a calcified byssus passing through a hole-like embayment of right valve. Ligament internal. Hinge without teeth. Central area of the interior thickened, with 1 or 2 retractor muscle scars in left valve, in addition to the single adductor scar. No pallial sinus.

Placunidae: shell thin, rounded to saddle-shaped, very compressed laterally, slightly inequivalve. Ligament internal, forming an inverted V-shaped structure. Hinge without teeth. A single adductor muscle scar. Pallial line without a sinus.

*Plicatulidae: shell slightly inequivalve, cemented to substrate by the right valve. Cardinal area small. Ligament internal. Hinge with 2 crenulated teeth and 2 sockets in each valve, symmetrically arranged in relation to the internal ligament. A single adductor muscle scar. No pallial sinus.

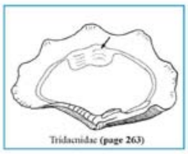


Figure D

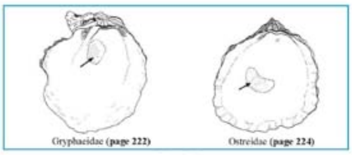


Figure E

Figure D:

Tridacnidae: shell equivalve, thick, heavy and often very large, with strongly scalloped free margins. Umbones ventral, free margins of the valves dorsal-most in position. Byssal gape, when developed, internally plicate. Outer surface with strong radial folds. Ligament external. Hinge with ridge-like cardinal and lateral teeth. A single adductor muscle scar, associated with a pedal retractor scar, submedian in position. Pallial line without a sinus.

Figure E:

Gryphaeidae: shell more or less inequivalve, cemented to substrate by the left valve, with a microscopic vesicular structure. Ligamental area with a shallow median groove. Hinge without teeth. A single adductor muscle scar, closer to the hinge. Internal margins with long, branched, sinuous chomata.

Ostreidae: shell inequivalve, cemented to substrate by the left valve, right valve quite flat. Ligamental area with a shallow median groove and 2 lateral thickenings. Hinge without teeth. A single adductor muscle scar, median in position or nearer to the ventral margin. Internal margins smooth or with simple short chomata.

6a. Shell with calcareous accessory plates or tube and pallets; a finger-like apophysis projecting from the umbonal cavity in each valve . . . . **Figure F**
6b. Shell without calcareous accessory plates or tube and pallets; no finger-like apophysis projecting in either valve . . . . → **7**

7a. Anterior and posterior adductor scars very unequal, the anterior one always small . . . . **Figure G**
7b. Anterior and posterior adductor scars not very unequal . . . . → **8**

8a. Hinge with numerous alternating small teeth and sockets, all or part of them transverse to dorsal margin. . . . . **Figure H**
8b. Hinge not as above . . . . → **9**

9a. Internal ligament present . . . . → **10**
9b. Internal ligament absent . . . . → **11**

10a. Hinge without teeth . . . . **Figure I**
10b. Hinge with well-developed teeth . . . . **Figure J**

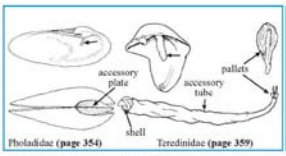


Figure F

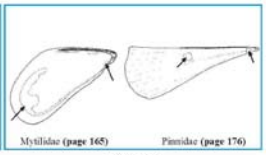


Figure G

Figure F:

Pholadidae: shell subequivalve, gaping. Dorsal margin forming an umbonal reflection. A number of accessory calcareous plates about the main shell. Ligament reduced. Hinge without teeth. A finger-like internal apophysis. Three adductor muscle scars. Pallial line deeply sinuated.

Teredinidae: shell reduced, equivalve, widely gaping. Anteroventral margin with a deep, right-angled notch. Dorsal margin forming an umbonal reflection. Ligament reduced. Hinge without teeth. A finger-like internal apophysis. An internal umbonoventral ridge, with a knob at both ends. Three adductor muscle scars. Accessory calcareous tube lining burrow long, closed by a pair of pallets.

Figure G:

Mytilidae: shell equivalve and very inequilateral, with a byssal gape. Umbones at or near anterior end. Periostracum prominent. Ligament external, deep-set, supported by a whitish ridge. Hinge teeth absent or reduced. Adductor muscle scars unequal, the anterior one small to absent. Pallial line without a sinus. Inner side with an extensive nacreous layer.

Pinnidae: shell brittle, equivalve, subtrigonal, ventrally and posteriorly gaping; very inequilateral, pointed in front. Anterior end eroded and internally closed by small transverse partitions. Ligament linear. Hinge without teeth. Interior with a thin nacreous layer, restricted to the anterior half. Two unequal adductor muscle scars.

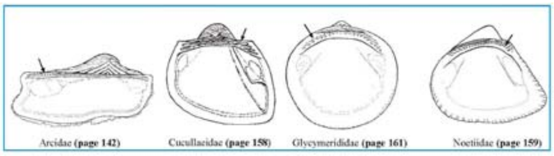


Figure H

Figure H:

Arcidae: shell equivalve or slightly inequivalve, mostly longer than high, more or less inequilateral. Umbones prosogyrate, on top of a wide cardinal area. Ligament external, often with V-shaped grooves. Hinge elongate, almost straight, with numerous small transverse teeth. Two subequal adductor muscle scars. Pallial line without a sinus.

Cucullaeidae: shell inflated, inequilateral, slightly inequivalve. Umbones subcentral, on top of a trigonal cardinal area with chevron-shaped grooves and external ligament. Hinge elongate, straightish, with a series of transverse teeth, and subhorizontal teeth at both ends. Two subequal adductor muscle scars, inner margin of posterior scar on a projecting shelf. Pallial line without a sinus.

Glycymerididae: shell equivalve, closed, subequilateral, rounded in outline. Submedian umbones, on top of a trigonal cardinal area engraved by tent-shaped grooves and covered with external ligament. Hinge arched, bearing a series of teeth diverging outwards. Two subequal adductor muscle scars, their inner margin with a radial ridge. Pallial line without a sinus.

Noetiidae: shell equivalve, generally inequilateral and longer than high. Umbones often opisthogyrate, set apart by a trigonal cardinal area. Ligament external, with oblique grooves and transverse striations. Hinge elongate, straightish, with numerous small transverse teeth. Two subequal adductor muscle scars with a ridge or a shelf along 1 or both scars. Pallial line without a sinus.

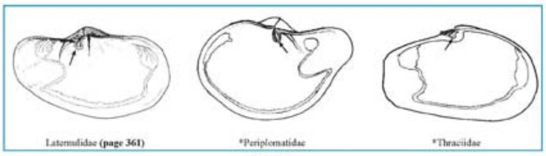


Figure I

Figure I:

Laternulidae: shell thin and brittle, elongate-ovate, truncate to rostrate posteriorly, gaping, subequivalve. Umbones with an obvious median slit. Outer surface finely granulated. Internal ligament attached on protruding spoon-like pits, each supported by an oblique radial ridge. Hinge without teeth. Interior subnacreous. Two adductor muscle scars. Pallial line with a broad sinus.

*Periplomatidae: shell rounded, subrostrate posteriorly, gaping, markedly inequivalve. Umbones with an obvious median slit. Outer surface finely granulated. Internal ligament attached on protruding spoon-like pits, each supported by an oblique buttress. Hinge without teeth. Interior subnacreous. Two adductor muscle scars. Pallial line with a rather deep sinus.

*Thraciidae: shell thin, elongate-ovate, truncate posteriorly, usually closed, subequivalve. Umbones without an obvious median slit. Outer surface finely granulated. Internal ligament attached on trigonal pits, not protruding ventrally nor supported by oblique buttresses. Hinge without teeth. Interior not nacreous. Two adductor muscle scars. Pallial line with a broad sinus.

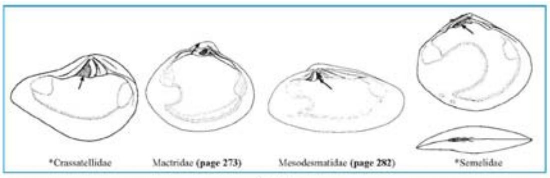


Figure J

Figure J:

*Crassatellidae: shell thick, equivalve. Umbones prosogyrate to orthogyrate. Sculpture mainly concentric. Lunule and escutcheon distinct. Internal ligament in a pit of hinge plate. Hinge with 2 cardinal teeth and lateral teeth. Two adductor muscle scars. Pallial line without a sinus.

Mactridae: shell equivalve. Umbones prosogyrate. Internal ligament well developed, in a trigonal pit of hinge plate. Hinge characteristic, with 2 cardinal teeth and lateral teeth; cardinal teeth of the left valve forming an inverted V-shaped process. Two adductor muscle scars. Pallial line with a well-developed sinus.

Mesodesmatidae: shell equivalve, inequilateral, subtrigonal to wedge-shaped. Umbones opisthogyrate. Internal ligament in a deep pit of hinge plate. One or 2 cardinal teeth and lateral teeth. Two adductor muscle scars. Pallial line with a short sinus.

*Semelidae: shell rather compressed, often slightly inequivalve, with a rightwards flexure posteriorly. Internal ligament in a small pit of hinge plate. Hinge with 2 cardinal teeth and lateral teeth. Two adductor muscle scars. Pallial line with a deep sinus. Cruciform muscles leaving small paired scars near pallial line.

11a. Hinge teeth and corresponding sockets more or less parallel to dorsal margin. . . . . . . **Figure K**
11b. Hinge teeth and corresponding sockets not parallel to dorsal margin. . . . . → **12**

12a. Shell more than twice longer than high, widely gaping anteriorly and posteriorly. . . . . . **Figure L**
12b. Shell not as above . . . . → **13**

13a. Anterior adductor scar elongate, with an oblique ventral lobe detached from pallial line . . **Figure M**
13b. Anterior adductor scar, if elongate, not with an oblique ventral lobe detached from pallial line . . . . → **14**

14a. Hinge with 3 cardinal teeth, at least in the left valve . . . . **Figure N**
14b. Hinge with no more than 2 cardinal teeth in either valve . . . . → **15**

15a. Pallial line with a sinus . . . . **Figure O**
15b. Pallial line without a sinus. . . . . → **16**

16a. Main sculpture of radial ribs . . . . **Figure P**
16b. Main sculpture concentric; radial ribs, when present, crossed by stronger concentric ridges . . **Figure Q**

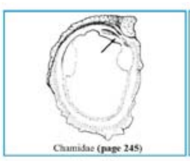


Figure K

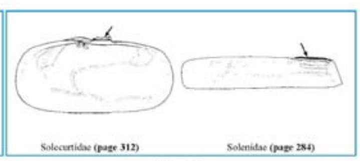


Figure L

Figure K:

Chamidae: shell thick, strongly inequivalve and inequilateral; very variable in shape, cemented to substrate by either the left or the right valve. Umbones prosogyrate, low, spirally wound. Ligament external. Hinge with large, curved teeth and corresponding sockets, more or less parallel to dorsal margin. Two subequal adductor muscle scars. Pallial line without a sinus.

Figure L:

Solecurtidae: shell equivalve, elongate-quadrate, widely gaping at both ends. Umbones subcentral. Ligament external, on projecting nymphs. Two cardinal teeth in either valve. Two adductor muscle scars. Pallial sinus deep.

Solenidae: shell equivalve, with a narrowly elongate shape, gaping at both ends. Umbones more or less near the anterior end. Ligament external. Hinge feeble. Two adductor muscle scars, the anterior one larger. Pallial sinus relatively shallow.

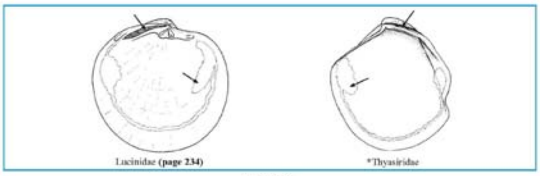


Figure M

Figure M:

Lucinidae: shell equivalve, lenticular, slightly inequilateral. Ligament more or less deeply sunken in posterodorsal margin. Two cardinal teeth and lateral teeth in either valve, sometimes reduced to absent. Two adductor muscle scars, the anterior narrowly elongate with an oblique ventral lobe detached from pallial line. No pallial sinus.

*Thyasiridae: shell equivalve, thin, trigonal, inequilateral. Posterior part of valves set off by 1 or more deep radial furrows or folds. Ligament marginal. Hinge teeth obsolete to absent. Two adductor muscle scars, the anterior elongate, with an oblique ventral lobe detached from pallial line. No pallial sinus.

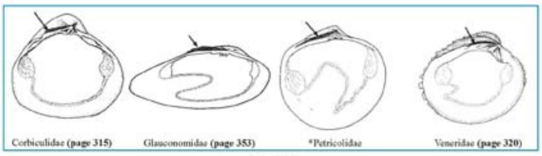


Figure N

Figure N:

Corbiculidae: shell equivalve, solid, umbones prosogyrate. No lunule nor escutcheon. Periostracum conspicuous. Ligament external. Three diverging cardinal teeth in each valve, and strong anterior and posterior lateral teeth. Two adductor muscle scars. Pallial sinus reduced to absent.

Glauconomidae: shell equivalve, gaping posteriorly, inequilateral. No lunule nor escutcheon. A conspicuous, greenish periostracum. Ligament external. Three cardinal teeth in each valve, lateral teeth wanting. Two adductor muscle scars. Pallial sinus deep and narrow.

*Petricolidae: shell equivalve, inequilateral, with prosogyrate umbones. No lunule nor escutcheon. Three cardinal teeth in left valve and only 2 in right valve; lateral teeth wanting. Two adductor muscle scars. Pallial sinus deep.

Veneridae: shell mostly solid, equivalve, inequilateral, with prosogyrate umbones. Lunule and/or escutcheon usually present. Ligament external. Three cardinal teeth in each valve, anterior lateral teeth sometimes present. Two adductor muscle scars. Pallial sinus usually present.

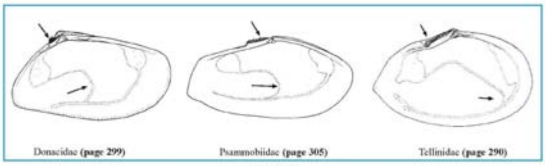


Figure O

Figure O:

Donacidae: shell equivalve, trigonal to wedge-shaped, with a shorter posterior end. Umbones opisthogyrate. Ligament external. Two small cardinal teeth and lateral teeth. Two adductor muscle scars. Pallial sinus deep. Cruciform muscle scars obscure.

Psammobiidae: shell ovate to subelliptical or trapezoidal, somewhat gaping. Ligament external, on projecting nymphs. Two small cardinal teeth in either valve; lateral teeth absent. Two adductor muscle scars. Pallial sinus deep. Cruciform muscle scars often obscure.

Tellinidae: shell rather thin and compressed, often slightly inequivalve, with a rightwards flexure on posterior end. Ligament external. Two small cardinal teeth in either valve; lateral teeth often present. Two adductor muscle scars. Pallial sinus deep. Cruciform muscles leaving small paired scars near pallial line.

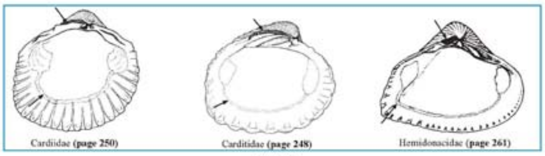


Figure P

Figure P:

Cardiidae: shell equivalve, inflated, oval to subquadrate, sometimes heart-shaped. Umbones prominent. External sculpture mostly radial. Ligament external. Hinge characteristic, with teeth curving outwards; 2 cardinal teeth and lateral teeth in each valve; cardinal teeth cruciform in arrangement. Two adductor muscle scars. Pallial line without a sinus.

Carditidae: shell equivalve, stout and inflated, inequilateral. Exterior mostly with radial ribs. Ligament external. Two cardinal teeth, unequal and with fine transverse striations; lateral teeth frequently reduced to absent. Two adductor muscle scars. Pallial line without a sinus.

Hemidonacidae: shell equivalve, subtrigonal to wedge-shaped and transversely elongate, more or less inequilateral. Outer surface with smooth radial ribs, often reduced on the anterior part of shell. Ligament external. Two cardinal teeth and elongate lateral teeth in each valve. Two adductor muscle scars. Pallial line without a sinus.

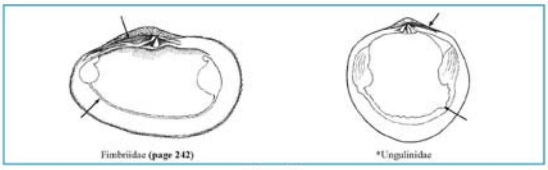


Figure Q

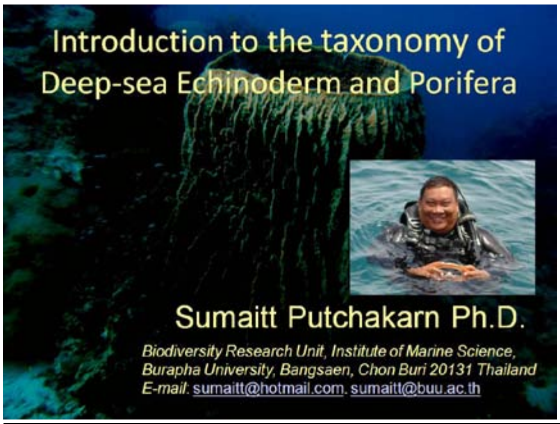
Figure Q:

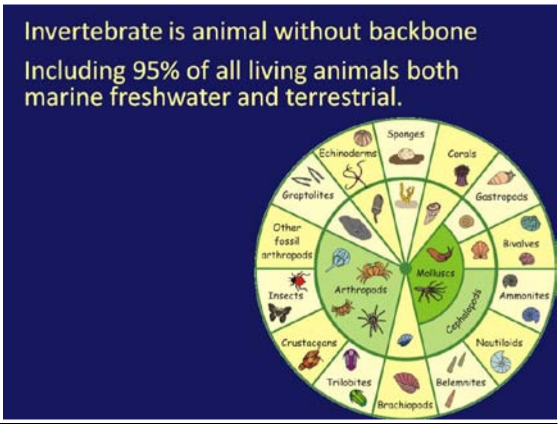
Fimbriidae: shell equivalve, inflated, thick, transversely elliptical. Lunule lanceolate, escutcheon narrow. Outer surface with latticed sculpture, concentric ribs more prominent. Ligament marginal. Two massive cardinal teeth, one nearby anterior lateral tooth, and one long, remote posterior lateral tooth in each valve. Two adductor muscle scars. Pallial line devoid of sinus.

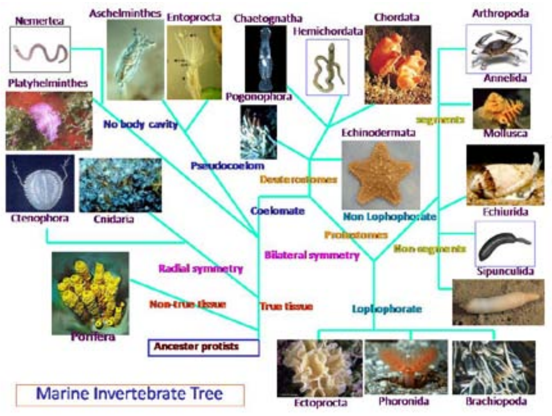
*Ungulinidae: shell equivalve, lenticular, slightly inequilateral. Ligament external, not sunken in a marginal groove. Two cardinal teeth in either valve, lateral teeth reduced to absent. Two adductor muscle scars, the anterior elongate but without an oblique ventral lobe detached from pallial line. No pallial sinus.

Annex 13: Introduction to the taxonomy of Deep-Sea Echinoderm and Porifera

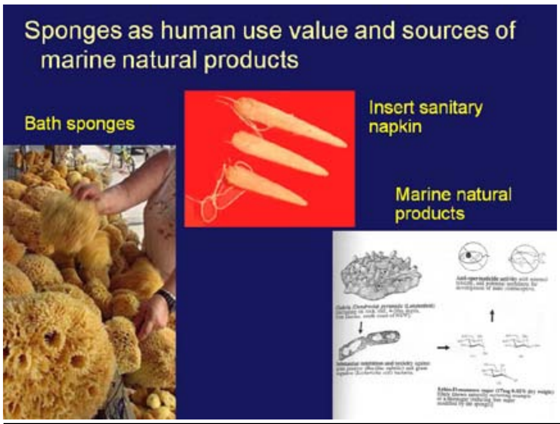
By Dr. Sumaitt Putchakarn

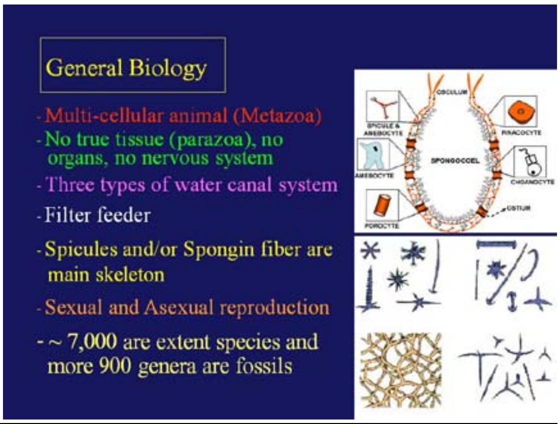

Introduction to the taxonomy of
Deep-sea Echinoderm and Porifera
Sumaitt Putchakarn Ph.D.
Biodiversity Research Unit, Institute of Marine Science,
Burapha University, Bangsaen, Chon Buri 20131 Thailand
E-mail: sumaitt@hotmail.com, sumaitt@buu.ac.th

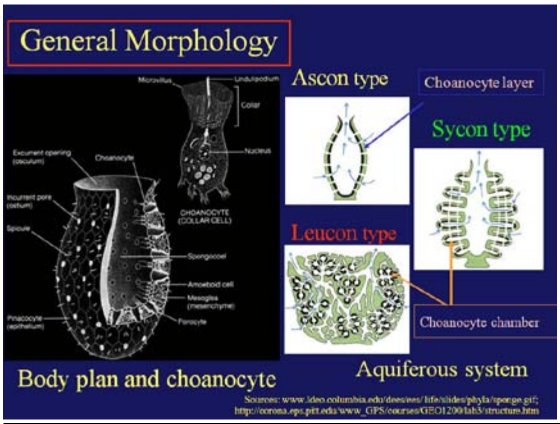

Invertebrate is animal without backbone
Including 95% of all living animals both marine freshwater and terrestrial.
Sponges
Corals
Echinoderms
Graptolites
Gastropods
Other fossil arthropods
Bivalves
Molluscs
Arthropods
Insects
Ammonites
Cephalopods
Crustaceans
Nautiloids
Trilobites
Belemnites
Brachiopods

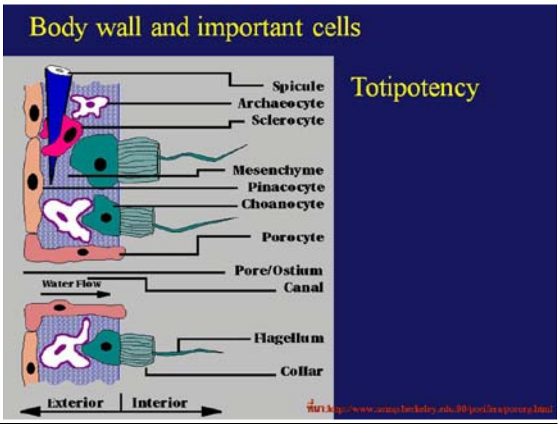

Nemertea
Aschelminthes
Entoprocta
Chaetognatha
Hemichordata
Chordata
Arthropoda
Platyhelminthes
Pogonophora
Annelida
No body cavity
segments
Mollusca
Echinodermata
Pseudocoelom
Deuterostomes
Ctenophora
Cnidaria
Coelomate
Non Lophophorate
Echiurida
Protostomes
Bilateral symmetry
Non segments
Radial symmetry
Sipunculida
Non-true tissue
True tissue
Lophophorate
Porifera
Ancester protists
Marine Invertebrate Tree
Ectoprocta
Phoronida
Brachiopoda

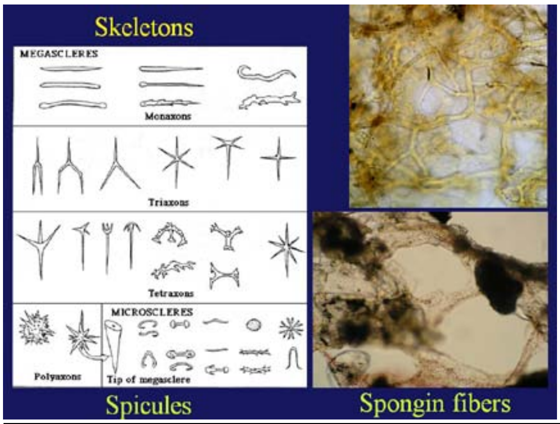

Phylum Porifera,
sponges

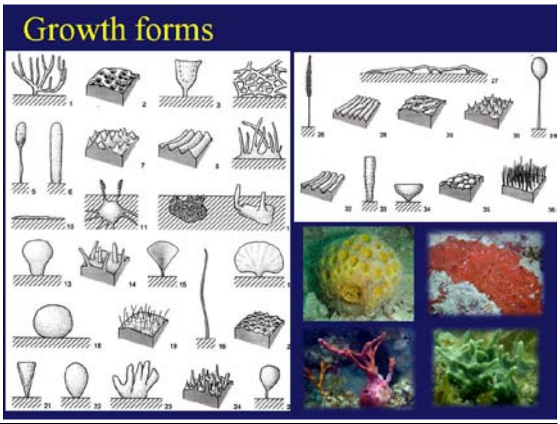

Sponges as human use value and sources of marine natural products
Bath sponges
Insert sanitary napkin
Marine natural products

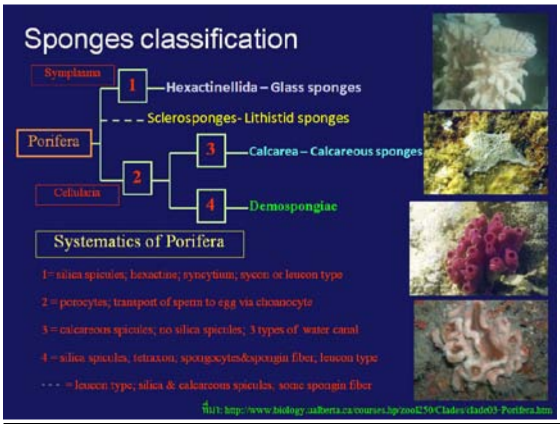

General Biology
- Multi-cellular animal (Metazoa)
- No true tissue (parazoa), no organs, no nervous system
- Three types of water canal system
- Filter feeder
- Spicules and/or Spongin fiber are main skeleton
- Sexual and Asexual reproduction
- ~ 7,000 are extent species and more 900 genera are fossils
OSCULUM
SPONGOCOEL
PINACOCYTE
CHOANOCYTE
POROCYTE
OSTIUM


General Morphology
Ascon type
Choanocyte layer
Sycon type
Leucon type
Choanocyte chamber
Body plan and choanocyte
Aquiferous system
Sources: www.ldeo.columbia.edu/dees/ees/life/slides/phyla/sponge.gif;
http://corona.eps.pitt.edu/www_GPS/courses/GEO1200/lab3/structure.htm

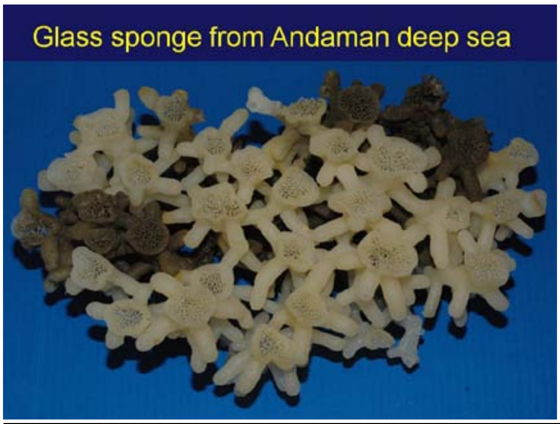

Body wall and important cells
Totipotency
Spicule
Archaeocyte
Sclerocyte
Mesenchyme
Pinacocyte
Choanocyte
Porocyte
Pore/Ostium
Water Flow
Canal
Flagellum
Collar
Exterior
Interior


Skeletons
MEGASCLERES
Monaxons
Triaxons
Tetraxons
MICROSCLERES
Polyaxons
Tip of megasclere
Spicules
Spongin fibers

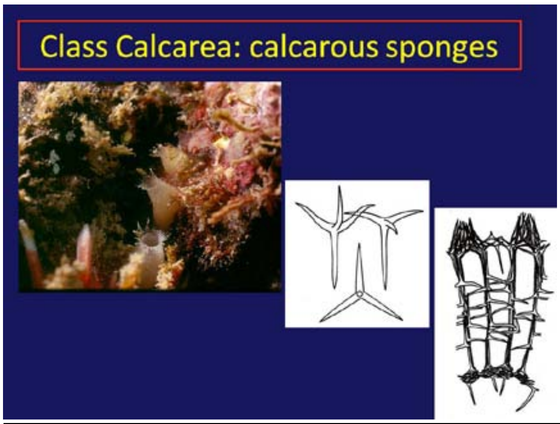

Growth forms

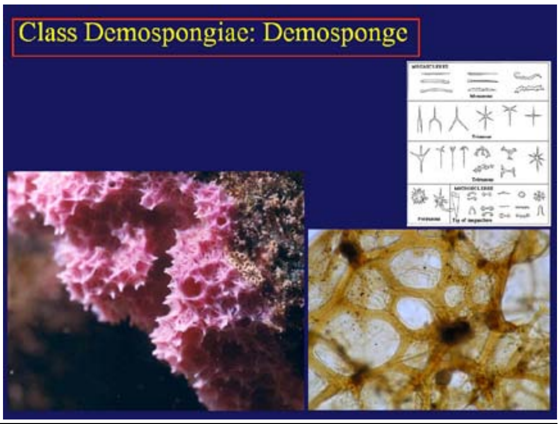

Sponges classification
Symplasma
Porifera
Cellularia
1 Hexactinellida – Glass sponges
Sclerosponges- Lithistid sponges
2
3 Calcarea – Calcareous sponges
4 Demospongiae
Systematics of Porifera
1= silica spicules; hexactine; syncytium; sycon or leucon type
2 = porocytes; transport of sperm to egg via choanocyte
3 = calcareous spicules; no silica spicules; 3 types of water canal
4 = silica spicules; tetraxon; spongocytes&spongin fiber; leucon type
- - - = leucon type; silica & calcareous spicules, some spongin fiber

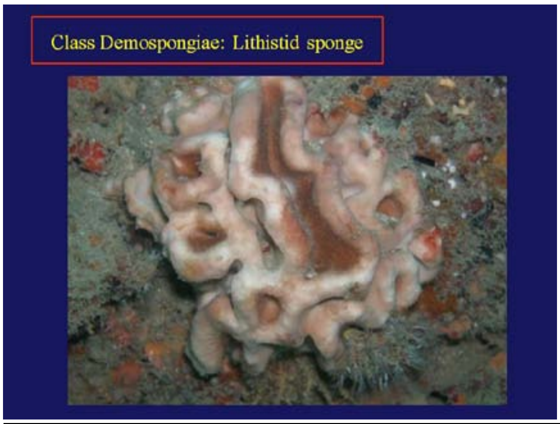

Class Hexactinellida: Glass sponges


Glass sponge from Andaman deep sea

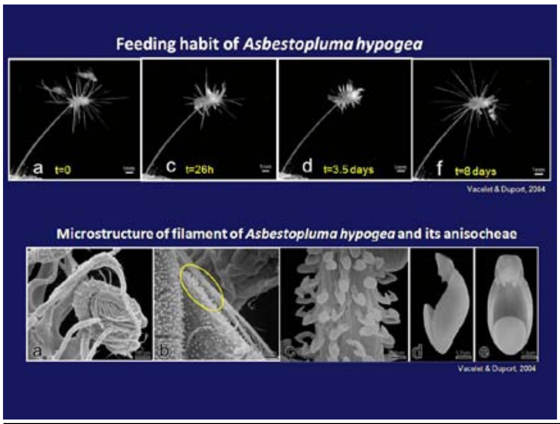

Glass sponge from Brubnei deep sea

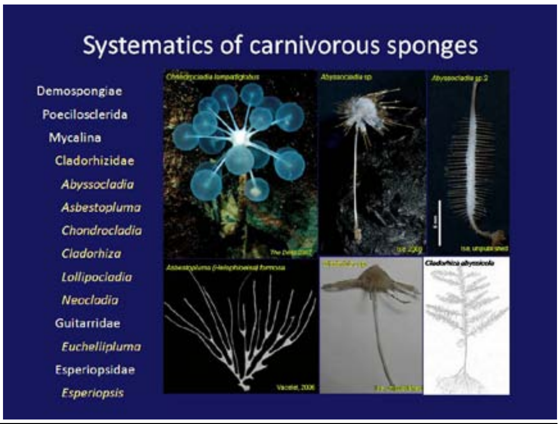

Class Calcarea: calcarous sponges


Class Demospongiae: Demosponge

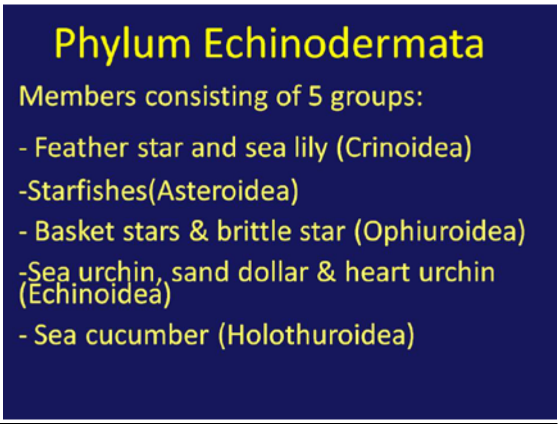

Class Demospongiae: Lithistid sponge


nature
A carnivorous sponge
Vacelet & Boury-Esnault, 1995

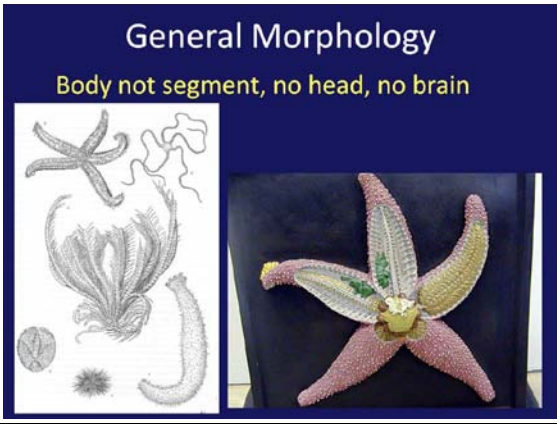

Feeding habit of Asbestopluma hypogea
a t=0
c t=26h
d t=3.5 days
f t=8 days
Vacelet & Duport, 2004
Microstructure of filament of Asbestopluma hypogea and its anisocheae
Vacelet & Duport, 2004


Systematics of carnivorous sponges
Demospongiae
Poecilosclerida
Mycalina
Cladorhizidae
Abyssocladia
Asbestopluma
Chondrocladia
Cladorhiza
Lollipocladia
Neocladia
Guitarridae
Euchelipluma
Esperiopsidae
Esperiopsis

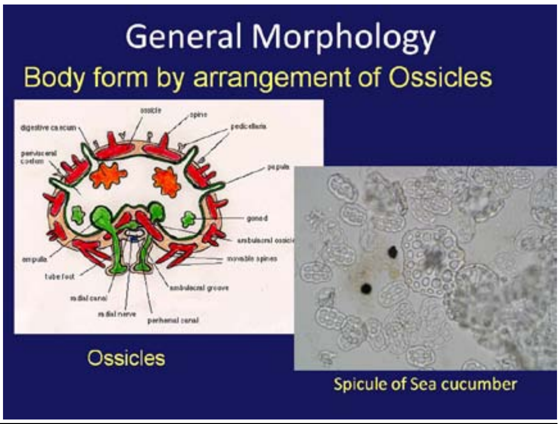

Abyssocladia sp.1 nov.
collected by ROV Hyper-Dolphin
from Myojin-Knoll, Izu-Ogasawara Trench
862m depth.

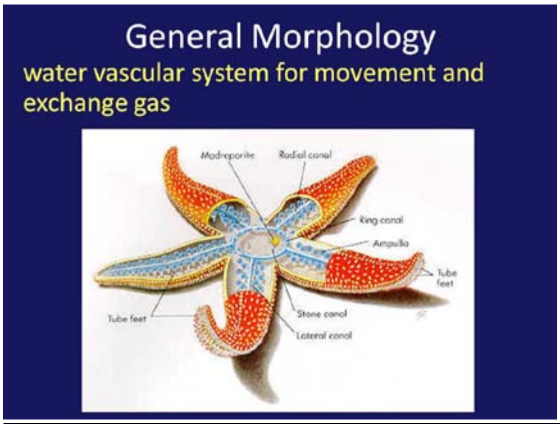

Phylum Echinodermata
Members consisting of 5 groups:
- Feather star and sea lily (Crinoidea)
-Starfishes(Asteroidea)
- Basket stars & brittle star (Ophiuroidea)
-Sea urchin, sand dollar & heart urchin (Echinoidea)
- Sea cucumber (Holothuroidea)

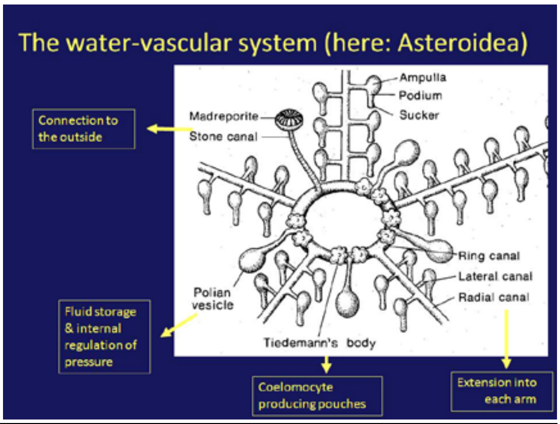

General Morphology
Adult pentamerous radial symmetry

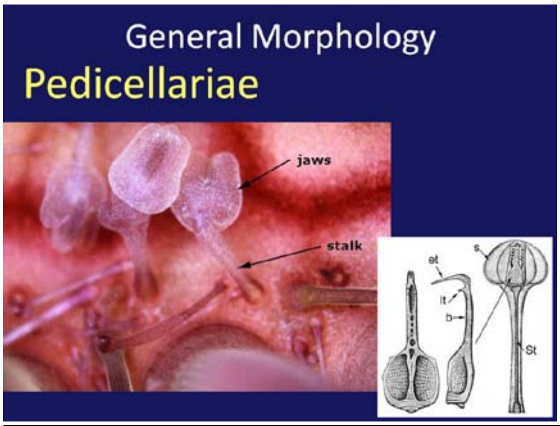

General Morphology
Body not segment, no head, no brain

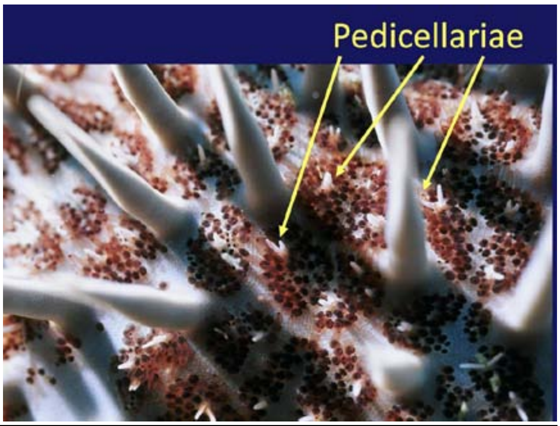

General Morphology
Body forms: star-like (Asteroidea, Ophiuroidea, Crinoidea); oval & hemispere (Echinoidea) & Cylindrical (Holothuroidea)

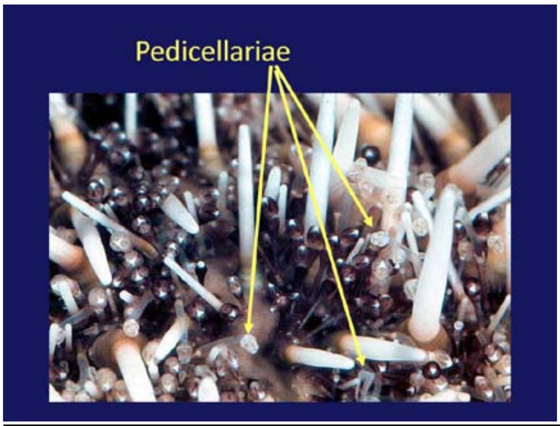

General Morphology
Body form by arrangement of Ossicles
Ossicles
Spicule of Sea cucumber

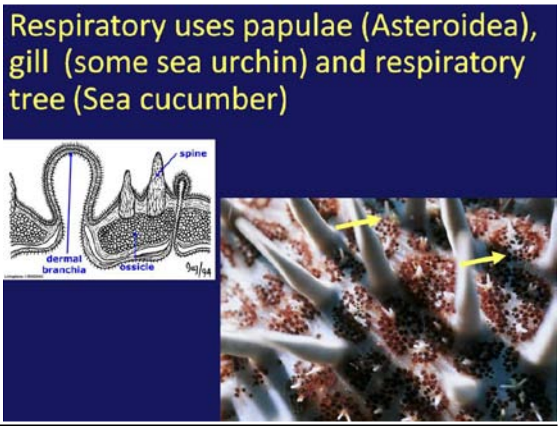

General Morphology
water vascular system for movement and exchange gas
Madreporite
Radial canal
Ring canal
Ampulla
Tube feet
Tube feet
Stone canal
Lateral canal


The water-vascular system (here: Asteroidea)
Ampulla
Podium
Sucker
Connection to the outside
Madreporite
Stone canal
Ring canal
Lateral canal
Radial canal
Polian vesicle
Fluid storage & internal regulation of pressure
Tiedemann's body
Coelomocyte producing pouches
Extension into each arm

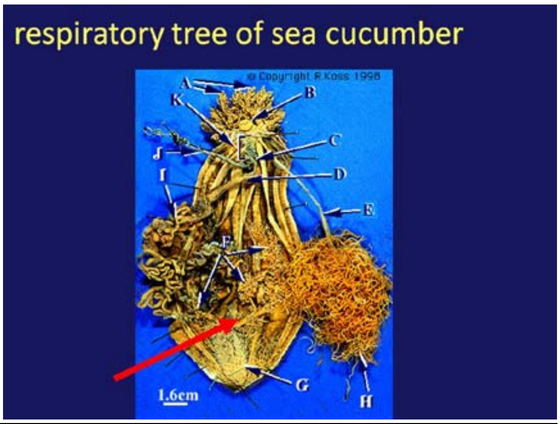

General Morphology
Pedicellariae
jaws
stalk

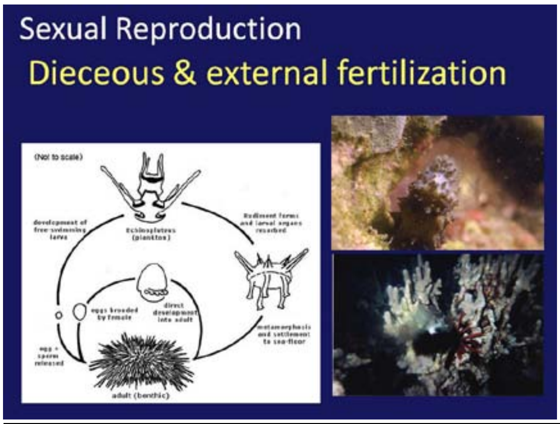

Pedicellariae

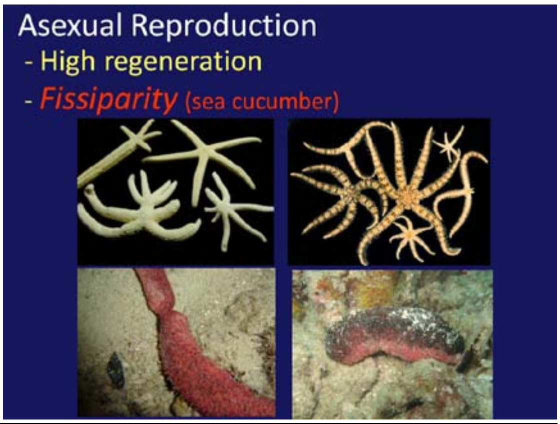

Pedicellariae


Respiratory uses papulae (Asteroidea), gill (some sea urchin) and respiratory tree (Sea cucumber)
spine
dermal branchia
ossicle


Gills of Sea urchin


respiratory tree of sea cucumber
1.6cm


Sexual Reproduction
Dieceous & external fertilization


Asexual Reproduction
- High regeneration
- Fissiparity (sea cucumber)


Feeding behavior
Predator
Suspension feeder
detritus feeder


Ecology
All echinoderms are marine and distribute from coastal to deep sea

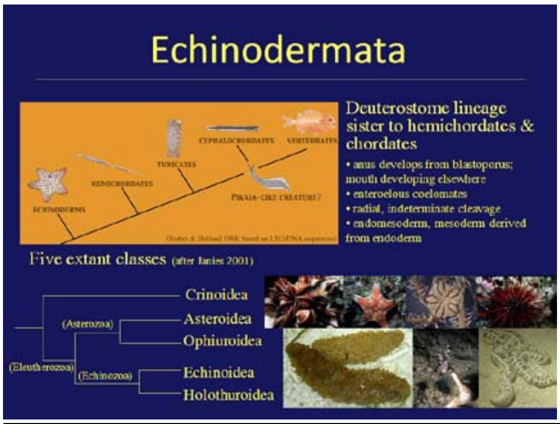

Important
- Echinoderms as food and fertilizer

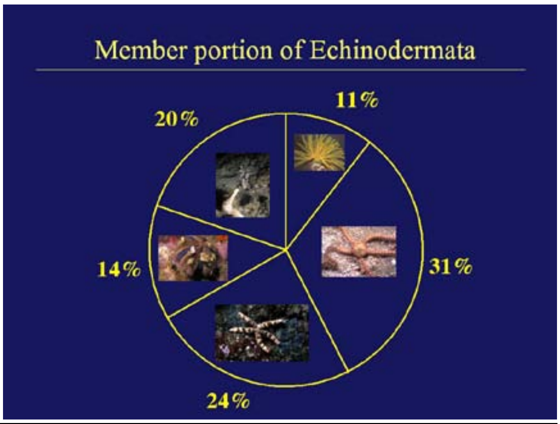

- Sea urchin egg


- Sea cucumber

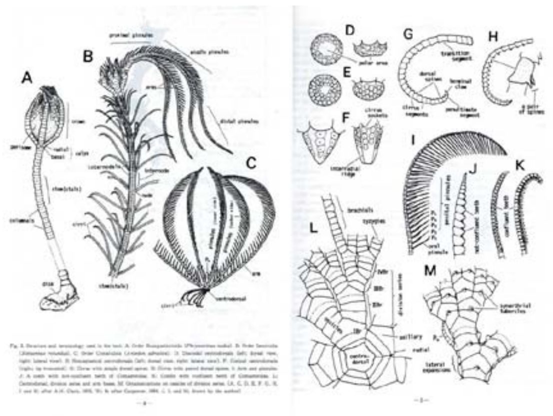

Crown of Thorn starfish outbreak in Coral reef

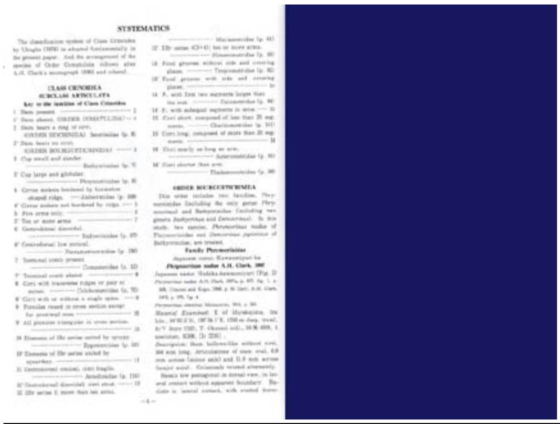

Sea cucumber product
TOOTHPASTE
Dr.RODZI'S
formula


Echinodermata
Deuterostome lineage
sister to hemichordates &
chordates
• anus develops from blastoporus;
mouth developing elsewhere
• enterocelous coelomates
• radial, indeterminate cleavage
• endomesoderm, mesoderm derived
from endoderm
Five extant classes (after Janies 2001)
Crinoidea
(Asterozoa)
Asteroidea
Ophiuroidea
(Eleutherozoa)
(Echinozoa)
Echinoidea
Holothuroidea

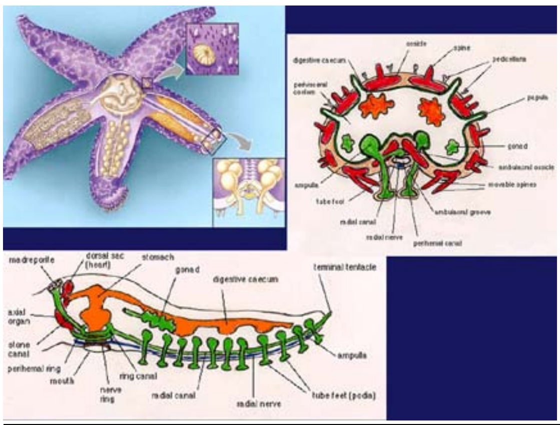

Member portion of Echinodermata
11%
20%
14%
31%
24%

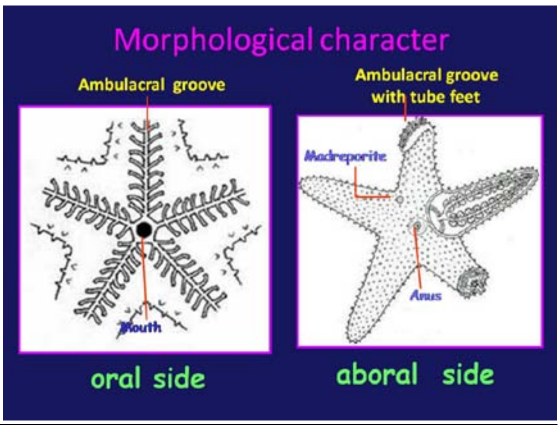

Phylum Echinodermata
Divided into 5 Clases:
Crinoidea: Sea lily, feather star


A
B
C
D
E
F
G
H
I
J
K
L
M

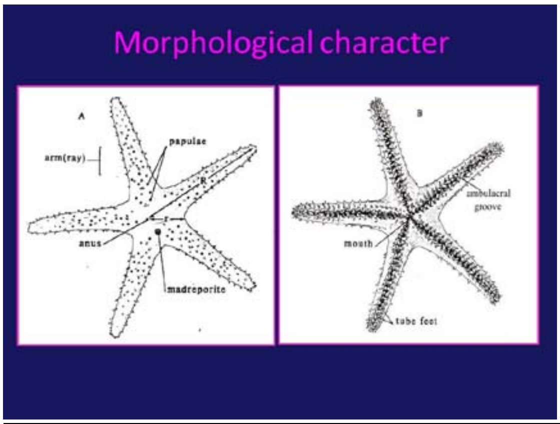

SYSTEMATICS

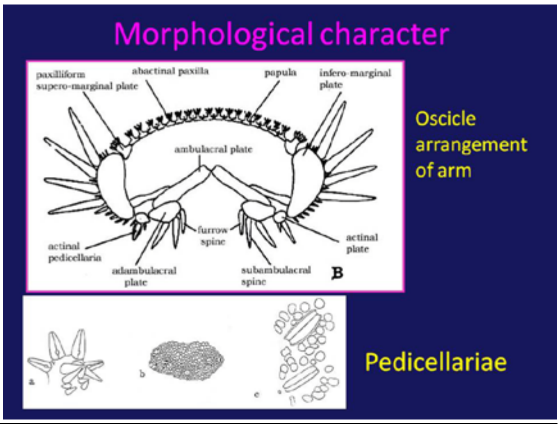
Starfishes (Asteroidea)

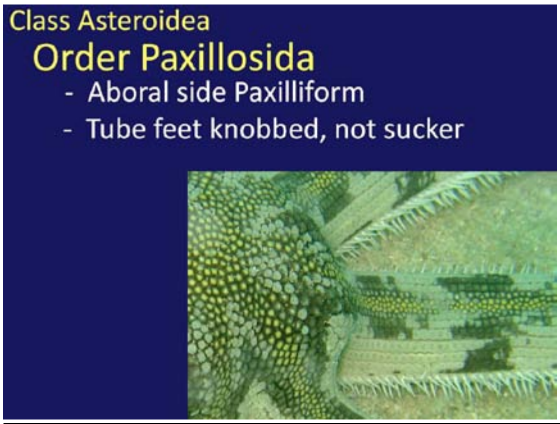


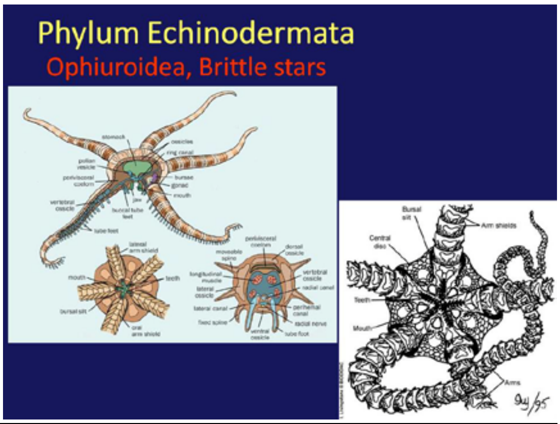


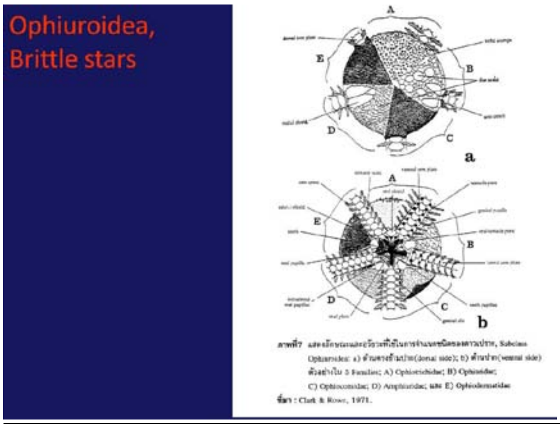
(continued) **Annex 13**

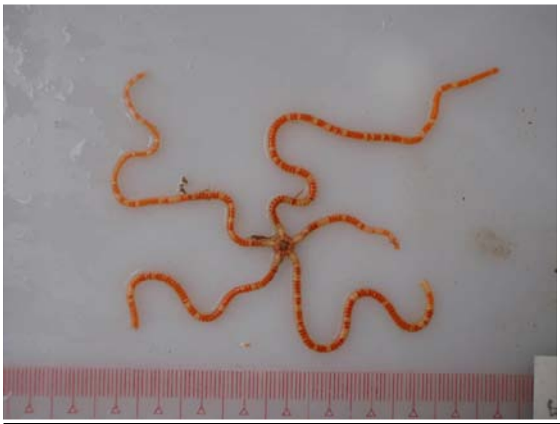


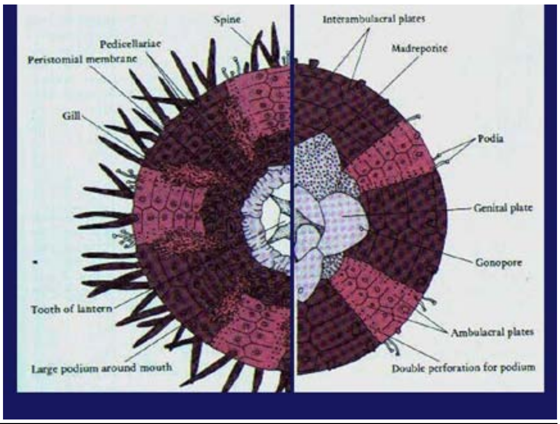


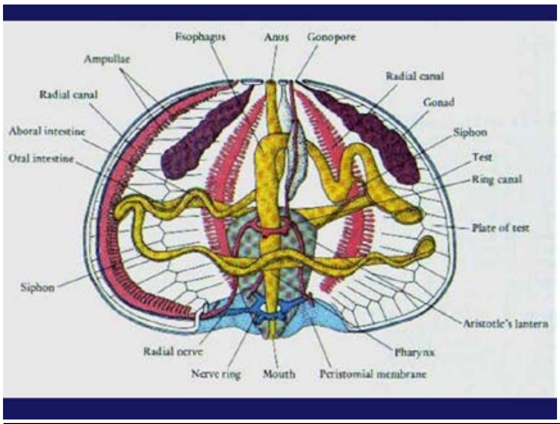


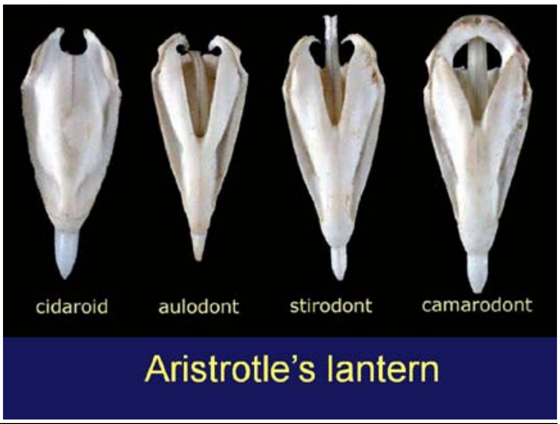

Phylum Echinodermata
Ophiuroidea, Brittle stars

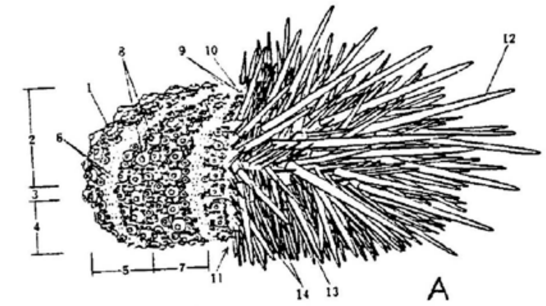

Ophiuroidea,
Brittle stars




Spine
Interambulacral plates
Pedicellariae
Peristomial membrane
Madreporite
Gill
Podia
Genital plate
Gonopore
Tooth of lantern
Ambulacral plates
Large podium around mouth
Double perforation for podium

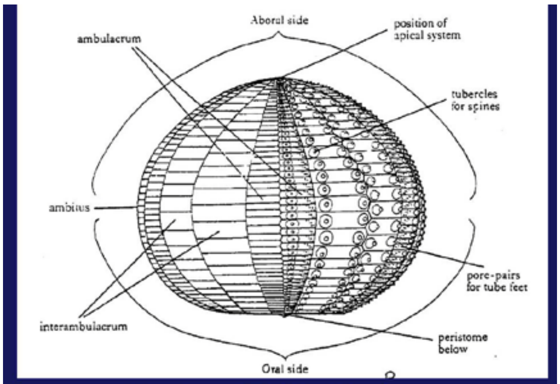

Esophagus
Anus
Gonopore
Ampullae
Radial canal
Radial canal
Gonad
Aboral intestine
Oral intestine
Siphon
Test
Ring canal
Plate of test
Siphon
Aristotle's lantern
Radial nerve
Pharynx
Nerve ring
Mouth
Peristomial membrane


cidaroid
aulodont
stirodont
camarodont
Aristrotle's lantern

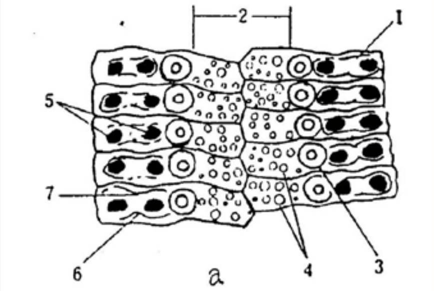


A: ลักษณะภายนอกของเม่นทะเล

1) test; 2) aboral side; 3) ambitus; 4) oral side; 5) ambulacrum; 6) pore pair; 7) interambulacrum; 8) tubercle; 9) apical system; 10) periproct; 11) peristome; 12) primary spine; 13) secondary spine; 14) miliary spine.

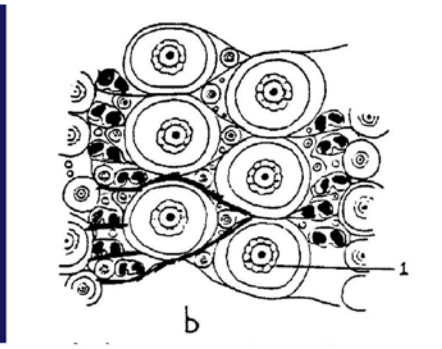


ลักษณะของเปลือกเม่นทะเล (Echinoidea)

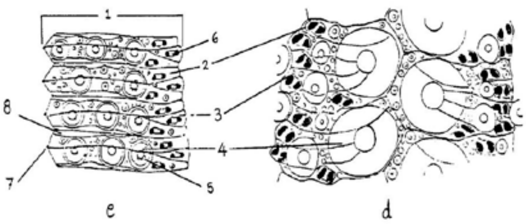


a) ambulacrum ที่มี ambulacral plate แบบธรรมดา

1) ambulacral plate; 2) median area; 3) primary tubercle; 4) miliary tubercles; 5) pore pair; 6) wall between pores; 7) upper ride.



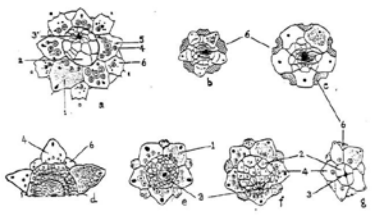
b) ambulacrum ที่มี ambulacral plate แบบแผ่นผสม Diadematoid type ที่มีแผ่นสมบูรณ์ 3 แผ่น; 1) crenulation.



c) ambulacrum ที่มี ambulacral plate แบบแผ่นผสม Echinoid type ที่มี demiplate 1 แผ่น

1) ambulacral plate; 2) primary plate; 3) demiplate; 4) primary tubercle; 5) crenulation; 6) pore pair; 7) angular pore; 8) pit.

d) ambulacrum ที่มี ambulacral plate แบบแผ่นผสม Echinoid type ที่มี demiplate มากกว่า 1 แผ่น



ภาพที่ 11 แสดงลักษณะของ apical system แบบต่าง ๆ ของเม่นทะเล

a)ลักษณะทั่วไป: 1) madreporite; 2) periproctal plate; 3) anal opening; 4) genital plate; 5) genital pore; 6) ocular plate; 7) periproct.

b)แบบ monocyclic ที่ ocular plate ติดกับ periproct.

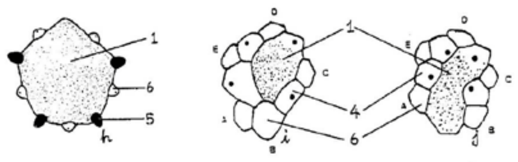
c)แบบ dicyclic ที่ ocular plate ไม่ติดกับ periproct จนทำให้เกิดเป็นวงแหวนของแผ่นหินปูน 2 วง

d)แบบ monocyclic ของ *Echinothrix calamalis*

e)แบบ dicyclic ของ *Salmacis virgulata* ที่มี anal opening อยู่ตรงกลาง

f)แบบ dicyclic ของ *Salmaciella dussumieri* ที่มี anal opening อยู่ติดขอบของ periproct

g)แบบ dicyclic ของ *Parasalenia gratiosa*



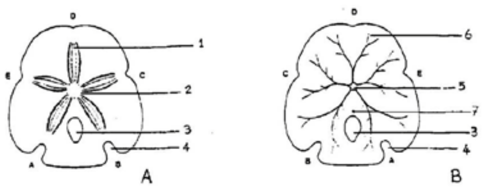
ภาพที่ 11 แสดงลักษณะของ apical system แบบต่าง ๆ ของเม่นทะเล

a)ลักษณะทั่วไป: 1) madreporite; 2) periproctal plate; 3) anal opening; 4) genital plate; 5) genital pore; 6) ocular plate; 7) periproct.

h)apical system ของเหรียญทะเล, *Arachnoides placenta* ตัวแทนใน Order Clypeasteroida ที่ genital plates เชื่อมรวมกันเป็นท่อตะแกรงน้ำ (madreporite)

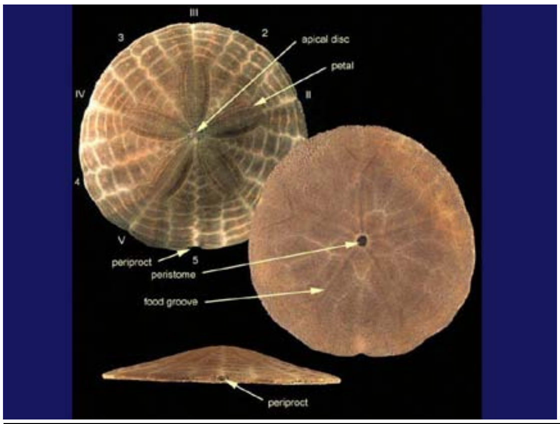
i)แบบ ethmophract ของเม่นหัวใจ ใน Order Spatangoida ที่ ocular plate บรรจบกัน

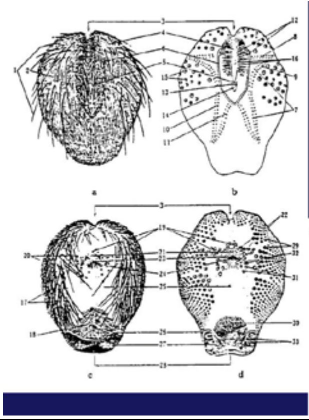
j)แบบ ethmolytic ของเม่นหัวใจ ใน Order Spatangoida ที่ท่อตะแกรงน้ำมีขนาดใหญ่และแยก ocular plate ออกจากกัน



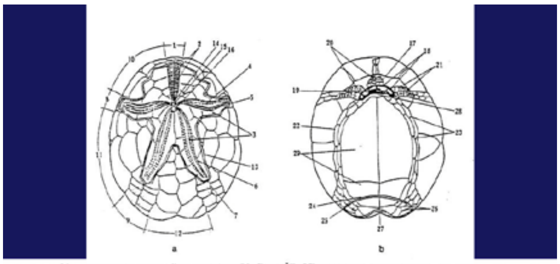
ภาพที่ 13 แสดงลักษณะโครงสร้างเปลือกของเหรียญทะเล A) aboral side; B) oral side

1) petal; 2) apical system; 3) lunule ที่อยู่ภายใน; 4) lunule ที่เปิดออกภายนอก; 5) mouth; 6) food groove; 7) anas.

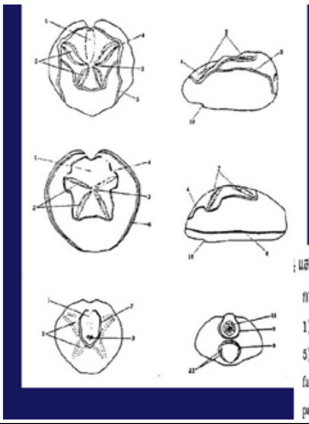




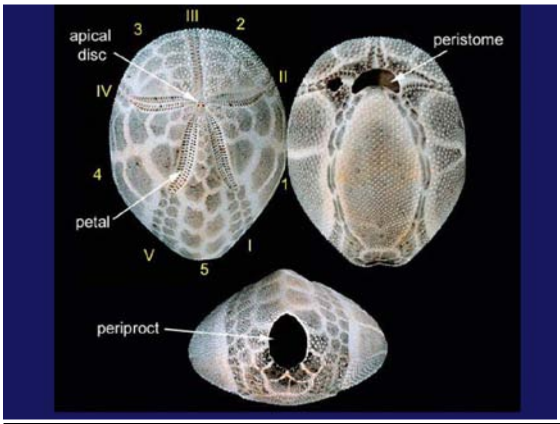
แสดงลักษณะของเปลือกเม่นหัวใจที่ใช้ในการจำแนกชนิด ของ Family Loveniidae, *Lovenia elongata*; a) aboral side, b) aboral side ของเปลือก, c) oral side, d) oral side ของเปลือก.
1) large primary spine; 2) aboral spine; 3) frontal notch; 4) frontal ambulacrum; 5) apical system; 6) interfasciole; 7) petals; 8) anterior pore-series of anterior petal; 9) posterior pore-series of anterior petal; 10) anterior pore-series of posterior petal; 11) posterior pore-series of posterior petal; 12) pore-series of frontal ambulacrum; 13) genital pore; 14) madreporite; 15) large primary tubercle; 16) smaller tubercle; 17) large oral spine; 18) spine on sternal system; 19); phyllodes 20) penicillate podia; 21) peristome; 22) peristomial plates; 23) mouth; 24) labrum; 25) sternal system; 26) subanal fasciole; 27) subanal region; 28) periproct; 29) large oral tubercle; 30) tubercle on sternal system; 31) pore of phyllodes; 32) sphaeridia; 33) subanal pore pair.

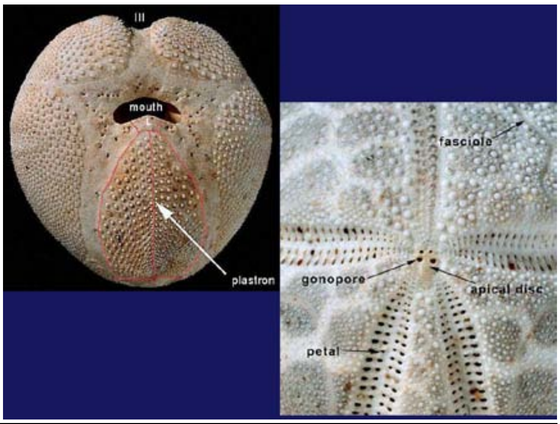


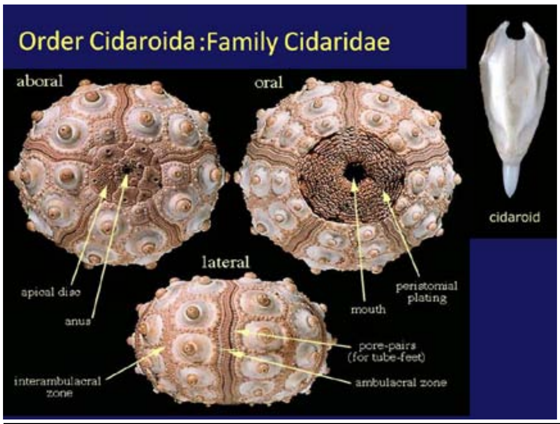
แสดงลักษณะของเปลือกเม่นหัวใจที่ใช้ในการจำแนกชนิด ของ Family Brissidae, *Brissus agassizii*; a) aboral side, b) oral side.
1) frontal ambulcrum; 2) pore-series of frontal ambulacrum; 3) petals; 4) anterior pore-series of anterior petal; 5) posterior pore-series of anterior petal; 6) anterior pore-series of posterior petal; 7) posterior pore-series of posterior petal; 8) antero-lateral ambulacrum; 9) postero-lateral ambulacrum; 10); antero-lateral interambulacrum; 11) postero-lateral interambulacrum; 12) posterior interamburacrum; 13) peripetalous fasciole; 14) apical system; 15) genital pore; 16) madreporite; 17) peristome; 18) peristomial plate; 19)mouth; 20) phyllodes; 21) pore of phyllodes; 22) posterior ambulacrum; 23) pore of posterior ambulacra; 24) subanal fasciole; 25) subanal region; 26) subanal pore pairs; 27) periproct; 28) labrum; 29) sternal system.



; แสดงตำแหน่งของแถบหนามเล็กละเอียด(fasciole)และอวัยวะที่ใช้ในการจำแนกชนิดของเม่นหัวใจ Order Spatangoida
1) frontal ambulacrum; 2) petals; 3) genital pore; 4) peripetalous fasciole; 5) latero-anal fasciole; 6) marginal fasciole; 7) innerfasciole; 8) subanal fasciole; 9) anal fasciole; 10) labrum; 11) periproct; 12) subanal pore pair.



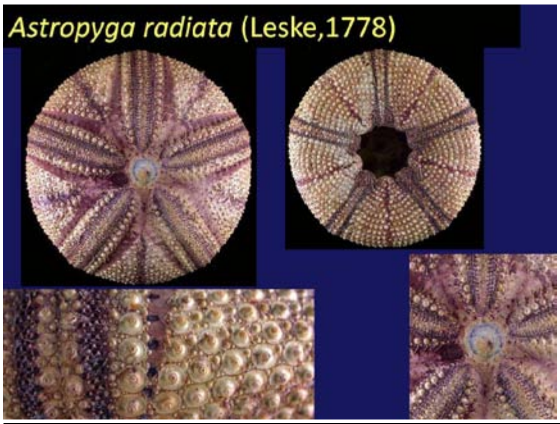


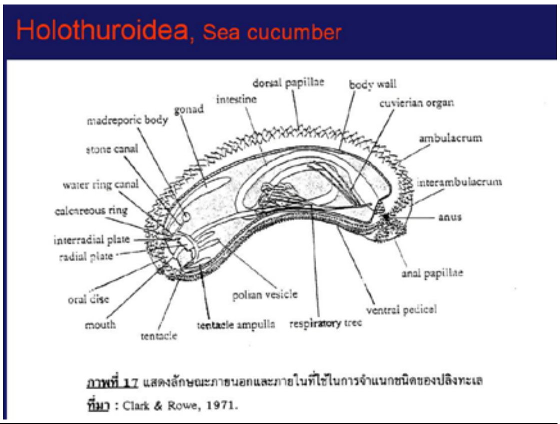


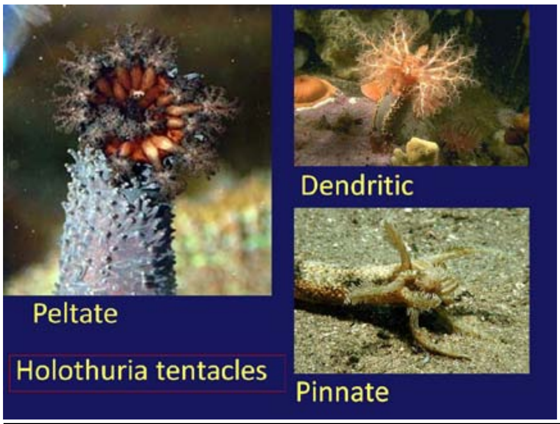
Prionocidaris bispinosa (Lamarck, 1816)


Prionocidaris bispinosa (Lamarck, 1816)

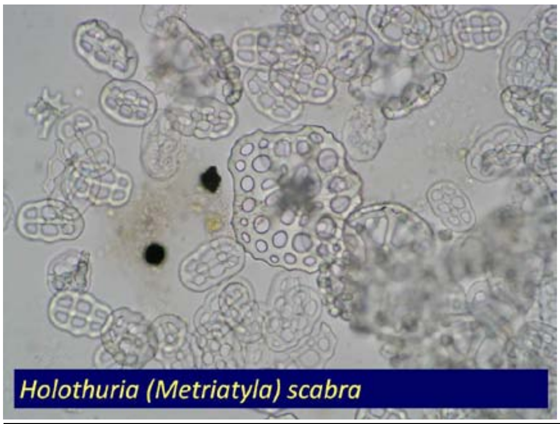

Astropyga radiata (Leske,1778)

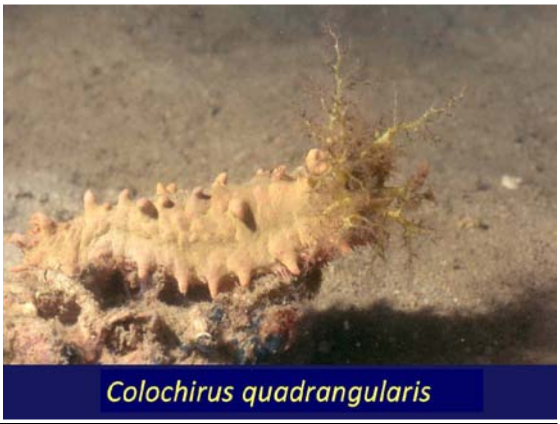

Astropyga radiata (Leske,1778)


Holothuroidea, Sea cucumber
dorsal papillae
body wall
intestine
cuvierian organ
gonad
madreporic body
ambulacrum
stone canal
water ring canal
interambulacrum
calcareous ring
anus
interradial plate
radial plate
anal papillae
oral disc
polian vesicle
ventral pedicel
mouth
tentacle ampulla
respiratory tree
tentacle
ภาพที่ 17 แสดงลักษณะภายนอกและภายในที่ใช้ในการจำแนกชนิดของปลิงทะเล
ที่มา : Clark & Rowe, 1971.


Dendritic
Peltate
Holothuria tentacles
Pinnate


Holothuria (Metriatyla) scabra


Holothuria (Metriatyla) scabra


Colochirus quadrangularis


Synaptula recta


CM 1 2 3 4 5 6
Acaudina molpadioides


Thank you very much

Annex 14: Introduction to the taxonomy of Deep-Sea shrimps and lobsters

By Dr. Suriyan Tunkijjanukij

Annex 14

Introduction to the taxonomy of deep-sea shrimps and lobsters

(emphasis on those found in the South China Sea and the Andaman sea)

Suriyan Tunkijjanukij
Faculty of Fisheries, Kasetsart University, Bangkok, 10900 THAILAND

Phylum Arthropoda Brunnich, 1772

(jointed-legged metazoan animals (Gr, *arthron* - joint; *pous* - foot))

- Jointed appendages
- Body segmented (tagmatization) :cephalon, thorax, abdomen
- Exoskeleton (cuticle)

Subphylum Crustacea Brünnich, 1772

(L. *crusta*, shell)

- 2 pairs of antennae
- Cephalothorax and abdomen
- Mandibles-type mouthparts
- 5 pairs of legs including cheliped attached to cephalothorax, swimmerets on abdomen

Class Malacostraca Latreille, 1802

(L. malaco- 'soft' + Gr *ostrakon* 'shell')

Subclass Hoplocarida Calman, 1904

Order Stomatopoda Latreille, 1817

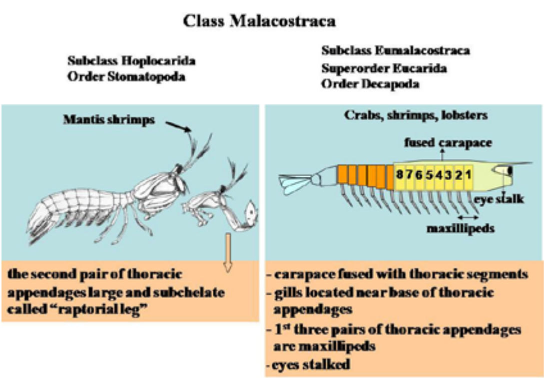
Subclass Eumalacostraca Grobben, 1892

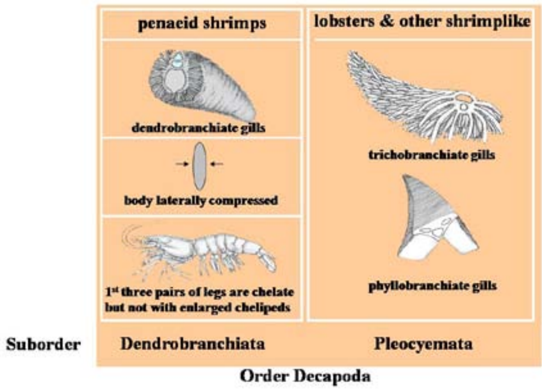
Superorder Eucarida Calman, 1904

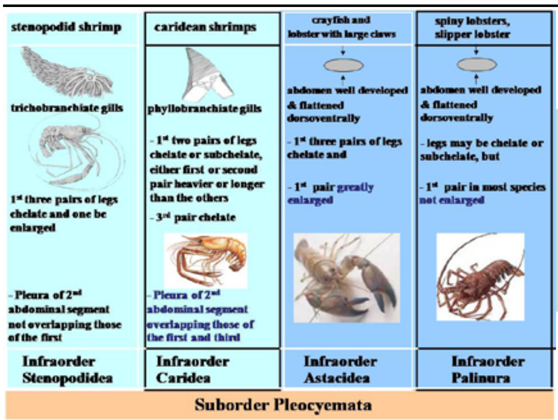
Order Euphausiacea Dana, 1852

Order Decapoda Latreille, 1802

(L, deca- 'ten' + Gr *pous, pod-* 'foot')

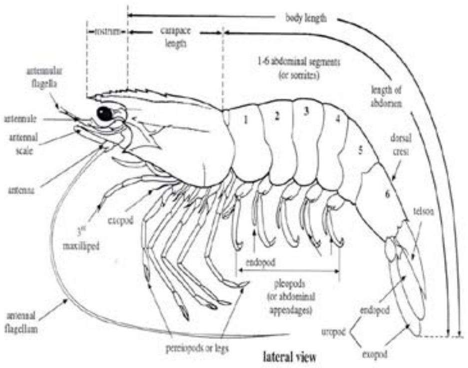


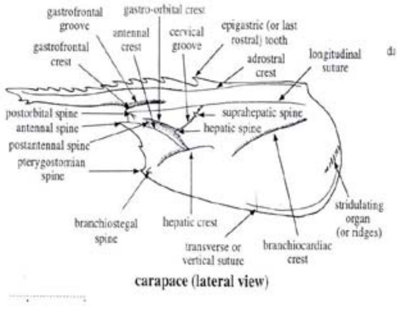


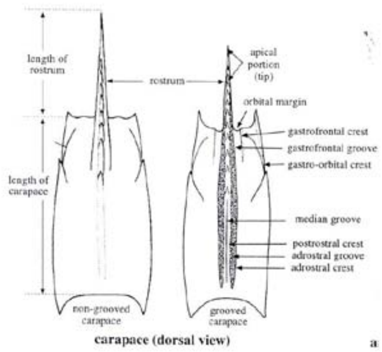


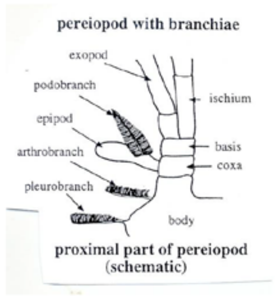
Shrimps and prawns

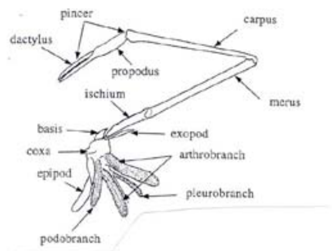
by T. Y. Chan

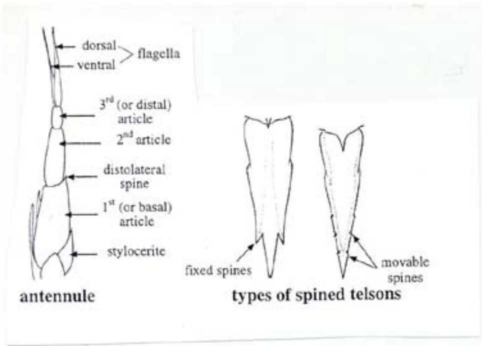

body length
rostrum
carapace length
1-6 abdominal segments (or somites)
antennular flagella
antennule
antennal scale
antenna
length of abdomen
dorsal crest
telson
exopod
3rd maxilliped
endopod
pleopods (or abdominal appendages)
endopod
uropod
exopod
antennal flagellum
pereiopods or legs
lateral view

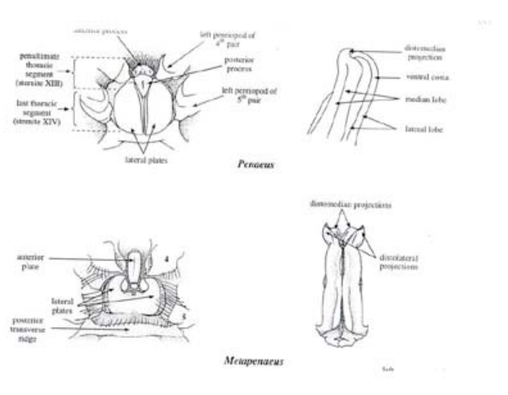

gastrofrontal groove
gastro-orbital crest
gastrofrontal crest
antennal crest
cervical groove
epigastric (or last rostral) tooth
adrostral crest
longitudinal suture
postorbital spine
antennal spine
postantennal spine
pterygostomian spine
suprahepatic spine
hepatic spine
branchiostegal spine
hepatic crest
transverse or vertical suture
branchiocardiac crest
stridulating organ (or ridges)
carapace (lateral view)

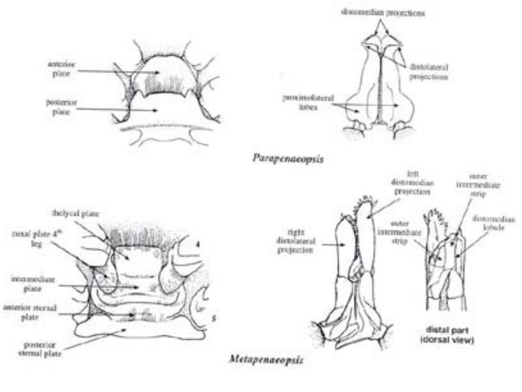

length of rostrum
rostrum
apical portion (tip)
orbital margin
gastrofrontal crest
gastrofrontal groove
gastro-orbital crest
length of carapace
median groove
postrostral crest
adrostral groove
adrostral crest
non-grooved carapace
grooved carapace
carapace (dorsal view)

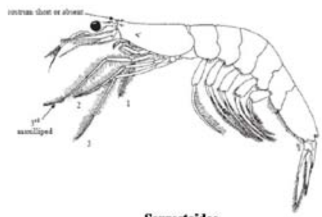

pereiopod with branchiae
exopod
podobranch
ischium
epipod
arthrobranch
basis
coxa
pleurobranch
body
proximal part of pereiopod (schematic)


pincer
carpus
dactylus
propodus
ischium
merus
basis
exopod
coxa
arthrobranch
epipod
pleurobranch
podobranch

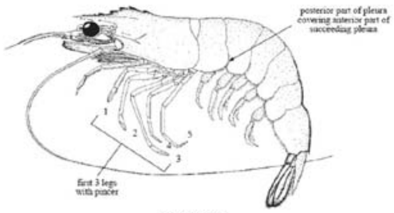

dorsal
ventral
flagella
3rd (or distal) article
2nd article
distolateral spine
1st (or basal) article
stylocerite
fixed spines
movable spines
antennule
types of spined telsons


Penaeus
Metapenaeus

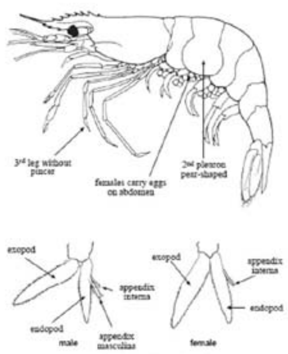

Parapenaeopsis
Metapenaeopsis
distal part (dorsal view)



Sergestoidea

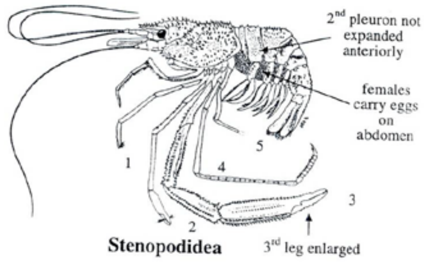


Penaeoidea

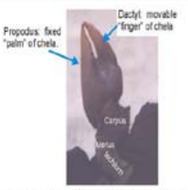


second abdominal leg (pleopod)

Caridea

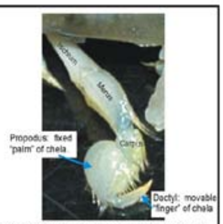


Stenopodidea



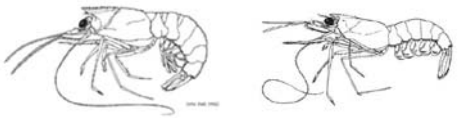
A chelate chela. Note how the 6th element (propodus) has an extension that serves as the fixed "finger" against which the 7th element (dactyl) clamps. Also note that the propodus-dactyl junction is nearly parallel to the axis of the leg.

Photo is of a cheliped from crab Hemigrapsus nudus by Dave Cowles



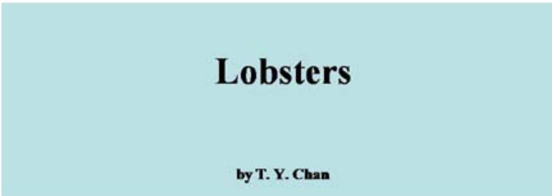
A subchelate chela. Note how the last element (dactyl) folds back onto the propodus and that the propodus-dactyl junction is nearly at right angles to the axis of the leg.

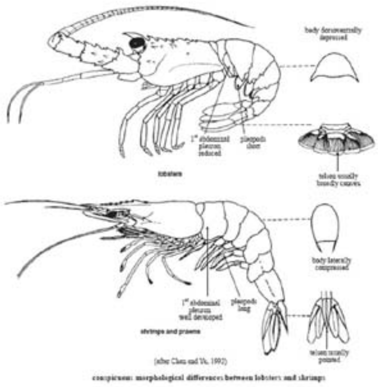
Photo is of a maxilliped from mantis shrimp Hemisquilla californiensis by Dave Cowles

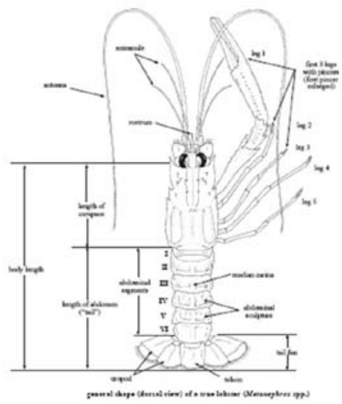


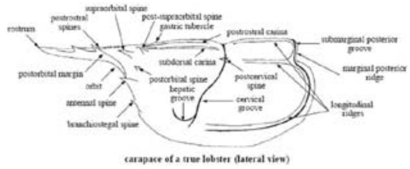
ridgeback shrimp — ***Solenocera choprai*** **Nataraj, 1945**

comp shrimp — ***Solenocera pectinata*** **(Bate, 1888)**





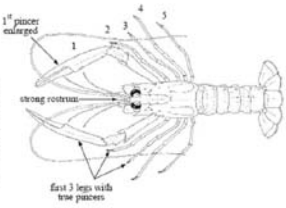


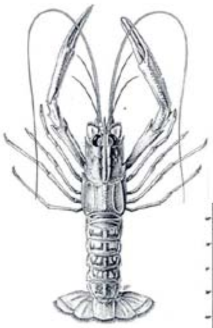


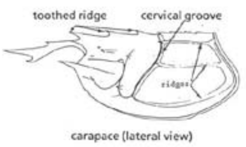
NEPHROPIDAE

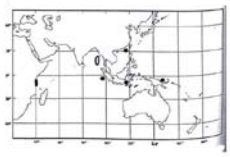
True lobsters and lobsterettes

Body tubular, surfaces almost naked or covered with thick fur; rostrum well developed; antennae long and thread-like; antennal scale, if present, with inner margin unarmed and curved; first 3 pairs of legs with true pincers, first pair much larger than others; abdominal pleura ending in acute ventral tooth; tail fan entirely hardened, telson armed with fixed spines and with posterior margin broadly convex.

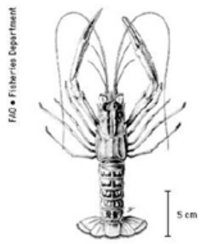








Andaman lobster
(*Metanephrops andamanicus*)



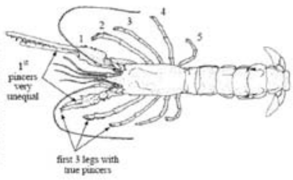
Diagnosis:
Carapace smooth between ridges and large spines.
Postrostral carinae with three teeth.
Chelae of first pereiopods heavily ridged and spinulose, without large spines.
No prominent basal spine on outer edge of movable finger of large chela.
Inner margin of merus of first pereiopod weakly spinulose.
Surface of abdominal tergites conspicuously sculptured.
Raised parts of dorsal surface of abdominal somites smooth and naked.
Second to fifth abdominal somites with marked dorsomedian carina, flanked by pair of conspicuous longitudinal grooves.
Fifth abdominal somite without distinct spines on carina separating tergite from pleuron.
Dorsomedian carina of sixth abdominal somite without submedian spines.
Spine in middle of lateral margin of sixth abdominal somite short, tip far from posterolateral margin of somite.

Andaman lobster (*Metanephrops andamanicus*)

THAUMASTOCHELIDAE

Pincer lobsters

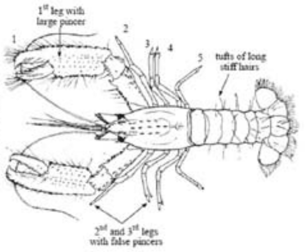
Body slightly depressed dorsoventrally; eyes strongly reduced, cornea lacking pigmentation; rostrum well developed; antennae long and thread-like, antennal scale bearing several large teeth along inner margin; first 3 pairs of legs (occasionally also fifth legs) with true pincers, first pair large but very unequal; abdominal pleura short, quadrangular and without large ventral tooth; tail fan entirely hardened, telson quadrangular and unarmed. Only 2 deep-water species known from the area, very rare and of no interest to fisheries.



ENOPLOMETOPIDAE

Reef lobsters

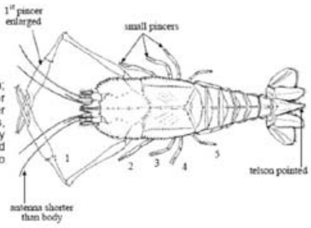
Body tubular and distributed with tufts of long stiff hairs; carapace with a well-developed rostrum; antennae long and thread-like, antennal scale with inner margin unarmed and curved; first pair of legs as large pincer, second and third legs slender and forming false pincers; abdominal pleura more or less rounded and sometimes ending in a strong ventral tooth; tail fan entirely hardened, telson bearing movable spines and with posterior margin broadly convex.



POLYCHELIDAE

Blind lobsters

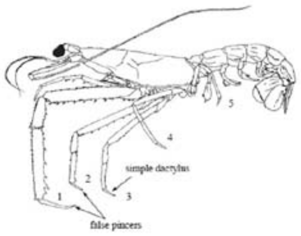
Eyes small, cornea lacking pigmentation; carapace box-like, rostrum absent or rudimentary; antennae thread-like, shorter than body; first 4 or all legs with true pincers, first pair long and slender; tail fan entirely hardened, telson pointed. All species found in very deep waters and of no interest to fisheries in the area.



GLYPHEIDAE

Fenix lobsters

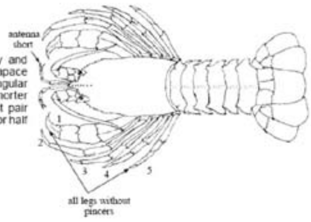
Body somewhat flattened dorsoventrally; eyes large and black, inserted on a median elevation of cephalon; carapace with a well-developed rostrum; antennae long and thread-like; first 2 legs forming false pincers, first pair very strong; uropods of tail fan entirely hardened. A single deep-water species, rare and of no commercial importance.



SYNAXIDAE

Furry lobsters

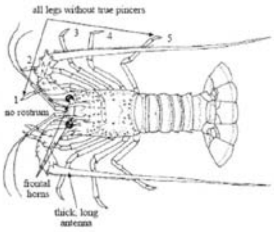
Body somewhat flattened dorsoventrally and very hairy, without enlarged spines; carapace laterally angular, with a broad and flat triangular or rounded rostrum; antennae whip-like, shorter than carapace; legs without pincers, first pair much more robust than the others; posterior half of tail fan soft and flexible.



PALINURIDAE

Spiny lobsters, langoustes

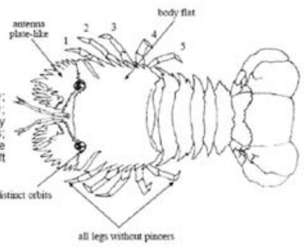
Body tubular or slightly flattened dorsoventrally; hairs, if present, few and scattered; rostrum absent or reduced to a small spine; carapace subcylindrical or prismatic, laterally rounded or straight, surface spiny and with a pair of large frontal horns above eyes; antennae very long and rather thick, whip-like or spear-like; legs without true pincers and first pair (except in *Justitia*) not or only slightly longer than the following legs, but often somewhat more robust; posterior half of tail fan soft and flexible.



SCYLLARIDAE

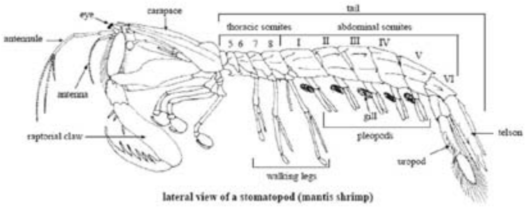
Slipper lobsters

Body strongly flattened dorsoventrally; carapace depressed and laterally angular; rostrum absent or minute; eyes enclosed by distinct orbits and without large frontal horns; antennae plate-like; legs without pincers, none of them enlarged; posterior half of tail fan soft and flexible.



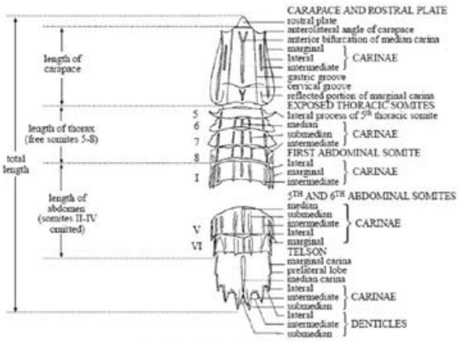
Stomatopods

by R. B. Manning

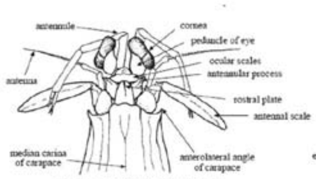


lateral view of a stomatopod (mantis shrimp)

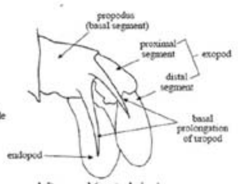
(continued) **Annex 14**



dorsal view (without head and extremities)



anterior part of body (dorsal view)



left uropod (ventral view)

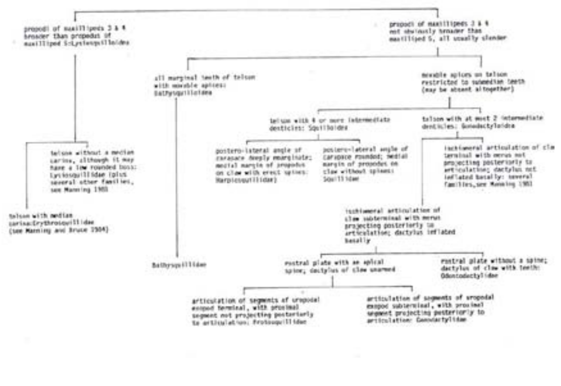


Plate 11. Classification of Stomatopoda (after key in Manning 1981).

Thank you for your kind attention

Annex 15: Guideline to identification of Deep-Sea crabs

By Assist. Prof. Puntip Wisespongpand

GUILDLINES TO IDENTIFICATION OF DEEP-SEA CRABS

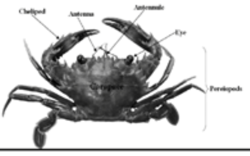
Assist.Prof. Puntip Wisespongpand
Department of Marine Science
Faculty of Fisheries, Kasetsart university
Bangkok, Thailand

Training Workshop on Identification of Deep-Sea Benthic Macroinvertebrate Vulnerable to Fishing Gear
14 July 2011

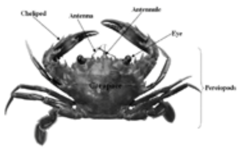
Organized by SEAFDEC, Thailand

What is crab??

- Invertebrates in Phylum Arthropoda = Crabs have segmented body and jointed appendages
- The body is consisted of head (5 segments), thorax or sternum (8 segments) and abdomen (6 segments) *BUT* the head and thorax are fused to be cephalothorax
- Body compress dorsoventrally , abdomen reduced or developed, telson is no longer functional

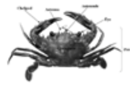


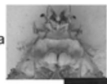
- Visible on the underside of a crab are the mouthparts or buccal cavity, sternum and abdomen
- Crabs are decapod crustaceans = ten jointed legs
- Two large claws = the symbol of crab
- 2 eyes which protrude from the front of the carapace
- 2 pair of sensing organs, antennule and antenna



Head

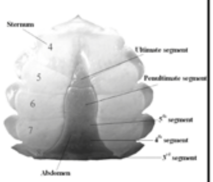
- 5 segments of head and 3 segments of sternum are fused to be cephalothorax and covered by carapace (chitinous exoskeleton)
- Head comprise of 5 appendages
  - antennule = first antenna
  - antenna = second antenna
  - mandible
  - maxillule, first maxilla
  - maxilla, second maxilla

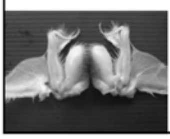


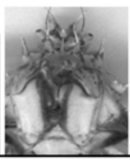


Sternum

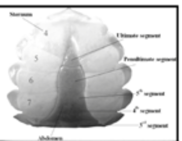
- 3 segments of sternum are fused with head and functioned as carapace
- 1st-3rd segment comprise of 3 appendages concealed into mouthpart
  - first maxiliped
  - second maxilliped
  - third maxilliped

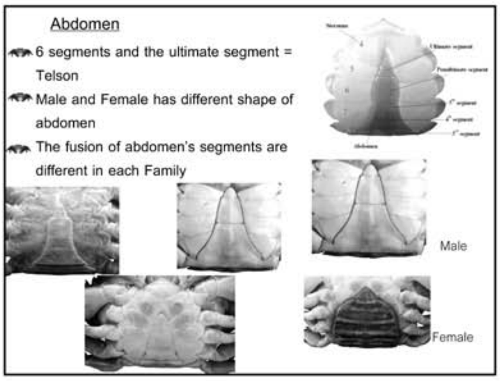


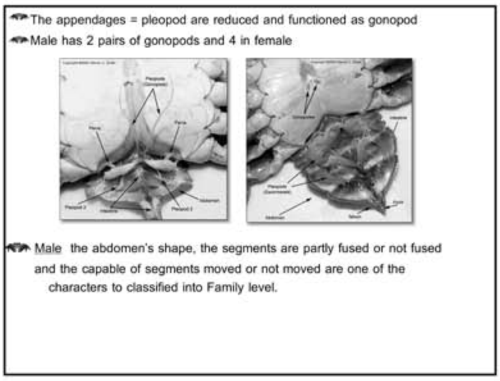


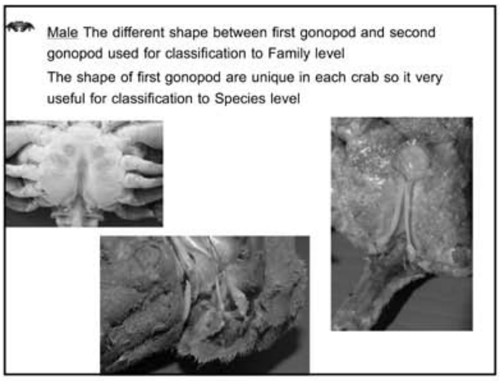


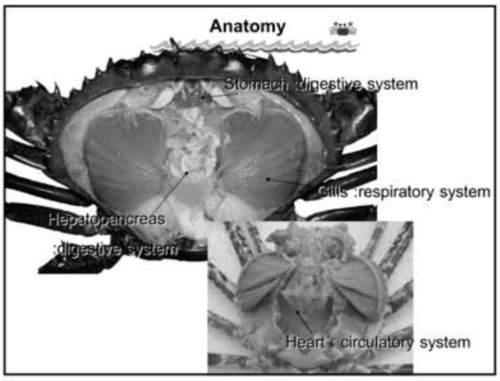
- 4th segment-8th segment are clearly appeared and comprised of 5 pairs of appendages = pereiopod (walking legs)
- The first pairs are large claws = chelipeds

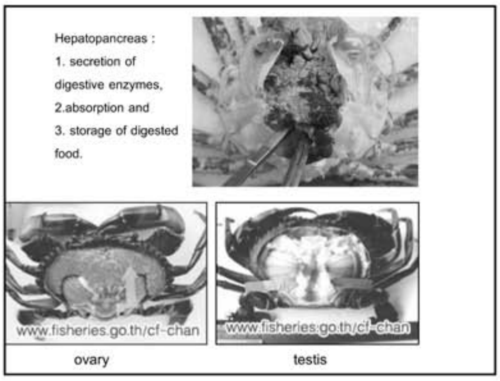


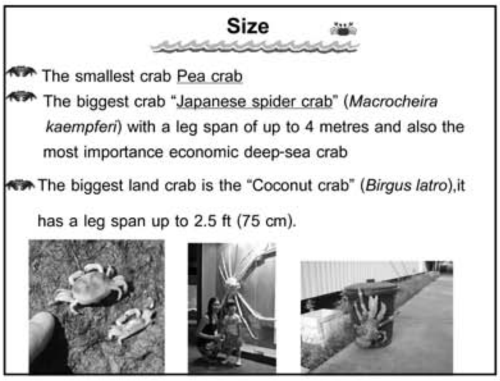

Abdomen
6 segments and the ultimate segment = Telson
Male and Female has different shape of abdomen
The fusion of abdomen's segments are different in each Family
Male
Female

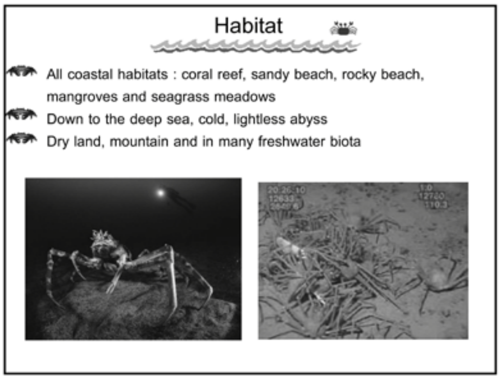

The appendages = pleopod are reduced and functioned as gonopod
Male has 2 pairs of gonopods and 4 in female
Male the abdomen's shape, the segments are partly fused or not fused and the capable of segments moved or not moved are one of the characters to classified into Family level.

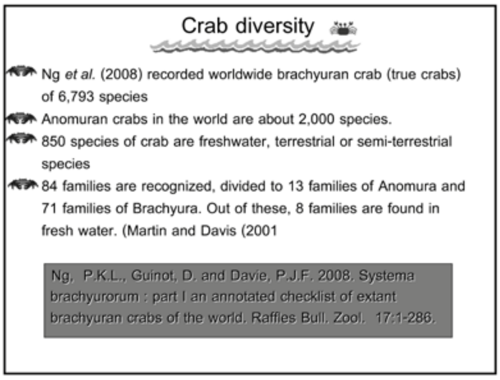

Male The different shape between first gonopod and second gonopod used for classification to Family level
The shape of first gonopod are unique in each crab so it very useful for classification to Species level

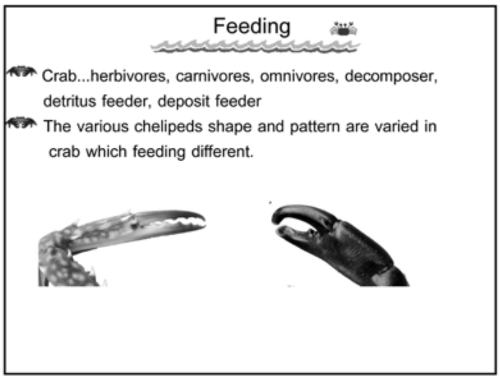

Anatomy
Stomach :digestive system
Gills :respiratory system
Hepatopancreas :digestive system
Heart : circulatory system

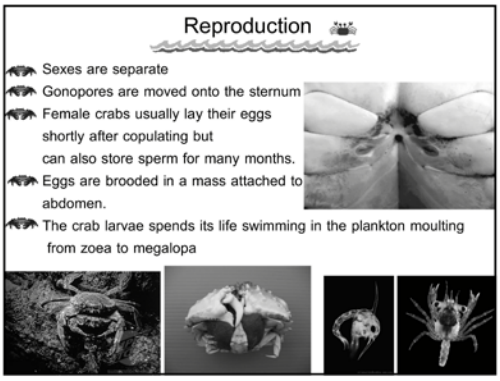

Hepatopancreas :
1. secretion of digestive enzymes,
2.absorption and
3. storage of digested food.
www.fisheries.go.th/cf-chan
www.fisheries.go.th/cf-chan
ovary
testis

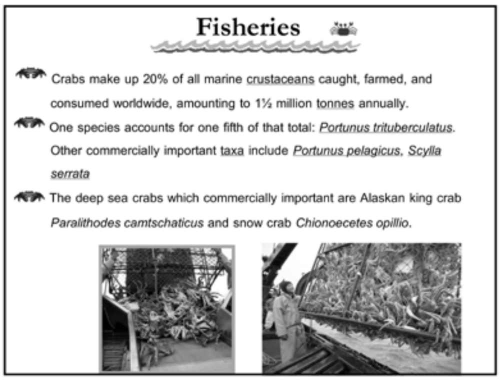

Size
The smallest crab Pea crab
The biggest crab "Japanese spider crab" (Macrocheira kaempferi) with a leg span of up to 4 metres and also the most importance economic deep-sea crab
The biggest land crab is the "Coconut crab" (Birgus latro),it has a leg span up to 2.5 ft (75 cm).

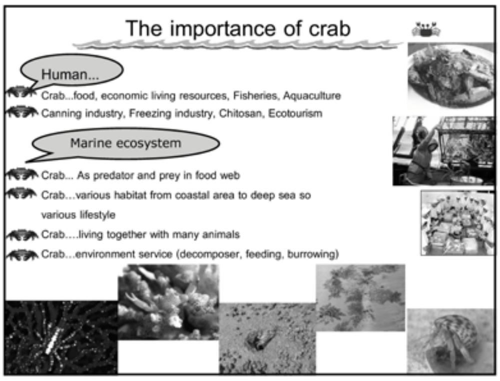

Habitat
All coastal habitats : coral reef, sandy beach, rocky beach, mangroves and seagrass meadows
Down to the deep sea, cold, lightless abyss
Dry land, mountain and in many freshwater biota


Crab diversity
Ng et al. (2008) recorded worldwide brachyuran crab (true crabs) of 6,793 species
Anomuran crabs in the world are about 2,000 species.
850 species of crab are freshwater, terrestrial or semi-terrestrial species
84 families are recognized, divided to 13 families of Anomura and 71 families of Brachyura. Out of these, 8 families are found in fresh water. (Martin and Davis (2001
Ng, P.K.L., Guinot, D. and Davie, P.J.F. 2008. Systema brachyurorum : part I an annotated checklist of extant brachyuran crabs of the world. Raffles Bull. Zool. 17:1-286.


Feeding
Crab...herbivores, carnivores, omnivores, decomposer, detritus feeder, deposit feeder
The various chelipeds shape and pattern are varied in crab which feeding different.


Reproduction
Sexes are separate
Gonopores are moved onto the sternum
Female crabs usually lay their eggs shortly after copulating but can also store sperm for many months.
Eggs are brooded in a mass attached to abdomen.
The crab larvae spends its life swimming in the plankton moulting from zoea to megalopa

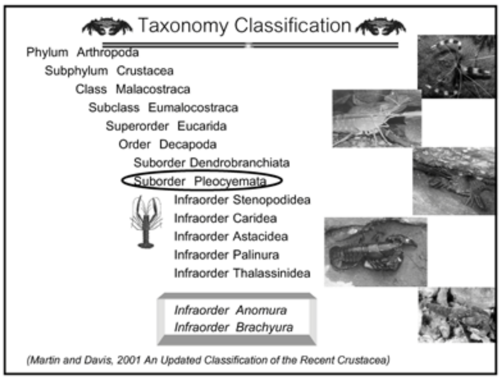

Fisheries
Crabs make up 20% of all marine crustaceans caught, farmed, and consumed worldwide, amounting to 1½ million tonnes annually.
One species accounts for one fifth of that total: Portunus trituberculatus. Other commercially important taxa include Portunus pelagicus, Scylla serrata
The deep sea crabs which commercially important are Alaskan king crab Paralithodes camtschaticus and snow crab Chionoecetes opillio.

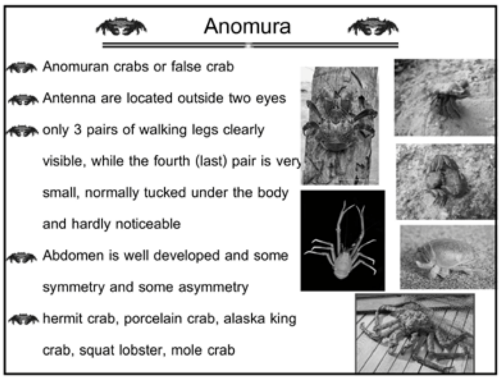

The importance of crab
Human...
Crab...food, economic living resources, Fisheries, Aquaculture
Canning industry, Freezing industry, Chitosan, Ecotourism
Marine ecosystem
Crab... As predator and prey in food web
Crab...various habitat from coastal area to deep sea so various lifestyle
Crab....living together with many animals
Crab...environment service (decomposer, feeding, burrowing)

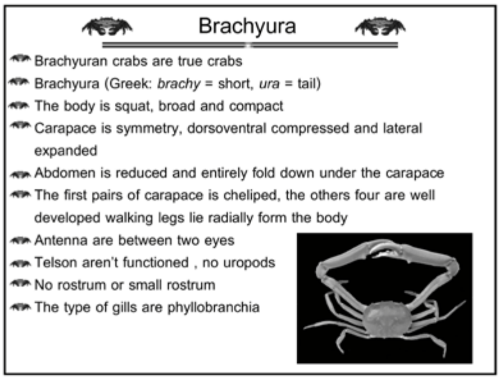
Annex 16: Classification of Deep-Sea crabs

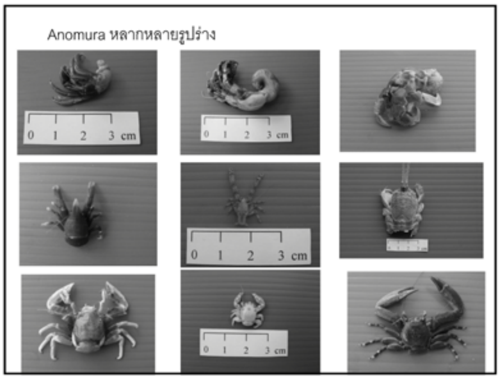
By Assist. Prof. Puntip Wisespongpand

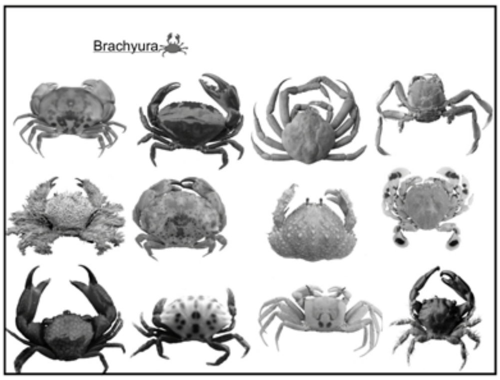
Annex 16

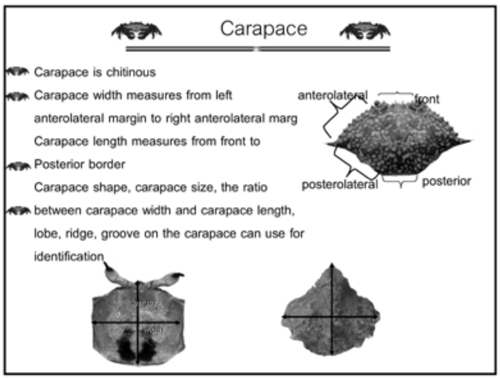

Taxonomy Classification
Phylum Arthropoda
Subphylum Crustacea
Class Malacostraca
Subclass Eumalocostraca
Superorder Eucarida
Order Decapoda
Suborder Dendrobranchiata
Suborder Pleocyemata
Infraorder Stenopodidea
Infraorder Caridea
Infraorder Astacidea
Infraorder Palinura
Infraorder Thalassinidea
Infraorder Anomura
Infraorder Brachyura
(Martin and Davis, 2001 An Updated Classification of the Recent Crustacea)

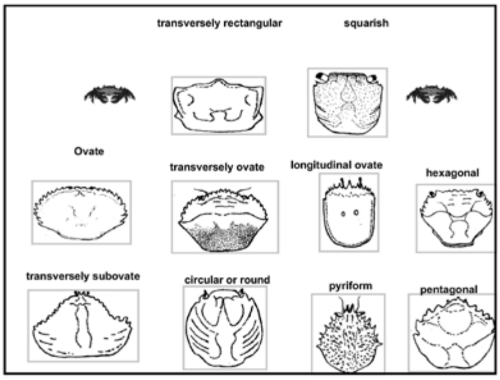

Anomura
Anomuran crabs or false crab
Antenna are located outside two eyes
only 3 pairs of walking legs clearly visible, while the fourth (last) pair is very small, normally tucked under the body and hardly noticeable
Abdomen is well developed and some symmetry and some asymmetry
hermit crab, porcelain crab, alaska king crab, squat lobster, mole crab

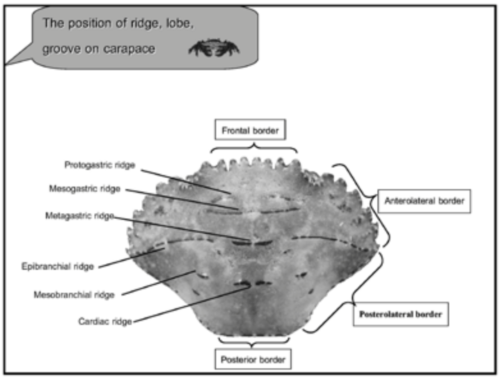

Brachyura
Brachyuran crabs are true crabs
Brachyura (Greek: brachy = short, ura = tail)
The body is squat, broad and compact
Carapace is symmetry, dorsoventral compressed and lateral expanded
Abdomen is reduced and entirely fold down under the carapace
The first pairs of carapace is cheliped, the others four are well developed walking legs lie radially form the body
Antenna are between two eyes
Telson aren't functioned , no uropods
No rostrum or small rostrum
The type of gills are phyllobranchia

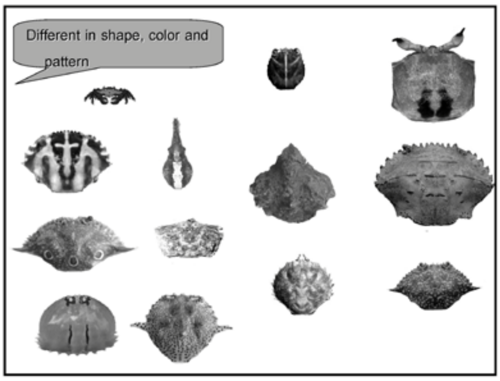

Anomura หลากหลายรูปร่าง
0 1 2 3 cm
0 1 2 3 cm
0 1 2 3 cm
0 1 2 3 cm

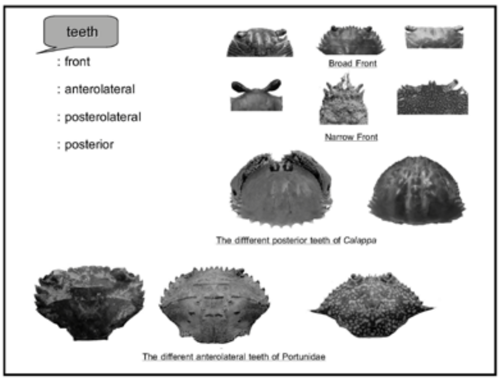

Brachyura

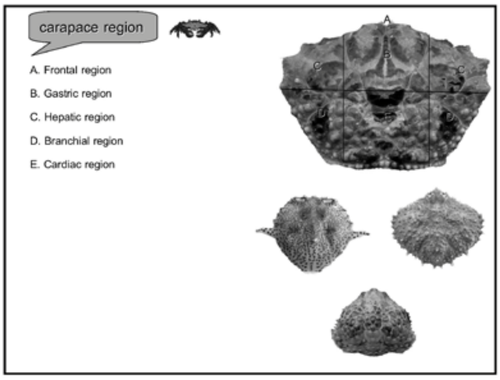

Carapace
Carapace is chitinous
Carapace width measures from left anterolateral margin to right anterolateral marg
Carapace length measures from front to Posterior border
Carapace shape, carapace size, the ratio between carapace width and carapace length, lobe, ridge, groove on the carapace can use for identification
anterolateral
front
posterolateral
posterior

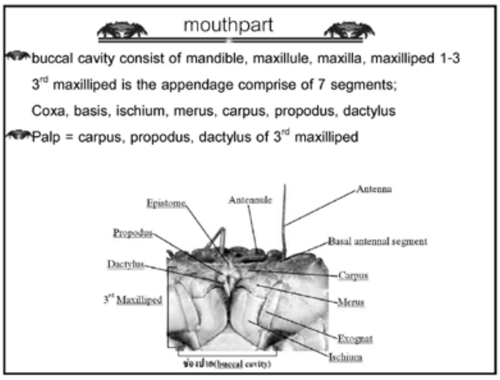

transversely rectangular
squarish
Ovate
transversely ovate
longitudinal ovate
hexagonal
transversely subovate
circular or round
pyriform
pentagonal


The position of ridge, lobe, groove on carapace
Frontal border
Protogastric ridge
Mesogastric ridge
Metagastric ridge
Epibranchial ridge
Mesobranchial ridge
Cardiac ridge
Anterolateral border
Posterolateral border
Posterior border


Different in shape, color and pattern


teeth
: front
: anterolateral
: posterolateral
: posterior
Broad Front
Narrow Front
The different posterior teeth of Calappa
The different anterolateral teeth of Portunidae


carapace region
A. Frontal region
B. Gastric region
C. Hepatic region
D. Branchial region
E. Cardiac region


mouthpart
buccal cavity consist of mandible, maxillule, maxilla, maxilliped 1-3
3rd maxilliped is the appendage comprise of 7 segments;
Coxa, basis, ischium, merus, carpus, propodus, dactylus
Palp = carpus, propodus, dactylus of 3rd maxilliped
Epistome
Antennule
Antenna
Propodus
Basal antennal segment
Dactylus
Carpus
3rd Maxilliped
Merus
Exognat
Ischium
(buccal cavity)

Annex 17: Deep-Sea crabs fisheries

By Assist. Prof. Puntip Wisespongpand

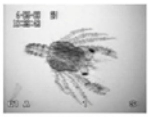
Deep Sea Crab Fisheries

Deep sea crab

- Crabs have evolved specific adaptations to cope with life in deep water.
- Red King crabs are anomuran crabs. Their abdomens are twisted to one side, they have large right-handed claws, and their legs fold backwards, instead of forwards. Thus they can walk straight forward.
- Red King crabs also have an unusual mode of development. Most crabs hatch from eggs as a swimming shrimp-like larva, that immediately begins to feed on small planktonic organisms. Red king crabs do this too, but before they become bottom-dwelling crabs, they go through a transitional stage that is not capable of eating.

Paralithodes camtschaticus

- The glaucothoe is a transitional stage between the larval and juvenile stages of king crabs. It can swim like the larvae, but has claws, and prefers to find structurally complex habitat in which to settle. It lacks functional mouthparts or digestive apparatus so does not feed for 3 to 4 weeks, until molting to the juvenile stage.
- Red king crabs live in relatively shallow water (less than 50 m). Because of this they are exposed to seasonally changing conditions of temperature and day length. As a result, they all reproduce during a specific season in the spring



- Golden king crabs live much deeper, from 200-500 m, so they may not be exposed to strong seasonal signals. As a result, they may not reproduce simultaneously, or even in the same season. The larvae of golden king crabs do not eat at all, but live off stored yolk, until they become bottom dwelling crabs many months later.
- In fact, no one has ever captured a larval golden king crab from the ocean. Eggs of golden king crabs are twice as large as those of the red king crab, and contain much more yolk. This is probably an adaptation allowing the larvae to survive at depths where there is much less plankton available as a food source.

Lithodes aequispina

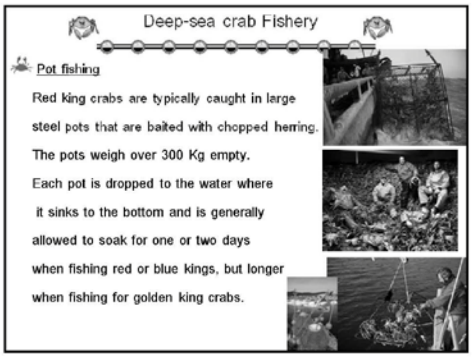
- The scarlet king crab *Lithodes couesi* lives even deeper than the golden king crab, and has legs that are much thinner in respect to their length. This may be an adaptation to low oxygen levels, since the scarlet crab lives at 1000 m, near the oxygen minimum zone. Thinner legs require less oxygen, hence less energy..

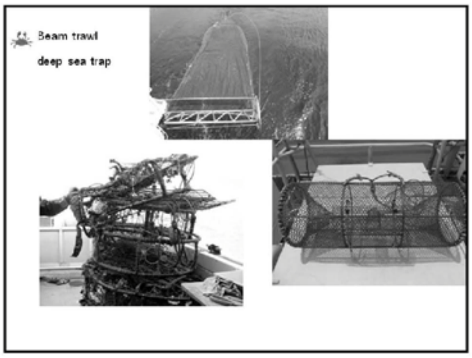
- The squat lobsters, lives below 2000 m. They are ghostly white and have no eyes. They live in rocky habitats where they can probably find food using their sense of smell. Because there is no light at this … eyes, like a blind cavefish.

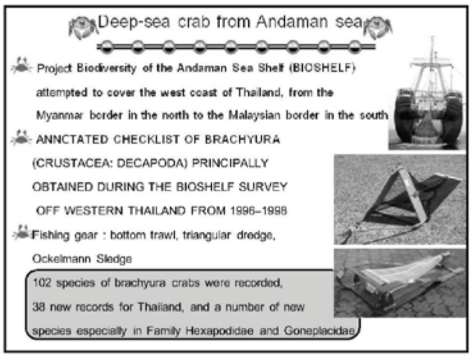
Munidopsis albatrossae, a blind "squat lobster" that lives at depths > 2500 m.

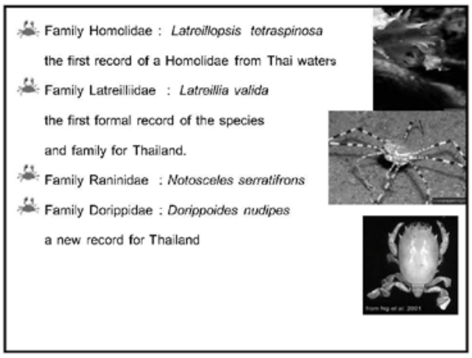
M. andamanica, eating wood that has sunk to the ocean floor, comprising trunks and leaves swept into the sea, as well as the odd shipwreck

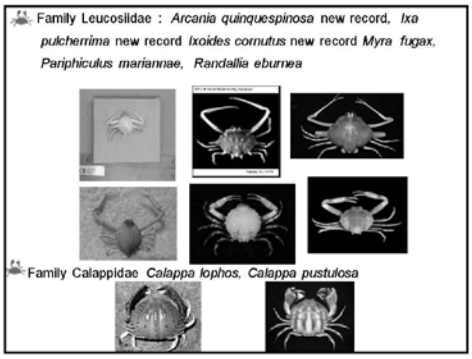
14/07/54

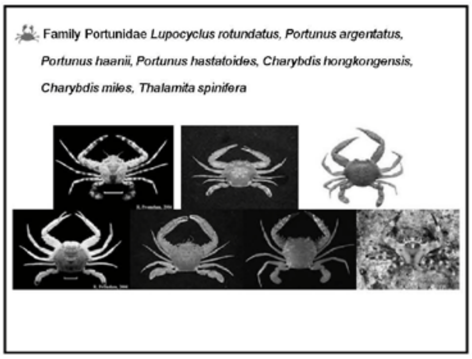

Deep-sea crab Fishery
Pot fishing
Red king crabs are typically caught in large
steel pots that are baited with chopped herring.
The pots weigh over 300 Kg empty.
Each pot is dropped to the water where
it sinks to the bottom and is generally
allowed to soak for one or two days
when fishing red or blue kings, but longer
when fishing for golden king crabs.


Beam trawl
deep sea trap

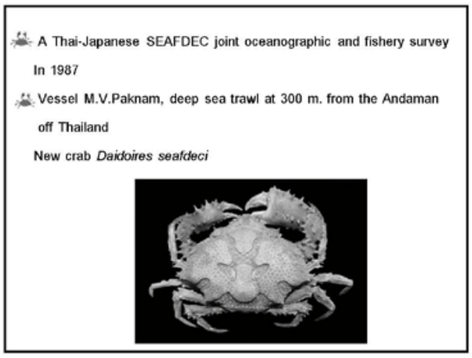

Deep-sea crab from Andaman sea
Project Biodiversity of the Andaman Sea Shelf (BIOSHELF)
attempted to cover the west coast of Thailand, from the
Myanmar border in the north to the Malaysian border in the south
ANNCTATED CHECKLIST OF BRACHYURA
(CRUSTACEA: DECAPODA) PRINCIPALLY
OBTAINED DURING THE BIOSHELF SURVEY
OFF WESTERN THAILAND FROM 1996–1998
Fishing gear : bottom trawl, triangular dredge,
Ockelmann Sledge
102 species of brachyura crabs were recorded,
38 new records for Thailand, and a number of new
species especially in Family Hexapodidae and Goneplacidae

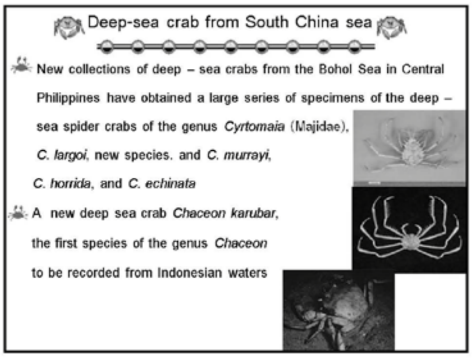

Family Homolidae : *Latreillopsis tetraspinosa*
the first record of a Homolidae from Thai waters
Family Latreilliidae : *Latreillia valida*
the first formal record of the species
and family for Thailand.
Family Raninidae : *Notosceles serratifrons*
Family Dorippidae : *Dorippoides nudipes*
a new record for Thailand

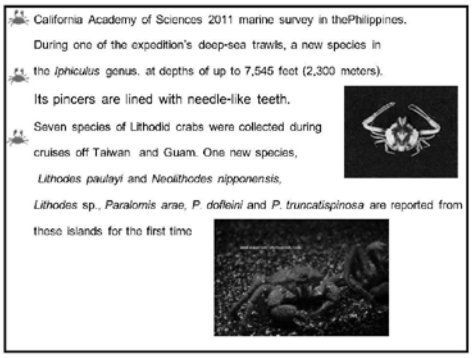

Family Leucosiidae : *Arcania quinquespinosa* new record, *Ixa pulcherrima* new record *Ixoides cornutus* new record *Myra fugax*, *Pariphiculus mariannae*, *Randallia eburnea*
Family Calappidae *Calappa lophos*, *Calappa pustulosa*


Family Portunidae *Lupocyclus rotundatus*, *Portunus argentatus*, *Portunus haanii*, *Portunus hastatoides*, *Charybdis hongkongensis*, *Charybdis miles*, *Thalamita spinifera*

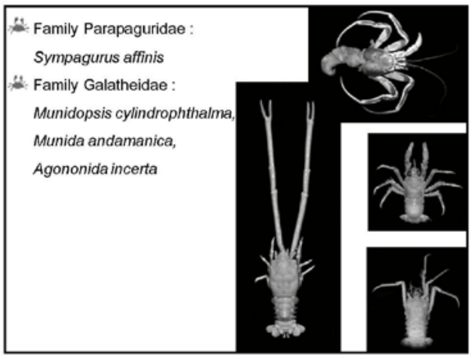
2

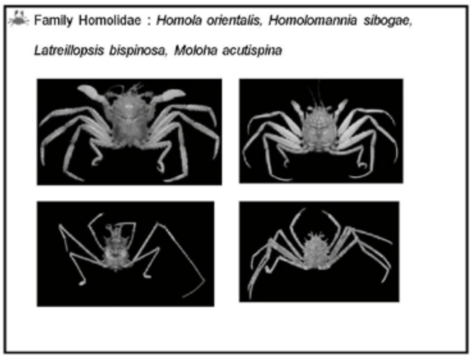

A Thai-Japanese SEAFDEC joint oceanographic and fishery survey In 1987
Vessel M.V.Paknam, deep sea trawl at 300 m. from the Andaman off Thailand
New crab *Daidoires seafdeci*


Deep-sea crab from South China sea
New collections of deep – sea crabs from the Bohol Sea in Central Philippines have obtained a large series of specimens of the deep – sea spider crabs of the genus *Cyrtomaia* (Majidae), *C. largoi*, new species. and *C. murrayi*, *C. horrida*, and *C. echinata*
A new deep sea crab *Chaceon karubar*, the first species of the genus *Chaceon* to be recorded from Indonesian waters

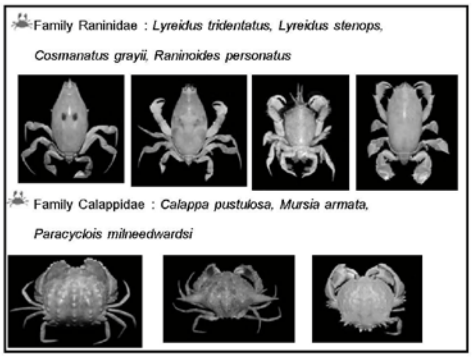

California Academy of Sciences 2011 marine survey in thePhilippines.
During one of the expedition's deep-sea trawls, a new species in the *Iphiculus* genus. at depths of up to 7,545 feet (2,300 meters).
Its pincers are lined with needle-like teeth.
Seven species of Lithodid crabs were collected during cruises off Taiwan and Guam. One new species, *Lithodes paulayi* and *Neolithodes nipponensis*, *Lithodes* sp., *Paralomis arae*, *P. dofleini* and *P. truncatispinosa* are reported from these islands for the first time

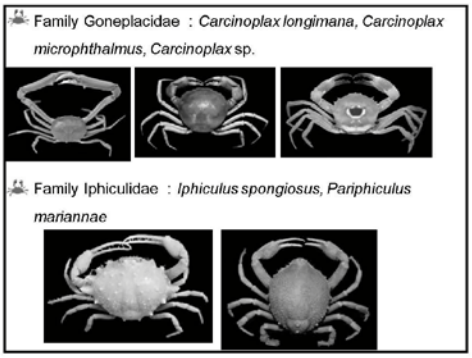

ep-sea crab from Brunei (South china s
Deep-sea crabs from Waters of Brunei Darussalam 15 September – 25 October 2010
Vessel M.V.SEAFDEC 2
Fishing gear bottom trawl (otter-board trawl and beam trawl)
deep-sea trap

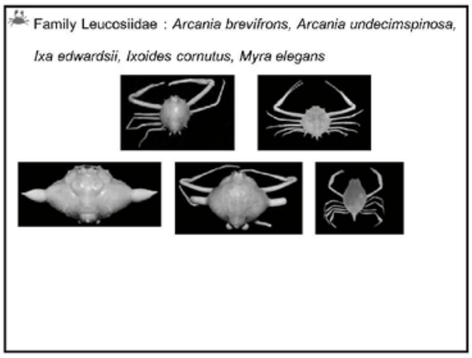

Family Parapaguridae :
Sympagurus affinis
Family Galatheidae :
Munidopsis cylindrophthalma,
Munida andamanica,
Agononida incerta

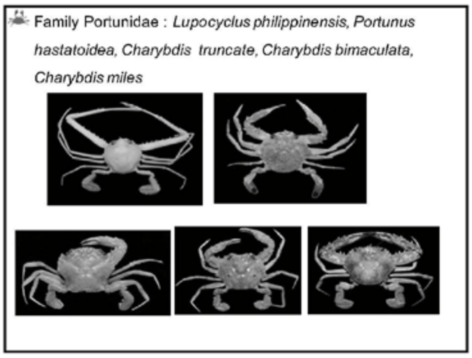

Family Homolidae : *Homola orientalis, Homolomannia sibogae, Latreillopsis bispinosa, Moloha acutispina*

14/07/54


Family Raninidae : *Lyreidus tridentatus, Lyreidus stenops, Cosmanatus grayii, Raninoides personatus*
Family Calappidae : *Calappa pustulosa, Mursia armata, Paracyclois milneedwardsi*


Family Goneplacidae : *Carcinoplax longimana, Carcinoplax microphthalmus, Carcinoplax* sp.
Family Iphiculidae : *Iphiculus spongiosus, Pariphiculus mariannae*


Family Leucosiidae : *Arcania brevifrons, Arcania undecimspinosa, Ixa edwardsii, Ixoides cornutus, Myra elegans*


Family Portunidae : *Lupocyclus philippinensis, Portunus hastatoidea, Charybdis truncate, Charybdis bimaculata, Charybdis miles*

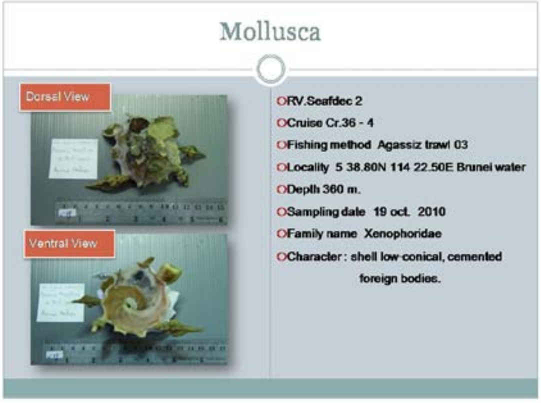
4

Annex 18/1: Results presentation of Group I

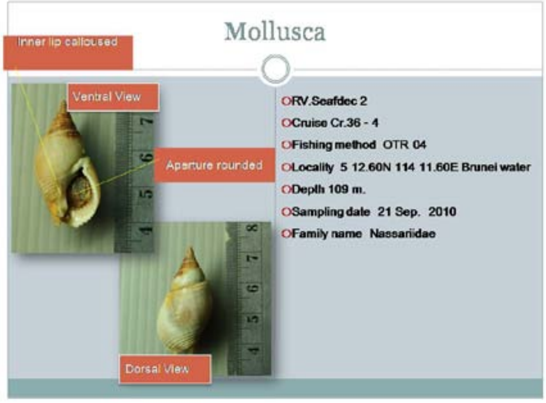
By Abd. Haris Hilmi Ahmad Arshad, DoF, Malaysia
Supasit Boonphienphol PMBC.Thailand
Werachart Pengchumrus PMBC.Thailand

Training Workshop on
Identification of Deep-sea Benthic
Macroinvertebrate to Fishing Gear
by
Abd. Haris Hilmi Ahmad Arshad, DoF, Malaysia
Supasit Boonphienphol PMBC,Thailand
Werachart Pengchumrus PMBC,Thailand

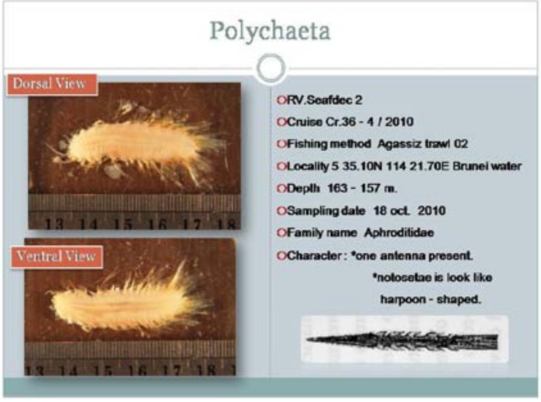
Mollusca
Columella folded
RV.Seafdec 2
Cruise Cr.36 - 4
Fishing method Beam trawl op. 04 St. A04
Locality 5 18 60N 114 15 70E Brunei water
Depth 115m.
Sampling date 28 Sept. 2010
Family name Marginellidae
Shell ovate, usually smooth and polished, often small. Aperture elongate with a short siphonal canal. Columella strongly folded. No operculum



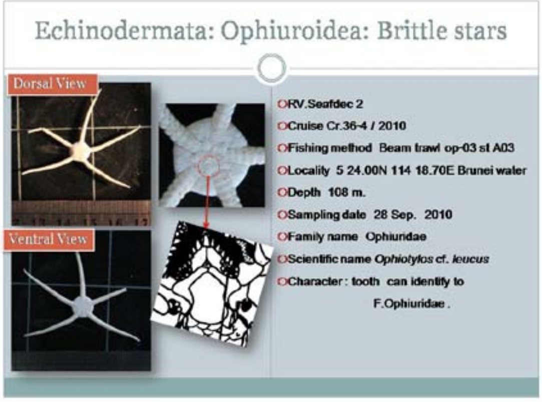
Mollusca
Dorsal View
Ventral View
RV.Seafdec 2
Cruise Cr.36 - 4
Fishing method Agassiz trawl 03
Locality 5 38.80N 114 22.50E Brunei water
Depth 360 m.
Sampling date 19 oct. 2010
Family name Xenophoridae
Character : shell low-conical, cemented foreign bodies.



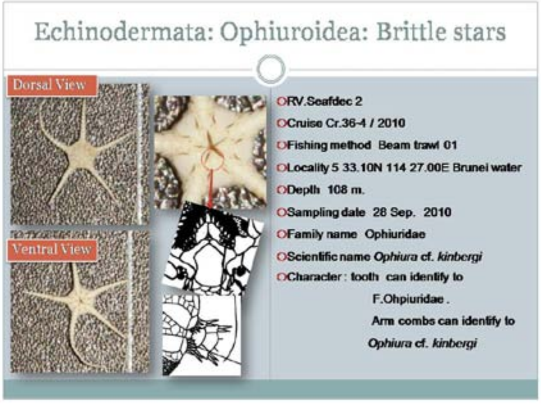
Mollusca
Inner lip calloused
Ventral View
Aperture rounded
Dorsal View
RV.Seafdec 2
Cruise Cr.36 - 4
Fishing method OTR 04
Locality 5 12.60N 114 11.60E Brunei water
Depth 109 m.
Sampling date 21 Sep. 2010
Family name Nassariidae



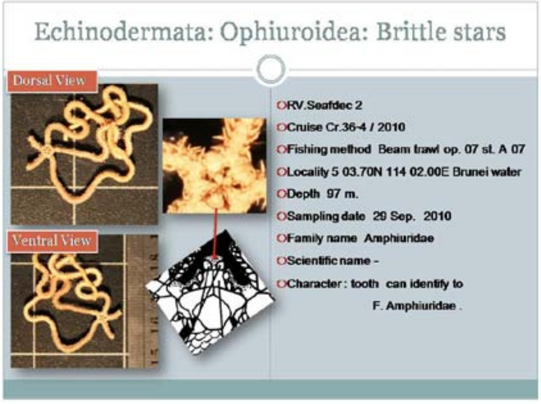
Polychaeta
Dorsal View
Ventral View
RV.Seafdec 2
Cruise Cr.36 - 4 / 2010
Fishing method Agassiz trawl 02
Locality 5 35.10N 114 21.70E Brunei water
Depth 163 - 157 m.
Sampling date 18 oct. 2010
Family name Aphroditidae
Character : *one antenna present.
*notosetae is look like harpoon - shaped.



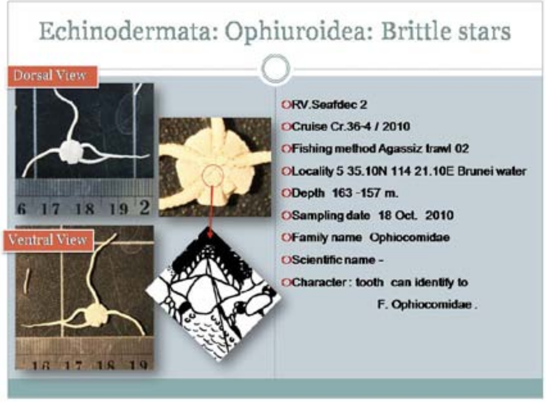
Echinodermata: Ophiuroidea: Brittle stars
Dorsal View
Ventral View
RV.Seafdec 2
Cruise Cr.36-4 / 2010
Fishing method Beam trawl op-03 st A03
Locality 5 24.00N 114 18.70E Brunei water
Depth 108 m.
Sampling date 28 Sep. 2010
Family name Ophiuridae
Scientific name Ophiolyfos cf. leucus
Character : tooth can identify to F.Ophiuridae .



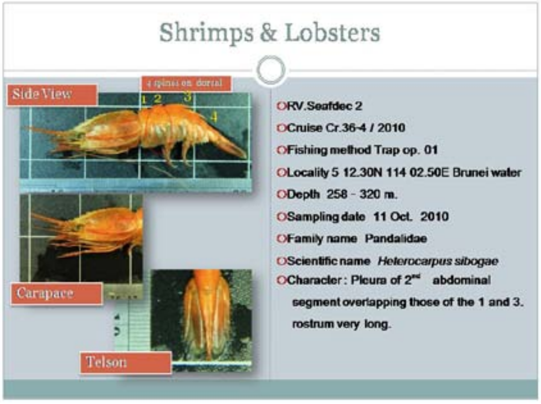
Echinodermata: Ophiuroidea: Brittle stars
Dorsal View
Ventral View
RV.Seafdec 2
Cruise Cr.36-4 / 2010
Fishing method Beam trawl 01
Locality 5 33.10N 114 27.00E Brunei water
Depth 108 m.
Sampling date 28 Sep. 2010
Family name Ophiuridae
Scientific name Ophiura cf. kinbergi
Character : tooth can identify to F.Ohpiuridae .
Arm combs can identify to Ophiura cf. kinbergi



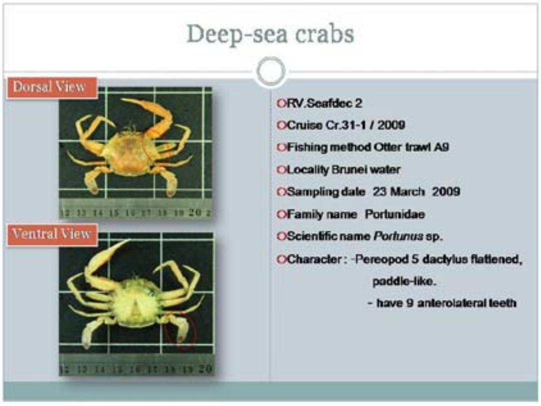
Echinodermata: Ophiuroidea: Brittle stars
Dorsal View
Ventral View
RV.Seafdec 2
Cruise Cr.36-4 / 2010
Fishing method Beam trawl op. 07 st. A 07
Locality 5 03.70N 114 02.00E Brunei water
Depth 97 m.
Sampling date 20 Sep. 2010
Family name Amphiuridae
Scientific name -
Character : tooth can identify to F. Amphiuridae .

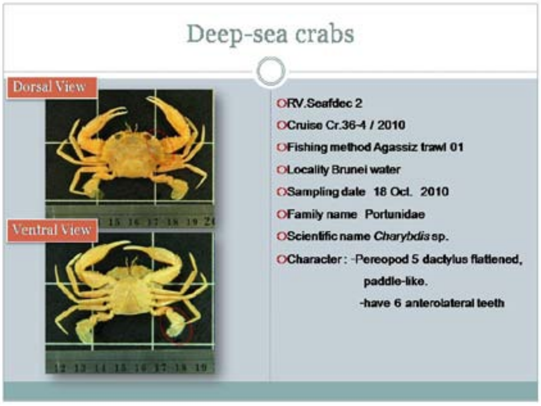

Echinodermata: Ophiuroidea: Brittle stars
Dorsal View
Ventral View
RV.Seafdec 2
Cruise Cr.36-4 / 2010
Fishing method Agassiz trawl 02
Locality 5 35.10N 114 21.10E Brunei water
Depth 163 -157 m.
Sampling date 18 Oct. 2010
Family name Ophiocomidae
Scientific name -
Character : tooth can identify to
F. Ophiocomidae .

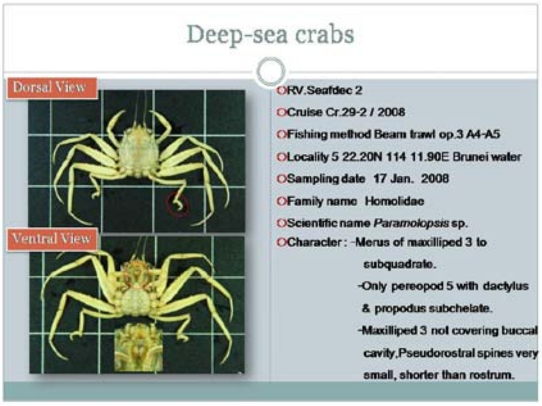

Shrimps & Lobsters
Dorsal View
Side View
RV.Seafdec 2
Cruise Cr.36-4 / 2010
Fishing method Beam trawl op.09
Locality 5 00.50N 113 47.60E Brunei water
Depth 169 m.
Sampling date 29 Sep. 2010
Family name Crangonidae
Scientific name -
Character : Pleura of 2nd abdominal
segment overlapping those of the 1 and 3.
- rostrum short.
- carpus of 2nd pair of pereiopod not
subdivided
- first pereiopod subchelate .


Shrimps & Lobsters
Side View
4 spines on dorsal
Carapace
Telson
RV.Seafdec 2
Cruise Cr.36-4 / 2010
Fishing method Trap op. 01
Locality 5 12.30N 114 02.50E Brunei water
Depth 258 - 320 m.
Sampling date 11 Oct. 2010
Family name Pandalidae
Scientific name *Heterocarpus sibogae*
Character : Pleura of 2nd abdominal
segment overlapping those of the 1 and 3.
rostrum very long.


Shrimps & Lobsters
Dorsal View
Side View
RV.Seafdec 2
Cruise Cr.36-4 / 2010
Fishing method Beam trawl op.12
Locality 5 22.20N 114 11.90E Brunei water
Depth 350 - 260 m.
Sampling date 30 Sep. 2010
Family name Polychelidae (Blind Lobster)
Scientific name -
Character : Eyes small, carapace box-like,
telson pointed,1-4 pereiopod
with true pincers .


Deep-sea crabs
Dorsal View
Ventral View
RV.Seafdec 2
Cruise Cr.31-1 / 2009
Fishing method Otter trawl A9
Locality Brunei water
Sampling date 23 March 2009
Family name Portunidae
Scientific name *Portunus* sp.
Character : -Pereopod 5 dactylus flattened,
paddle-like.
- have 9 anterolateral teeth


Deep-sea crabs
Dorsal View
Ventral View
RV.Seafdec 2
Cruise Cr.36-4 / 2010
Fishing method Agassiz trawl 01
Locality Brunei water
Sampling date 18 Oct. 2010
Family name Portunidae
Scientific name *Charybdis* sp.
Character : -Pereopod 5 dactylus flattened,
paddle-like.
-have 6 anterolateral teeth


Deep-sea crabs
Dorsal View
Ventral View
RV.Seafdec 2
Cruise Cr.29-2 / 2008
Fishing method Beam trawl op.3 A4-A5
Locality 5 22.20N 114 11.90E Brunei water
Sampling date 17 Jan. 2008
Family name Homolidae
Scientific name *Paramolopsis* sp.
Character : -Merus of maxilliped 3 to
subquadrate.
-Only pereopod 5 with dactylus
& propodus subchelate.
-Maxilliped 3 not covering buccal
cavity,Pseudorostral spines very
small, shorter than rostrum.

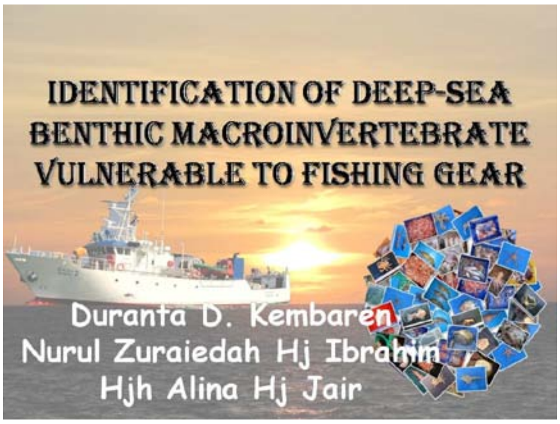

Thank you
Terima kasih
Kop khun krub

Annex 18/2: Results presentation of Group II

By Duranta D. Kembaren

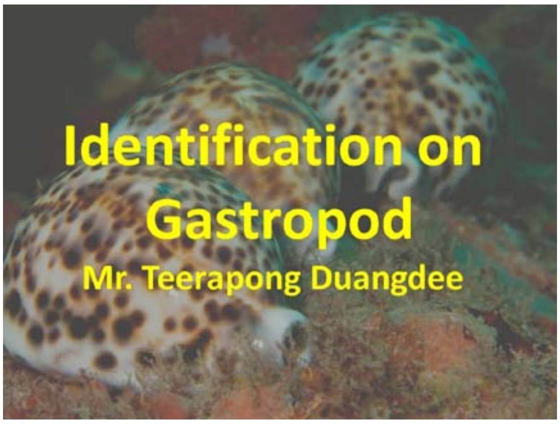
Nurul Zuraiedah Hj Ibrahim

Hjh Alina Hj Jair

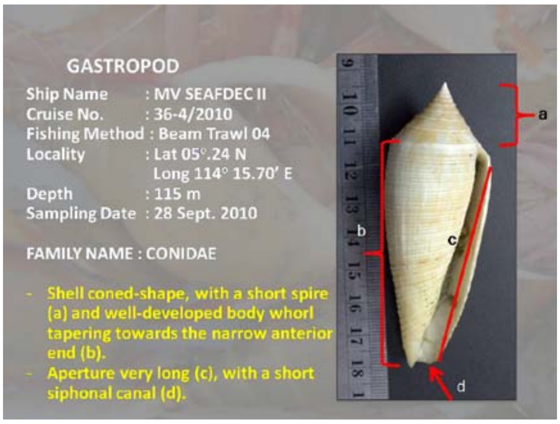

IDENTIFICATION OF DEEP-SEA BENTHIC MACROINVERTEBRATE VULNERABLE TO FISHING GEAR
Duranta D. Kembaren
Nurul Zuraiedah Hj Ibrahim
Hjh Alina Hj Jair

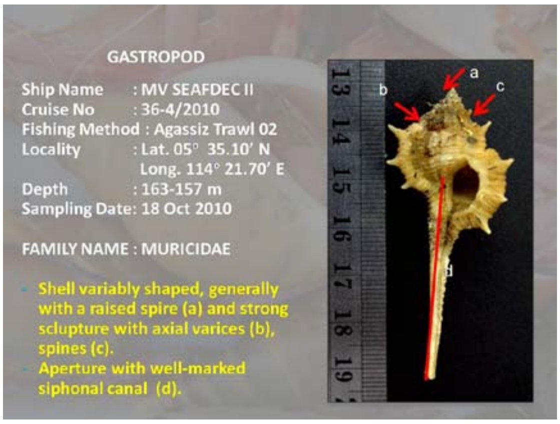

Objectives
Participant' ability on deep-sea benthic macroinvertebrate identification will be enhanced through practical works;
Deep-sea benthic macroinvertebrate specimen collected from fisheries resources survey by MV. SEAFDEC 2 will be identified to the lowest taxa.

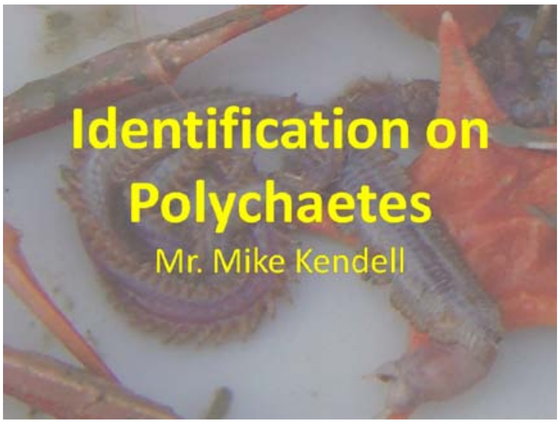

Commanly captured in the South China Sea at the sea depth between 100 and 300 meter such as :
Gastropods
Bilvalves
Polychaetes
Echinoderm
Porifera
Shrimps
Lobsters and
Crabs

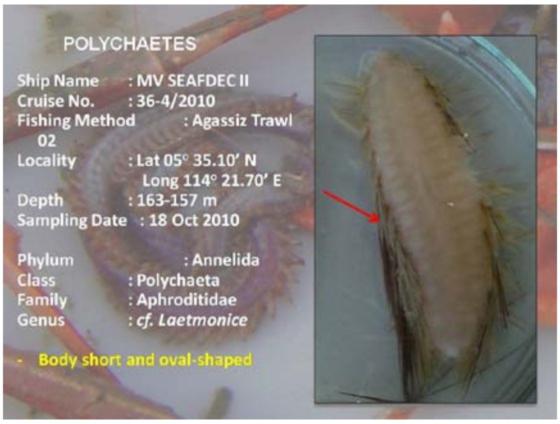

Identification on Gastropod
Mr. Teerapong Duangdee

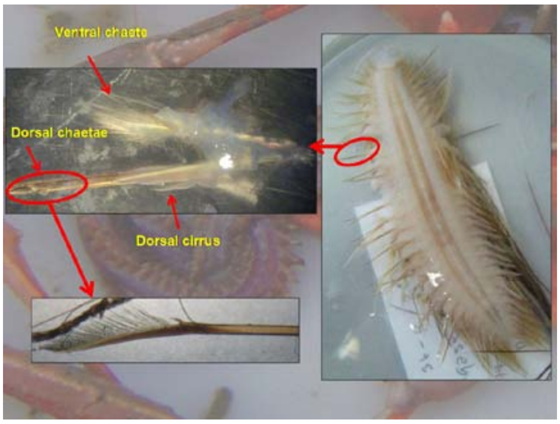

GASTROPOD
Ship Name : MV SEAFDEC II
Cruise No. : 36-4/2010
Fishing Method : Otter Trawl 04
Locality : Lat. 05° 12.60' N
Long. 114° 11.60' E
Depth : 109 m
Sampling Date : 21 Sept 2010
Family : Strombidae
a. Shell thick soild, large body whorl, notch at outer lip
b. operculum corneous, claw-like
b
a

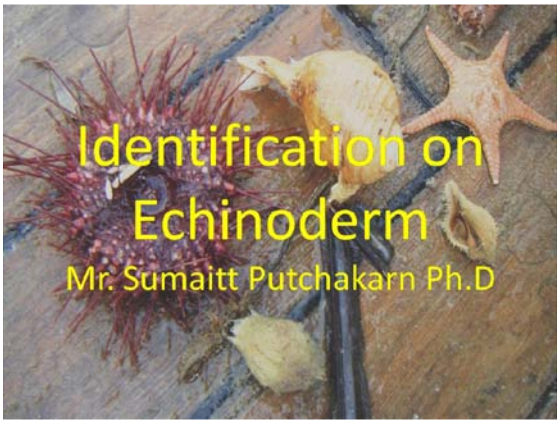

GASTROPOD
Ship Name : MV SEAFDEC II
Cruise No. : 36-4/2010
Fishing Method : Beam Trawl 04
Locality : Lat 05°.24 N
Long 114° 15.70' E
Depth : 115 m
Sampling Date : 28 Sept. 2010
FAMILY NAME : CONIDAE
- Shell coned-shape, with a short spire (a) and well-developed body whorl tapering towards the narrow anterior end (b).
- Aperture very long (c), with a short siphonal canal (d).
a
b
c
d


GASTROPOD
Ship Name : MV SEAFDEC II
Cruise No : 36-4/2010
Fishing Method : Agassiz Trawl 02
Locality : Lat. 05° 35.10' N
Long. 114° 21.70' E
Depth : 163-157 m
Sampling Date: 18 Oct 2010
FAMILY NAME : MURICIDAE
- Shell variably shaped, generally with a raised spire (a) and strong sclupture with axial varices (b), spines (c).
- Aperture with well-marked siphonal canal (d).
a
b
c

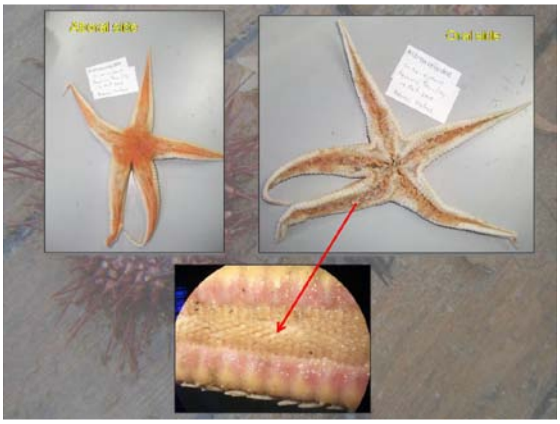

Identification on Polychaetes
Mr. Mike Kendell

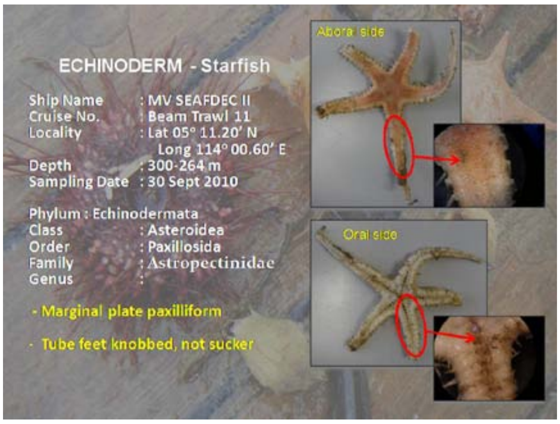

POLYCHAETES
Ship Name : MV SEAFDEC II
Cruise No. : 36-4/2010
Fishing Method : Agassiz Trawl 02
Locality : Lat 05° 35.10' N
Long 114° 21.70' E
Depth : 163-157 m
Sampling Date : 18 Oct 2010
Phylum : Annelida
Class : Polychaeta
Family : Aphroditidae
Genus : cf. Laetmonice
- Body short and oval-shaped


Ventral chaete
Dorsal chaetae
Dorsal cirrus


Identification on
Echinoderm
Mr. Sumaitt Putchakarn Ph.D


ECHINODERM - Starfish
Ship Name : MV SEAFDEC II
Cruise No. : 36-4/2010
Fishing Method : Agassiz Trawl 03
Locality : Lat 05° 38.80' N
Long 114° 22.50' E
Depth : 360 m
Sampling Date : 19 Oct 2010
Phylum : Echinodermata
Class : Asteroidea
Order : Paxillosida
Family : Astropectinidae
Genus : Persephonaster
Species : Persephonaster euryactis
- Marginal plate not paxilliform
- Tube feet knobbed, not sucker

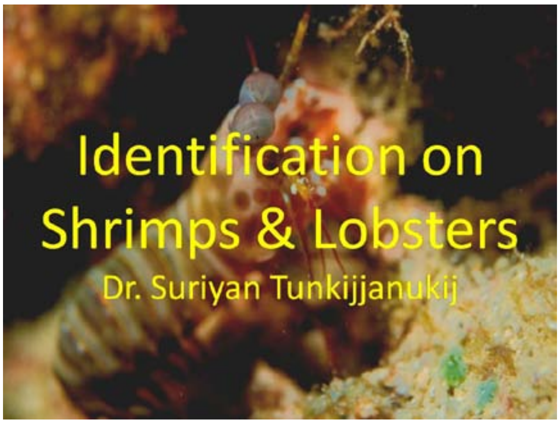



ECHINODERM - Starfish
Ship Name : MV SEAFDEC II
Cruise No. : Beam Trawl 11
Locality : Lat 05° 11.20' N
Long 114° 00.60' E
Depth : 300-264 m
Sampling Date : 30 Sept 2010
Phylum : Echinodermata
Class : Asteroidea
Order : Paxillosida
Family : Astropectinidae
Genus
- Marginal plate paxilliform
- Tube feet knobbed, not sucker
Aboral side
Oral side

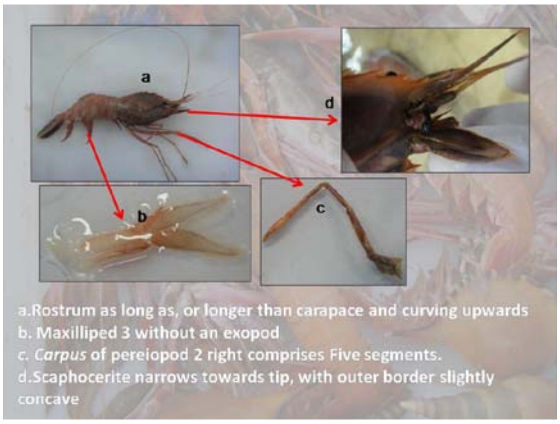

ECHINODERM - Starfish
Ship Name : MV SEAFDEC II
Cruise No. : 36-4/2010
Fishing Method : Beam Trawl 10
Locality : Lat: 05° 07.10' N
Long : 113° 52.60' E
Depth : 264 m
Sampling Date : 30 Sept 2010
Phylum : Echinodermata
Class : Asteroidea
Order : Valvatida
Family : Goniasteridae
- Marginal plate well-develop
- Tube feet sucker
Aboral side
Oral side

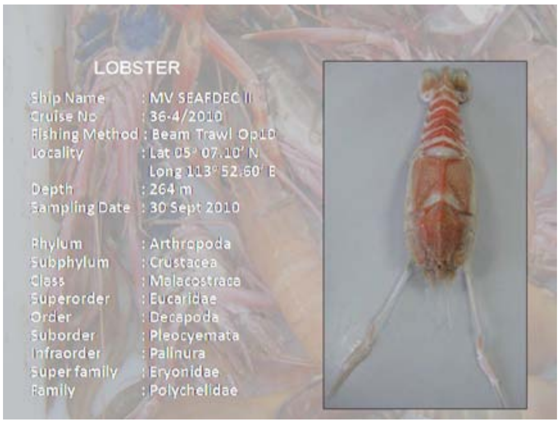

ECHINODERM - Starfish
Ship Name : MV SEAFDEC II
Cruise No : Beam Trawl 01
Locality : Lat 05° 33.10' N
Long 114° 27.00' E
Depth : 180 m
Sampling Date : 28 Sept 2010
Phylum : Echinodermata
Class : Asteroidea
Order : Valvatida
Family : Goniasteridae
Genus : Stellaster
Species : Stellaster equestris
- Marginal plate well-develop
- Tube feet sucker
Aboral side
Oral side

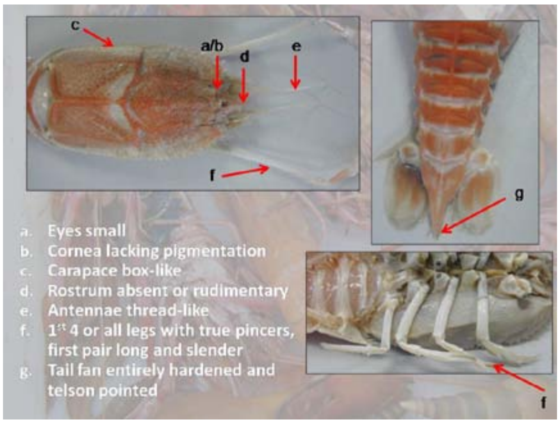

ECHINODERM - Starfish
Ship Name : MV SEAFDEC II
Cruise No : Beam Trawl 01
Locality : Lat 05° 33.10' N
Long 114° 27.00' E
Depth : 180 m
Sampling Date : 28 Sept 2010
Phylum : Echinodermata
Class : Asteroidea
Order : Valvatida
Family : Goniasteridae
Genus : Iconaster
- Marginal plate well-develop
- Tube feet sucker
Aboral side
Oral side

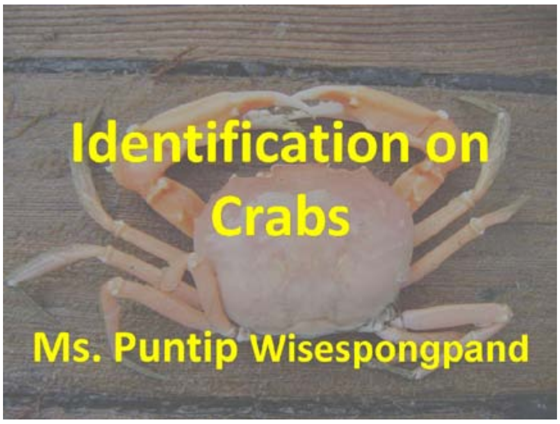

Identification on
Shrimps & Lobsters
Dr. Suriyan Tunkijjanukij

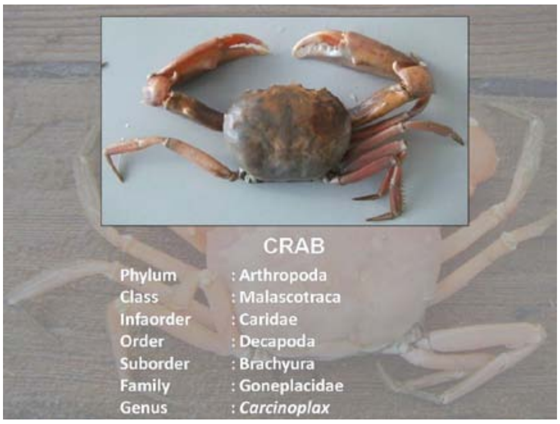

SHRIMP
Ship Name : MV SEAFDEC II
Cruise No : 36-4/2010
Fishing Method : Trap 03
Locality : Lat 05° 36.90' N
Long 114° 21.70' E
Depth : 388 m
Sampling Date : 18 Oct 2010
Phylum : Arthropoda
Class : Malascotraca
Infaorder : Caridae
Order : Decapoda
Suborder : Pleocyemata
Family : Pandalidae
Genus : Pandalus
Species : Pandalus propinquus


a
b
c
d
a.Rostrum as long as, or longer than carapace and curving upwards
b. Maxilliped 3 without an exopod
c. Carpus of pereiopod 2 right comprises Five segments.
d.Scaphocerite narrows towards tip, with outer border slightly concave

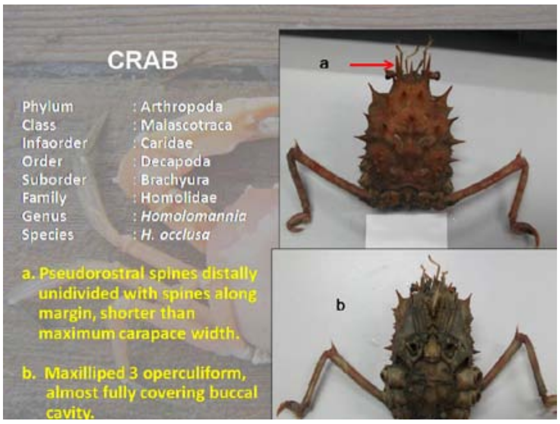

LOBSTER
Ship Name : MV SEAFDEC II
Cruise No : 36-4/2010
Fishing Method : Beam Trawl Op10
Locality : Lat 05° 07.10' N
Long 113° 52.60' E
Depth : 264 m
Sampling Date : 30 Sept 2010
Phylum : Arthropoda
Subphylum : Crustacea
Class : Malacostraca
Superorder : Eucaridae
Order : Decapoda
Suborder : Pleocyemata
Infraorder : Palinura
Super family : Eryonidae
Family : Polychelidae


c
a/b
d
e
f
g
f
a. Eyes small
b. Cornea lacking pigmentation
c. Carapace box-like
d. Rostrum absent or rudimentary
e. Antennae thread-like
f. 1st 4 or all legs with true pincers, first pair long and slender
g. Tail fan entirely hardened and telson pointed


Identification on
Crabs
Ms. Puntip Wisespongpand


CRAB
Phylum : Arthropoda
Class : Malascotraca
Infaorder : Caridae
Order : Decapoda
Suborder : Brachyura
Family : Goneplacidae
Genus : Carcinoplax

(continued) **Annex 18/2**



Annex 18/3: Results presentation of Group III

By Mr.Aekkarat Wongkeaw

Mr.Eakapol Rattanapan

Mr.Watcharapong Chumchuen

Group III

Mr.Aekkarat Wongkeaw

Mr.Eakapol Rattanapan

Mr.Watcharapong Chumchuen

Identification Results

- Gastropods
- Polychaetes
- Sponges
- Crabs

Abbreviations

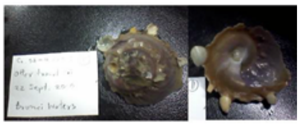
- Fam. = Family
- M. = Male
- F. = Female
- Cp. = Carapace
- W/ = With
- W/O = Without

Gastropods

- Shell well developed
- Not ear/cap shaped

Xenophoridae

- Shell W/O anterior siphon canal
- Shell length shorter than width
- Umbilicus not open
- Cemented foreign bodies



Muricidae

- Shell W/Rised spire
- Strong sculpture W/Axial varices spines
- Tubercle process
- Aperture W/Well-mark siphon canal

Cassidae

- Shell thick W/Large body whorl
- Small conical spire
- Short siphon canal
- Recurved dorsally
- Outer lip thickened

Polychaete

Polychaete

Fam. Polynodontidae

- Scale on dorsal
- Only one lobe as neuropodium on parapodium
- Simple setae
- Eyes W/Stalk

Sponges

Class Hexactinellida

Class Demospongiae

Class Haxactinellida

Order Lyssacinosida
Fam. Euplectellidae

- 6 ray spicules
- Include discohexasters

http://porifera.lifedesks.org/files/porifera/images/Slide5_53.JPG

Class Demospongiae

Order Spirophorida
Fam. Tettilidae

- 4 ray spicules
- Small conical shapes

www.eol.org/pages/6827?vetted=true

Crabs

Fam. Portunidae

Fam. Calappidae

Portunidae

- M. genital opening on coxo-sternal & F. on sterna
- Pereopods: 5 pairs
- Transversely ovate Carapace
- Cp. Broader than long
- Front W/Multidentate
- 5th Pereopod Flattened

Portunidae

- Anterolateral with 6 teeth
- Merus shorter than Cp.
- Merus W/4 spines
- Manus W/4 Spines
- Cp. W/O cross-like mark
- Ventral surface of manus with squamiform/not smooth

Charybdis miles

Calappidae

- Cp. W/Clypeiform process
- Rigth chaela with forceps-like
- 3rd maxiliped merus not triangular
- Ambulatory legs almost uncovered by carapace

Calappa pustulosa

For This Program

- Improve our skills on MBMI
- It is a good change for our work together in the future

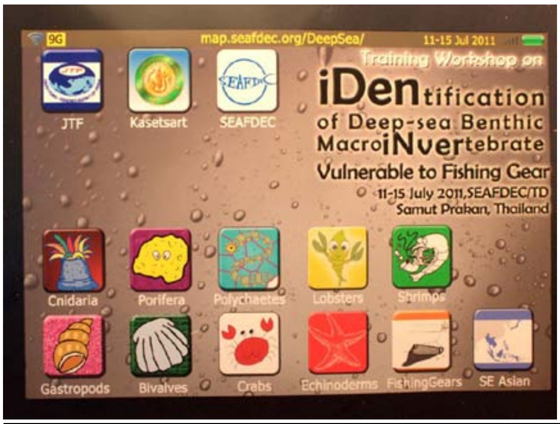
Annex 18/4: Results presentation of Group IV

By Mr. Joeren Yleana

Mr. Val Borja

Ms. Ngo Thi MauThu

Ms. Ngo Thi Thanh Huong



The PHilippines-VIetnam Laboratory Exercise Results

"Regional Training/Workshop on Identification of Deep-Sea Benthic Macro Invertebrates Vulnerable to Fishing Gear"

11-15 July 2011

Results…

Taxa Group/ No. Specimen

Group	Family	Genus sp.	No.
Gastropoda	*Turridae*	–	1
	Epitonidae	–	1
	Personidae	*Distorsio reticularis*	1
	Ovulidae	*Volva volva*	1
Polychaeta	*Aphroditidae*	*Laetmonice sp.*	1
Echinodermata	*Cidaridae*	*Goniocidaris sp.*	4
	Echinothuriidae	*Calveriosoma sp.*	6
	Schizasteridae	*Linopneustis sp.*	1
	Diadematidae	*Chaetodiadema sp.*	4

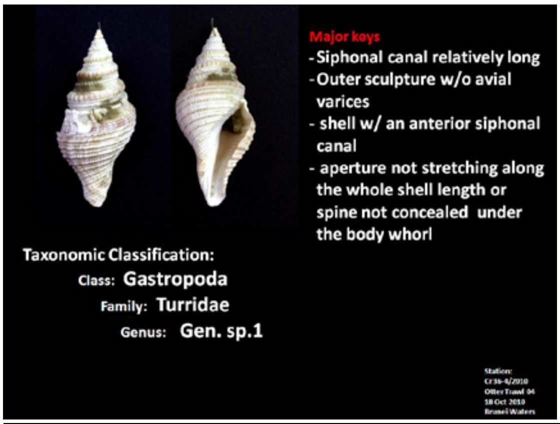
Results…

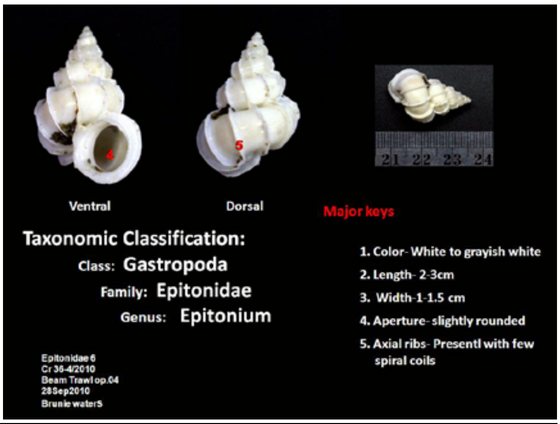
Taxa Group/ No. Specimen

Group	Family	Genus sp.	No.
Crustacea	*Squillidae*	*Oratosquilla sp.*	1
	Aristeidae	*Aristeus virilis*	1
	Solenoceridae	*Haliporoides sibugae*	1
	Nephropidae	*Metanephrops sinensis*	1
	Calappidae	*Paracyclois milneedwardsi*	1
	Raninidae	*Lyreidas tridentatus*	1
	Portunidae	*Carybdis acuta*	1

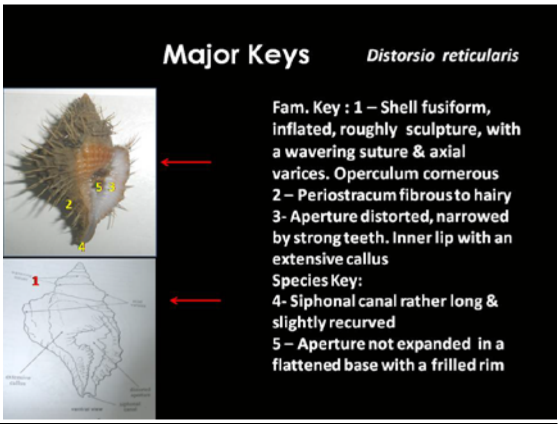
TOTAL Specimen……… **27**

Gastropoda

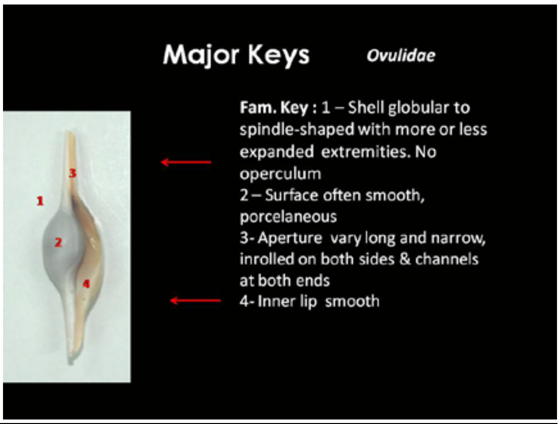

Major keys
- Siphonal canal relatively long
- Outer sculpture w/o avial varices
- shell w/ an anterior siphonal canal
- aperture not stretching along the whole shell length or spine not concealed under the body whorl
Taxonomic Classification:
Class: Gastropoda
Family: Turridae
Genus: Gen. sp.1

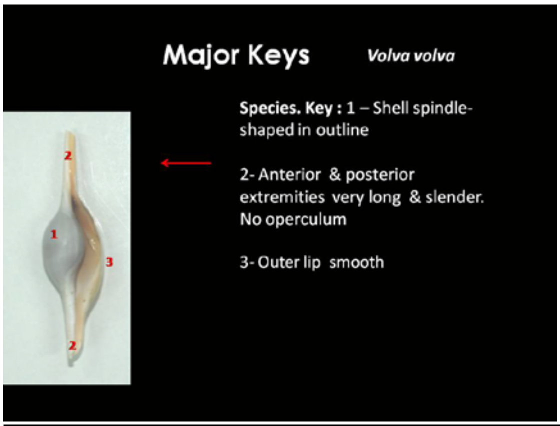

Ventral
Dorsal
Major keys
Taxonomic Classification:
Class: Gastropoda
Family: Epitonidae
Genus: Epitonium
1. Color- White to grayish white
2. Length- 2-3cm
3. Width-1-1.5 cm
4. Aperture- slightly rounded
5. Axial ribs- Presentl with few spiral coils
Epitonidae 6
Cr 36-4/2010
Beam Trawl op.04
28Sep2010
Brunie waterS

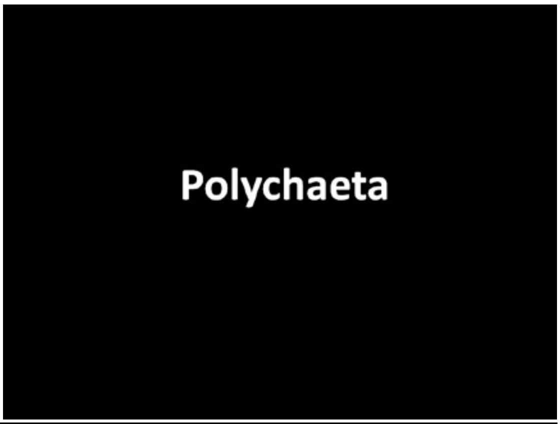

GASTROPODS
Taxonomic Classification:
Class: Gastropod
Family: Personidae
Sci. Name: Distorsio reticularis
Station:
Cr 36-4/2010
Beam Trawl op.01
28 Sept 2010
Brunei Water

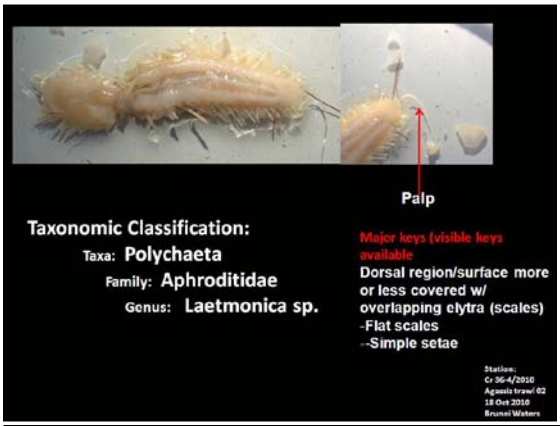

Major Keys
Distorsio reticularis
Fam. Key : 1 – Shell fusiform, inflated, roughly sculpture, with a wavering suture & axial varices. Operculum corneous
2 – Periostracum fibrous to hairy
3- Aperture distorted, narrowed by strong teeth. Inner lip with an extensive callus
Species Key:
4- Siphonal canal rather long & slightly recurved
5 – Aperture not expanded in a flattened base with a frilled rim


GASTROPODS
Taxonomic Classification:
Class: Gastropoda
Family: Ovulidae
Sci. Name: Volva volva
Station:
Cr 36-4/2010
Beam Trawl op.04
28 Sept 2010
Brunei Water

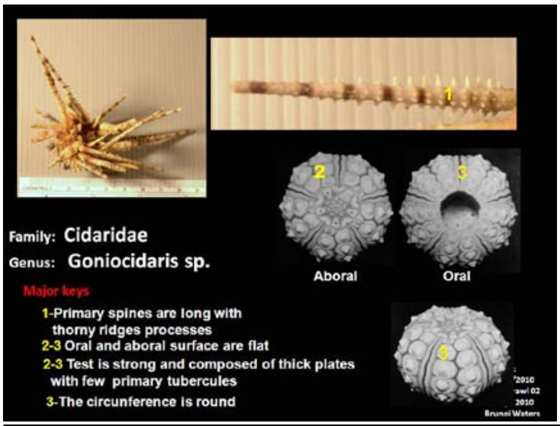

Major Keys
Ovulidae
Fam. Key : 1 – Shell globular to spindle-shaped with more or less expanded extremities. No operculum
2 – Surface often smooth, porcelaneous
3- Aperture vary long and narrow, inrolled on both sides & channels at both ends
4- Inner lip smooth

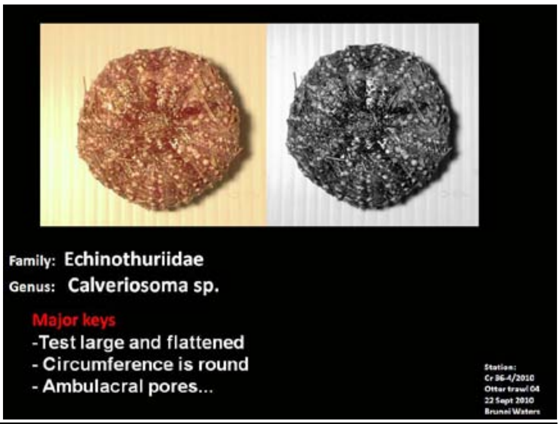

Major Keys
Volva volva
Species. Key : 1 – Shell spindle-shaped in outline
2- Anterior & posterior extremities very long & slender. No operculum
3- Outer lip smooth

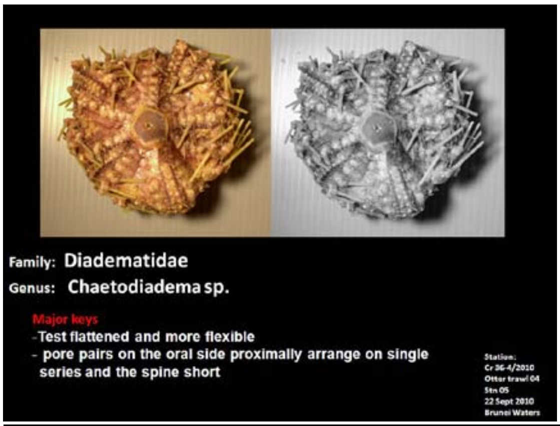

Polychaeta

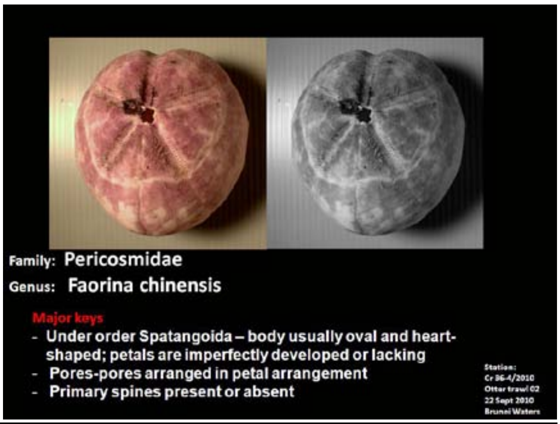

Palp
Taxonomic Classification:
Taxa: Polychaeta
Family: Aphroditidae
Genus: Laetmonica sp.
Major keys (visible keys available
Dorsal region/surface more or less covered w/ overlapping elytra (scales)
-Flat scales
--Simple setae
Station:
Cr 36-4/2010
Agassiz trawl 02
18 Oct 2010
Brunei Waters


Echinodermata


Family: Cidaridae
Genus: Goniocidaris sp.
Aboral
Oral
Major keys
1-Primary spines are long with thorny ridges processes
2-3 Oral and aboral surface are flat
2-3 Test is strong and composed of thick plates with few primary tubercules
3-The circunference is round
Brunei Waters

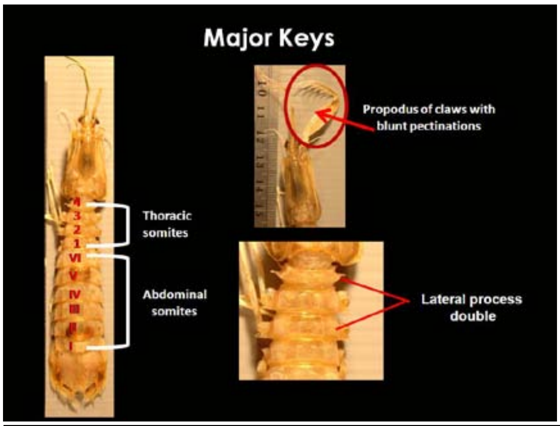

Family: Echinothuriidae
Genus: Calveriosoma sp.
Major keys
-Test large and flattened
- Circumference is round
- Ambulacral pores...
Station:
Cr 36-4/2010
Otter trawl 04
22 Sept 2010
Brunei Waters


Family: Diadematidae
Genus: Chaetodiadema sp.
Major keys
-Test flattened and more flexible
- pore pairs on the oral side proximally arrange on single series and the spine short
Station:
Cr 36-4/2010
Otter trawl 04
Stn 05
22 Sept 2010
Brunei Waters

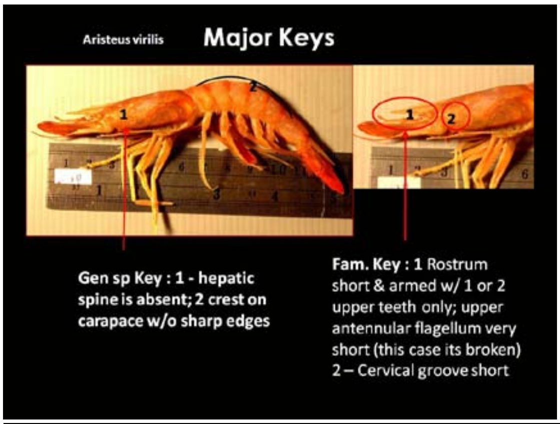

Family: Pericosmidae
Genus: Faorina chinensis
Major keys
- Under order Spatangoida – body usually oval and heart-shaped; petals are imperfectly developed or lacking
- Pores-pores arranged in petal arrangement
- Primary spines present or absent
Station:
Cr 36-4/2010
Otter trawl 02
22 Sept 2010
Brunei Waters


Crustacea

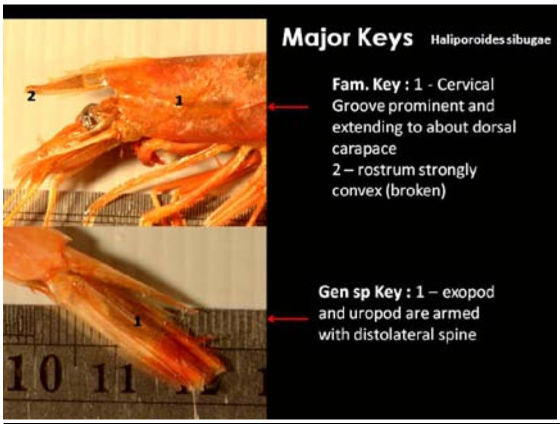

Mantis Shrimps
Order: Stomatopoda
Family: Squillidae
Genus: Oratosquilla sp.
Station:
Cr 36-4/2010
Beam Trawl 07
29 Sept 2010
Brunei Waters


Major Keys
Propodus of claws with blunt pectinations
Thoracic somites
Abdominal somites
Lateral process double

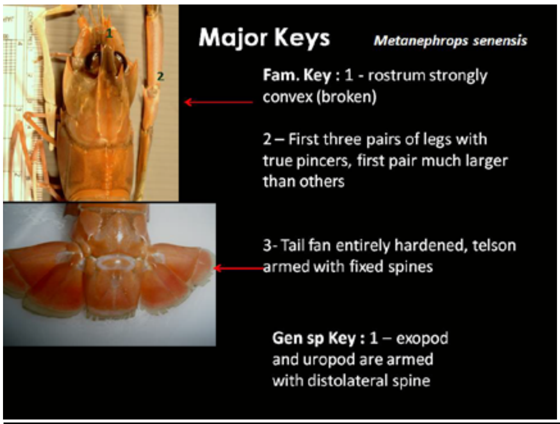

Order: Penaeoidea
Family: Aristeidae
Sci. Name: Aristeus virilis
Station:
Cr 36-4/2010
Agassiz Trawl 03
19 Oct 2010
Brunei Waters

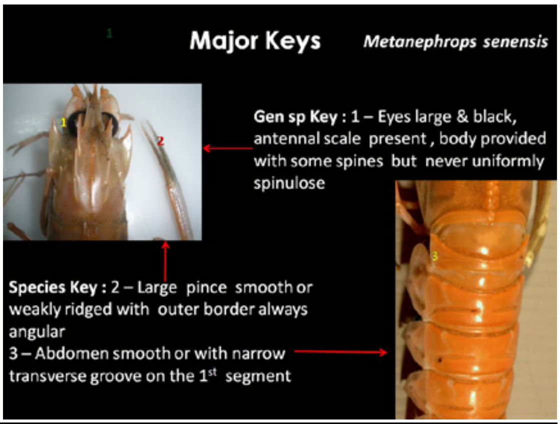

Aristeus virilis
Major Keys
Gen sp Key : 1 - hepatic spine is absent; 2 crest on carapace w/o sharp edges
Fam. Key : 1 Rostrum short & armed w/ 1 or 2 upper teeth only; upper antennular flagellum very short (this case its broken)
2 – Cervical groove short


Order: Penaeoidea
Family: Solenoceridae
Sci. Name: Haliporoides sibugae
Station:
Cr 36-4/2010
Agassiz Trawl 03
19 Oct 2010
Brunei Waters

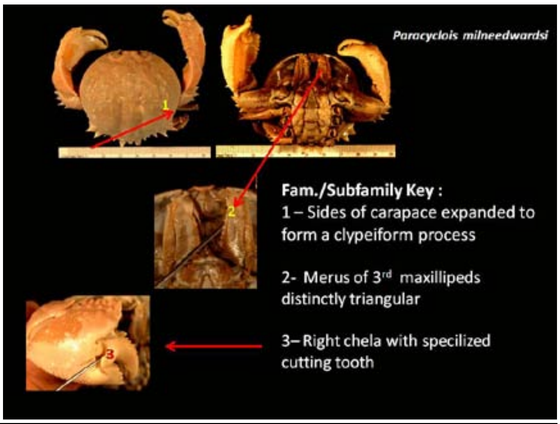

Major Keys
Haliporoides sibugae
Fam. Key : 1 - Cervical Groove prominent and extending to about dorsal carapace
2 – rostrum strongly convex (broken)
Gen sp Key : 1 – exopod and uropod are armed with distolateral spine

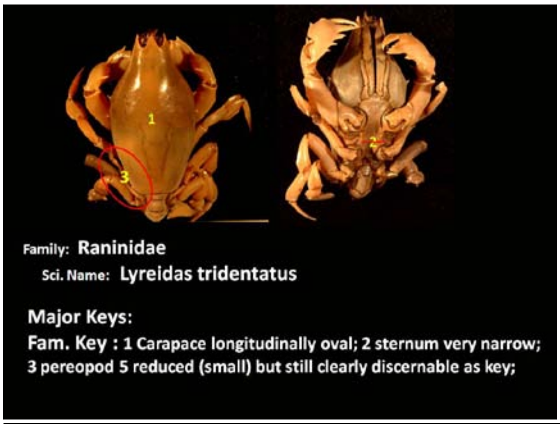

LOBSTER
Taxonomic Classification:
Order: Decapoda
Family: Nephropidae
Sci. Name: Metanephrops sinensis
Station:
Cr 36-4/2010
Beam Trawl 10
St. A11-A12
30 Sept 2010
Brunei Water

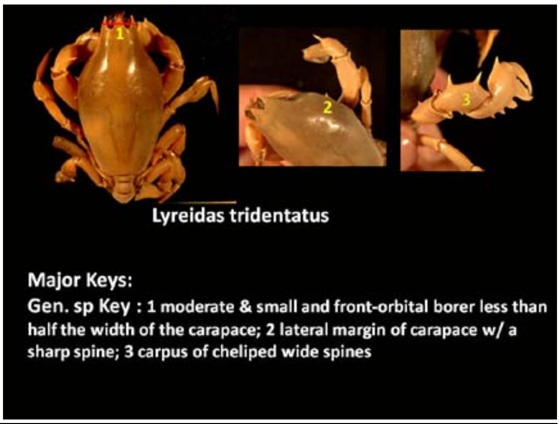

Major Keys
Metanephrops senensis
Fam. Key : 1 - rostrum strongly convex (broken)
2 – First three pairs of legs with true pincers, first pair much larger than others
3- Tail fan entirely hardened, telson armed with fixed spines
Gen sp Key : 1 – exopod and uropod are armed with distolateral spine

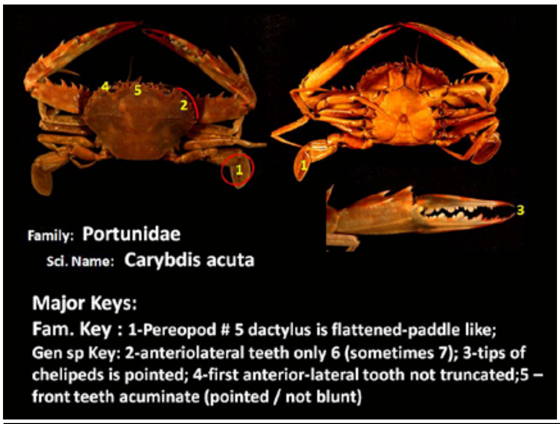

Major Keys
Metanephrops senensis
Gen sp Key : 1 – Eyes large & black, antennal scale present, body provided with some spines but never uniformly spinulose
Species Key : 2 – Large pince smooth or weakly ridged with outer border always angular
3 – Abdomen smooth or with narrow transverse groove on the 1st segment


Taxonomic Classification:
Order: *Decapoda*
Family: *Calappidae*
Subfamily: *Calappinae*
Sci. Name: Paracyclois *milneedwardsi*
(Miers, 1886)


Paracyclois milneedwardsi
1
2
3
Fam./Subfamily Key :
1 – Sides of carapace expanded to form a clypeiform process
2- Merus of 3rd maxillipeds distinctly triangular
3 – Right chela with specilized cutting tooth


1
3
Family: Raninidae
Sci. Name: Lyreidas tridentatus
Major Keys:
Fam. Key : 1 Carapace longitudinally oval; 2 sternum very narrow; 3 pereopod 5 reduced (small) but still clearly discernable as key;


1
2
3
Lyreidas tridentatus
Major Keys:
Gen. sp Key : 1 moderate & small and front-orbital borer less than half the width of the carapace; 2 lateral margin of carapace w/ a sharp spine; 3 carpus of cheliped wide spines


4
5
2
1
3
Family: Portunidae
Sci. Name: Carybdis acuta
Major Keys:
Fam. Key : 1-Pereopod # 5 dactylus is flattened-paddle like;
Gen sp Key: 2-anteriolateral teeth only 6 (sometimes 7); 3-tips of chelipeds is pointed; 4-first anterior-lateral tooth not truncated;5 – front teeth acuminate (pointed / not blunt)


THANK YOU

Annex 18/5: Results presentation of Group V

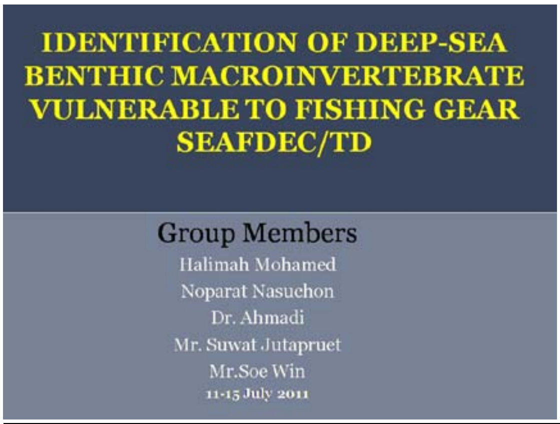
By Ms. Halimah Mohamed

Mrs. Noparat Nasuchon

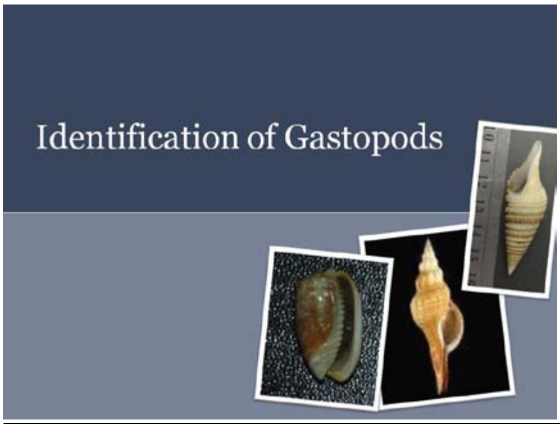
Dr. Ahmadi

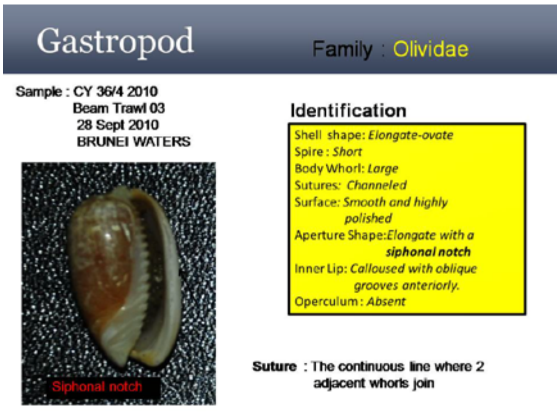
Mr. Suwat Jutapruet

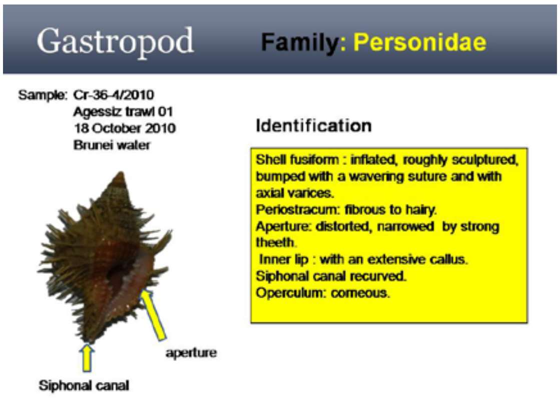
Mr. Soe Win

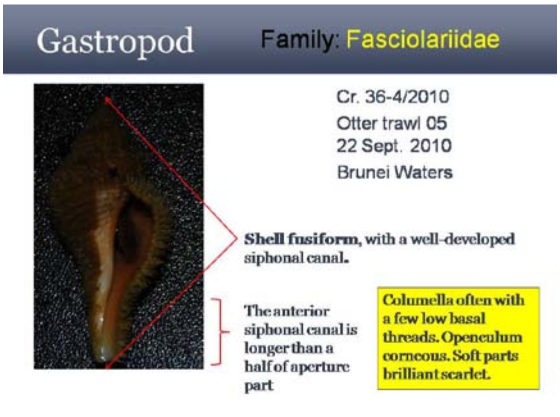

IDENTIFICATION OF DEEP-SEA BENTHIC MACROINVERTEBRATE VULNERABLE TO FISHING GEAR SEAFDEC/TD
Group Members
Halimah Mohamed
Noparat Nasuchon
Dr. Ahmadi
Mr. Suwat Jutapruet
Mr.Soe Win
11-15 July 2011

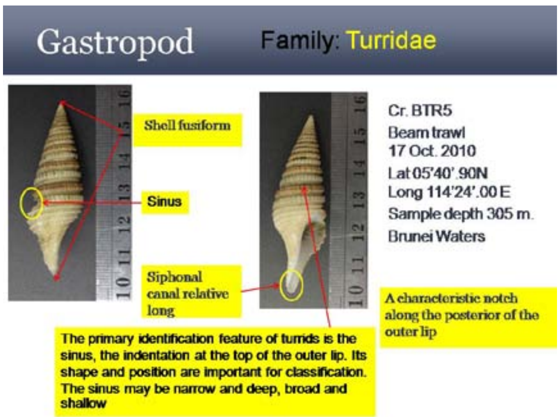

Gastropods: (4)
Olividae, Personidae, Fasciolariidae, Turridae
Polychate: (2)
Ophelidae
Sigalionidae
Echinoderm: (2)
Antedonidae
Metacrinus rotundus
Sea Cucumber: (2)
Eumolpadia sp
Acaudina molpadoides
Shrimp, Lobster, and Stomatopods
Shrimp: (4)
Aristaeomorpha foliacea, Metanaphrops sinensis, Caridae sulcirostris, Palaemon adspersue.
Lobster: (1)
Puerulus angulatus
Stomatopod: (2)
Chloridopsis immaculata, Lysiosquilla sulcirostris
Crabs: (8)
Carcinoplax micropthalmus, Medaeops granulosus, Paracyclois milneedwardsi, Mursia armata, Iphiculus spongiosus, Calappa pustulosa, Latreillopsis bispinosa, Ixa edwardii.
No. Specimen Identified = 25
Caught by :
-Beam trawl and
-Agassiz traw
Location:
Brunei waters

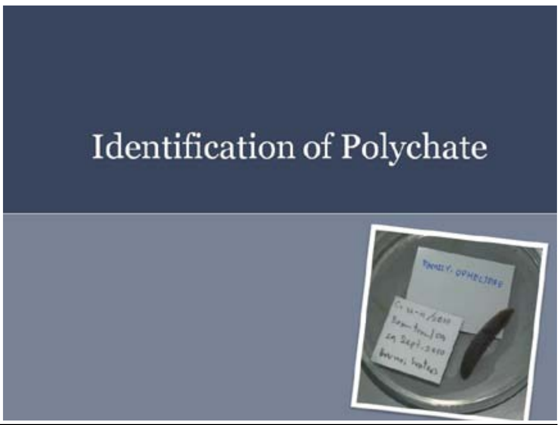

Identification of Gastopods

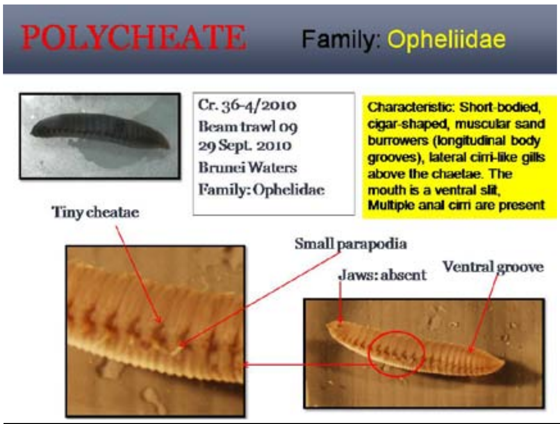

Gastropod
Family : Olividae
Sample : CY 36/4 2010
Beam Trawl 03
28 Sept 2010
BRUNEI WATERS
Identification
Shell shape: Elongate-ovate
Spire : Short
Body Whorl: Large
Sutures: Channeled
Surface: Smooth and highly polished
Aperture Shape:Elongate with a siphonal notch
Inner Lip: Callosed with oblique grooves anteriorly.
Operculum : Absent
Siphonal notch
Suture : The continuous line where 2 adjacent whorls join

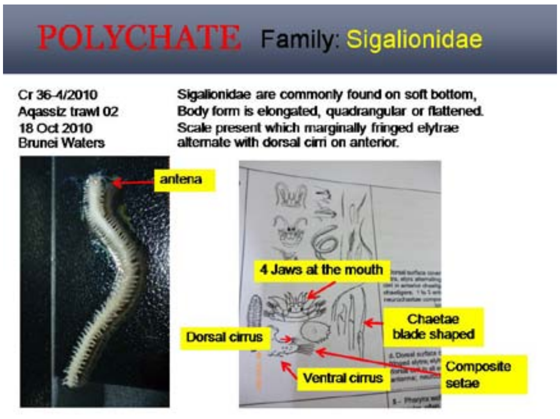

Gastropod
Family: Personidae
Sample: Cr-36-4/2010
Agessiz trawl 01
18 October 2010
Brunei water
Identification
Shell fusiform : inflated, roughly sculptured, bumped with a wavering suture and with axial varices.
Periostracum: fibrous to hairy.
Aperture: distorted, narrowed by strong theeth.
Inner lip : with an extensive callus.
Siphonal canal recurved.
Operculum: corneous.
aperture
Siphonal canal

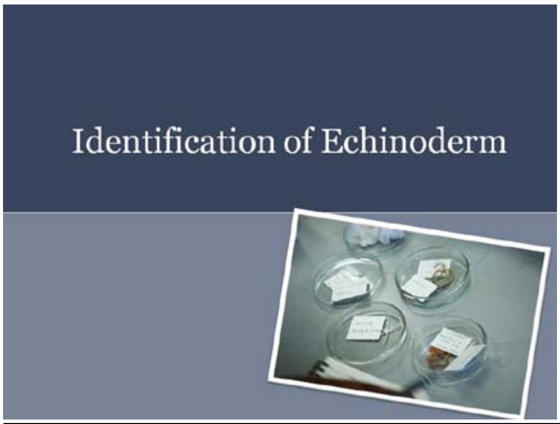

Gastropod
Family: Fasciolariidae
Cr. 36-4/2010
Otter trawl 05
22 Sept. 2010
Brunei Waters
Shell fusiform, with a well-developed siphonal canal.
The anterior siphonal canal is longer than a half of aperture part
Columella often with a few low basal threads. Operculum corneous. Soft parts brilliant scarlet.

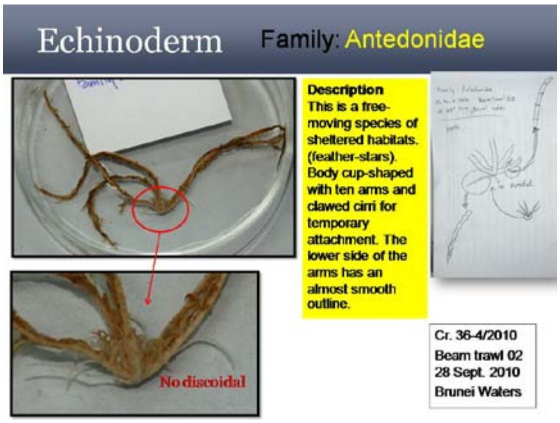

Gastropod
Family: Turridae
Shell fusiform
Sinus
Siphonal canal relative long
Cr. BTR5
Beam trawl
17 Oct. 2010
Lat 05'40'.90N
Long 114'24'.00 E
Sample depth 305 m.
Brunei Waters
A characteristic notch along the posterior of the outer lip
The primary identification feature of turrids is the sinus, the indentation at the top of the outer lip. Its shape and position are important for classification. The sinus may be narrow and deep, broad and shallow

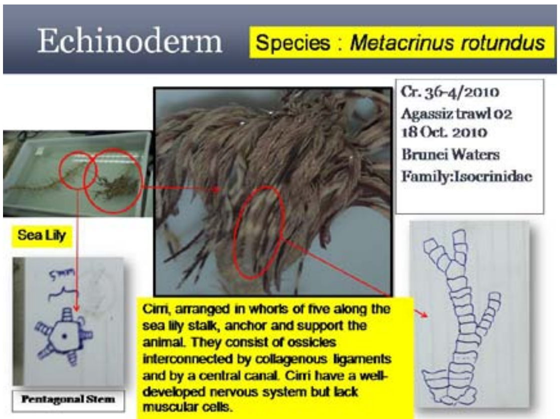

Identification of Polychate

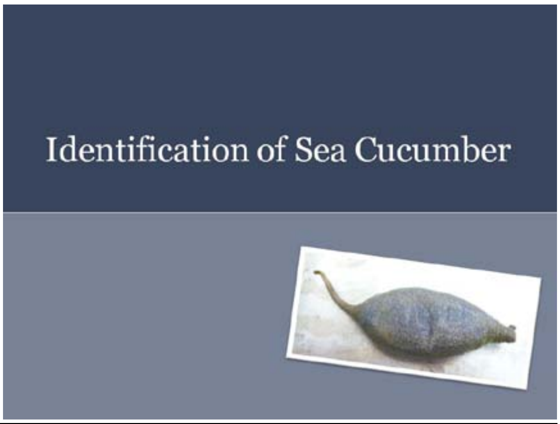

POLYCHEATE
Family: Opheliidae
Cr. 36-4/2010
Beam trawl 09
29 Sept. 2010
Brunei Waters
Family: Ophelidae
Characteristic: Short-bodied, cigar-shaped, muscular sand burrowers (longitudinal body grooves), lateral cirri-like gills above the chaetae. The mouth is a ventral slit, Multiple anal cirri are present
Tiny cheatae
Small parapodia
Jaws: absent
Ventral groove

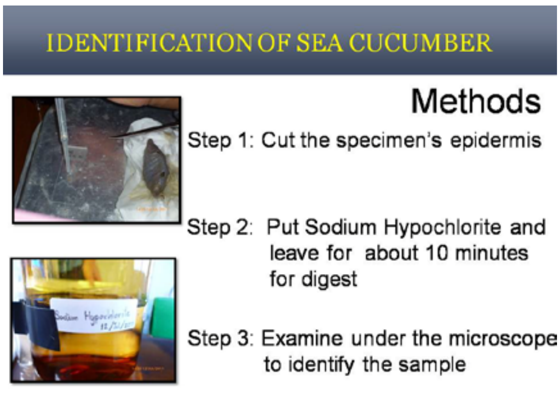

POLYCHATE
Family: Sigalionidae
Cr 36-4/2010
Agassiz trawl 02
18 Oct 2010
Brunei Waters
Sigalionidae are commonly found on soft bottom, Body form is elongated, quadrangular or flattened. Scale present which marginally fringed elytrae alternate with dorsal cirri on anterior.
antena
4 Jaws at the mouth
Chaetae blade shaped
Dorsal cirrus
Composite setae
Ventral cirrus

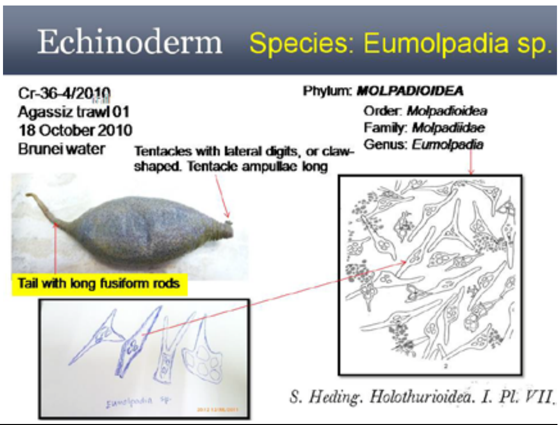

Identification of Echinoderm

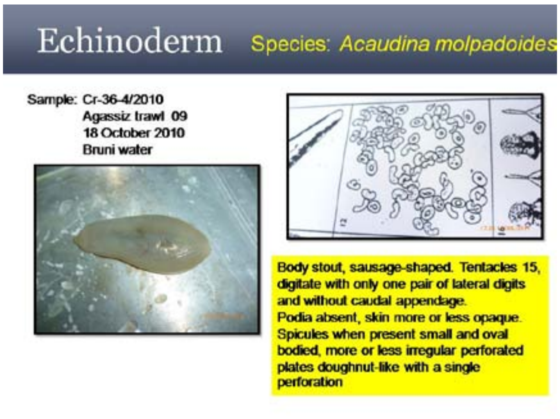

Echinoderm
Family: Antedonidae
Description
This is a free-moving species of sheltered habitats. (feather-stars). Body cup-shaped with ten arms and clawed cirri for temporary attachment. The lower side of the arms has an almost smooth outline.
Cr. 36-4/2010
Beam trawl 02
28 Sept. 2010
Brunei Waters
No discoidal

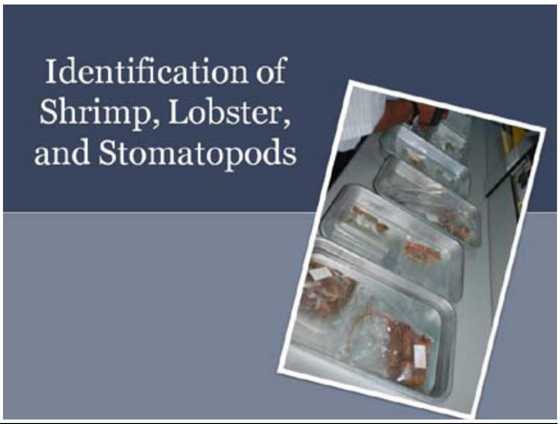

Echinoderm
Species : Metacrinus rotundus
Cr. 36-4/2010
Agassiz trawl 02
18 Oct. 2010
Brunei Waters
Family: Isocrinidae
Sea Lily
Pentagonal Stem
Cirri, arranged in whorls of five along the sea lily stalk, anchor and support the animal. They consist of ossicles interconnected by collagenous ligaments and by a central canal. Cirri have a well-developed nervous system but lack muscular cells.

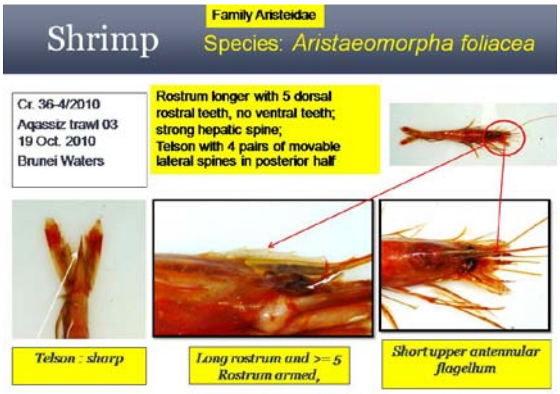

Identification of Sea Cucumber


IDENTIFICATION OF SEA CUCUMBER
Methods
Step 1: Cut the specimen's epidermis
Step 2: Put Sodium Hypochlorite and leave for about 10 minutes for digest
Step 3: Examine under the microscope to identify the sample

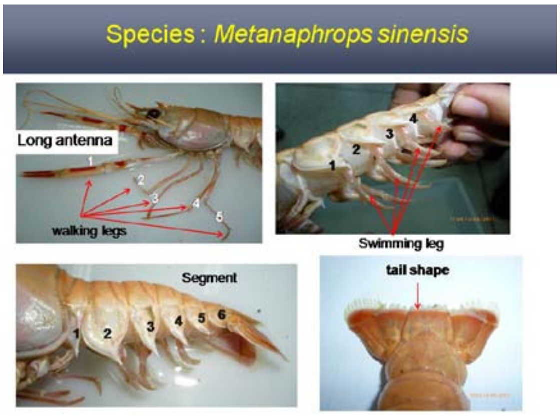

Echinoderm
Species: Eumolpadia sp.
Cr-36-4/2010
Agassiz trawl 01
18 October 2010
Brunei water
Phylum: MOLPADIOIDEA
Order: Molpadioidea
Family: Molpadiidae
Genus: Eumolpadia
Tentacles with lateral digits, or claw-shaped. Tentacle ampullae long
Tail with long fusiform rods
S. Heding. Holothurioidea. I. Pl. VII.

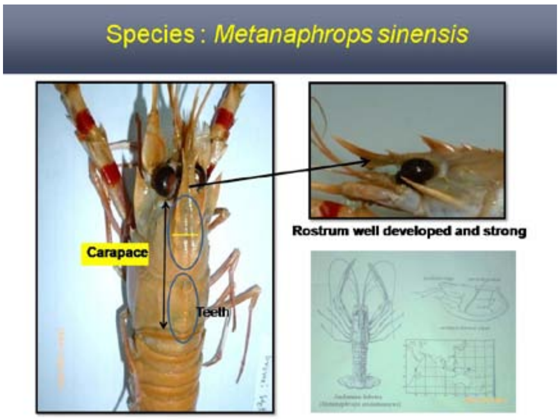

Echinoderm
Species: Acaudina molpadoides
Sample: Cr-36-4/2010
Agassiz trawl 09
18 October 2010
Bruni water
Body stout, sausage-shaped. Tentacles 15, digitate with only one pair of lateral digits and without caudal appendage.
Podia absent, skin more or less opaque.
Spicules when present small and oval bodied, more or less irregular perforated plates doughnut-like with a single perforation

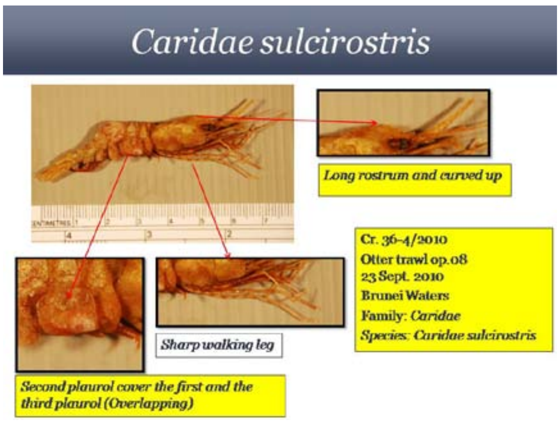

Identification of Shrimp, Lobster, and Stomatopods

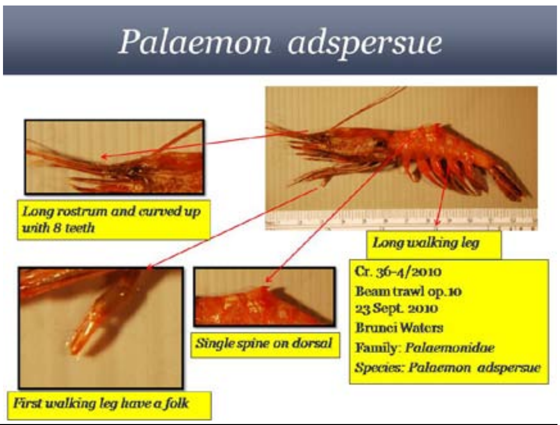

Shrimp
Family Aristeidae
Species: Aristaeomorpha foliacea
Cr. 36-4/2010
Agassiz trawl 03
19 Oct. 2010
Brunei Waters
Rostrum longer with 5 dorsal rostral teeth, no ventral teeth; strong hepatic spine;
Telson with 4 pairs of movable lateral spines in posterior half
Telson : sharp
Long rostrum and >= 5 Rostrum armed,
Short upper antennular flagellum

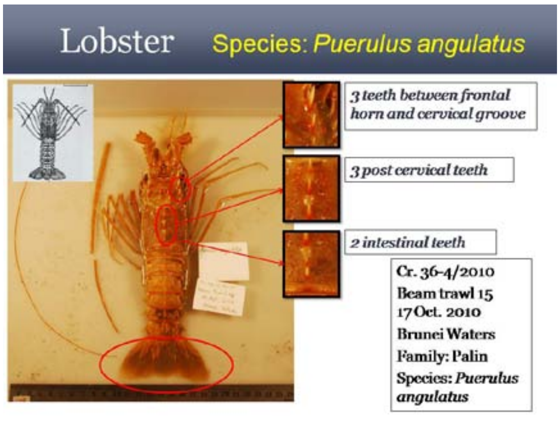

Family: Nephropoidea
Species : Metanaphrops sinensis
Sample: Cr 36-4 2010
Beam Trawl 09
29 Sept 2010
Brunei Waters

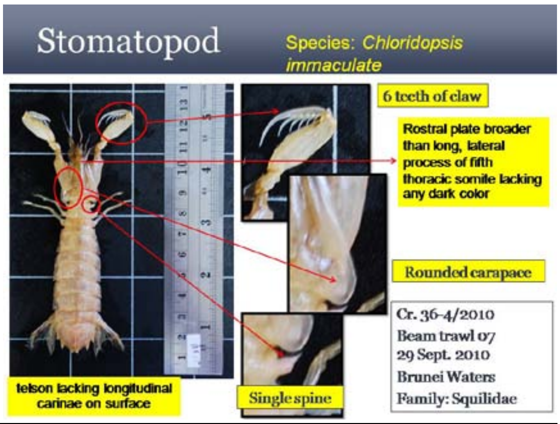

Species : Metanaphrops sinensis
Long antenna
walking legs
Swimming leg
Segment
tail shape

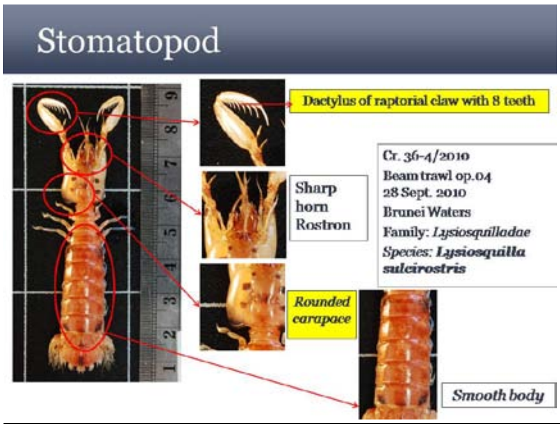

Species : Metanaphrops sinensis
Carapace
Teeth
Rostrum well developed and strong

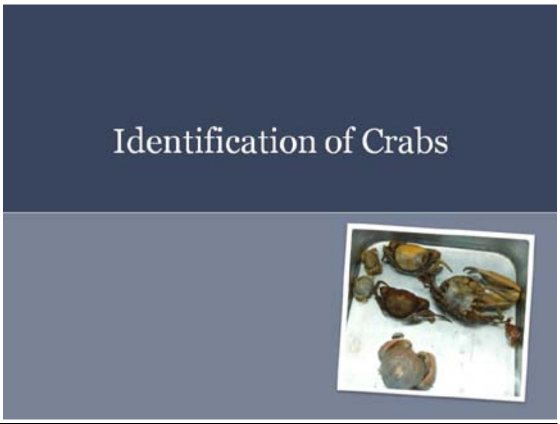

Caridae sulcirostris
Long rostrum and curved up
Sharp walking leg
Cr. 36-4/2010
Otter trawl op.08
23 Sept. 2010
Brunei Waters
Family: Caridae
Species: Caridae sulcirostris
Second plaurol cover the first and the third plaurol (Overlapping)

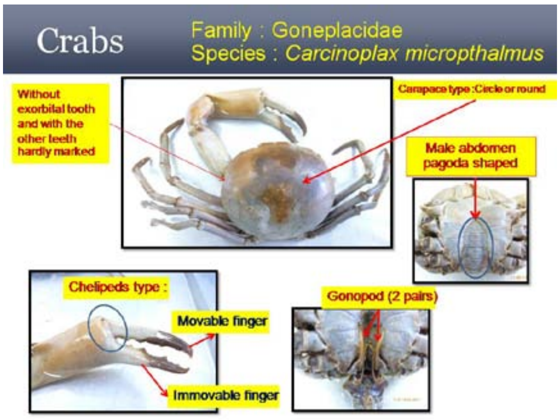

Palaemon adspersue
Long rostrum and curved up with 8 teeth
Long walking leg
Cr. 36-4/2010
Beam trawl op.10
23 Sept. 2010
Brunei Waters
Family: Palaemonidae
Species: Palaemon adspersue
Single spine on dorsal
First walking leg have a folk

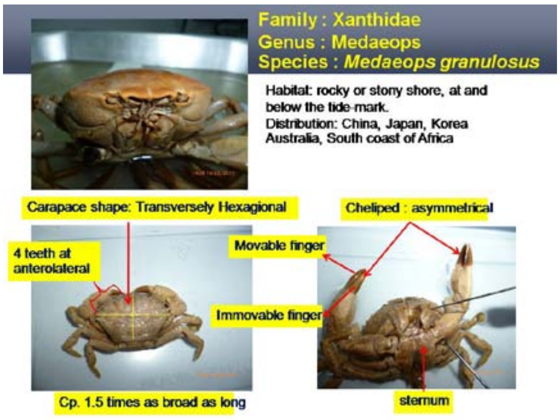

Lobster
Species: *Puerulus angulatus*
3 teeth between frontal horn and cervical groove
3 post cervical teeth
2 intestinal teeth
Cr. 36-4/2010
Beam trawl 15
17 Oct. 2010
Brunei Waters
Family: Palin
Species: Puerulus angulatus

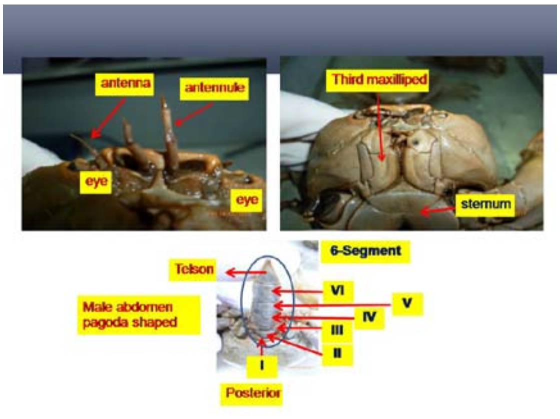

Stomatopod
Species: *Chloridopsis immaculate*
6 teeth of claw
Rostral plate broader than long, lateral process of fifth thoracic somile lacking any dark color
Rounded carapace
Cr. 36-4/2010
Beam trawl 07
29 Sept. 2010
Brunei Waters
Family: Squilidae
telson lacking longitudinal carinae on surface
Single spine

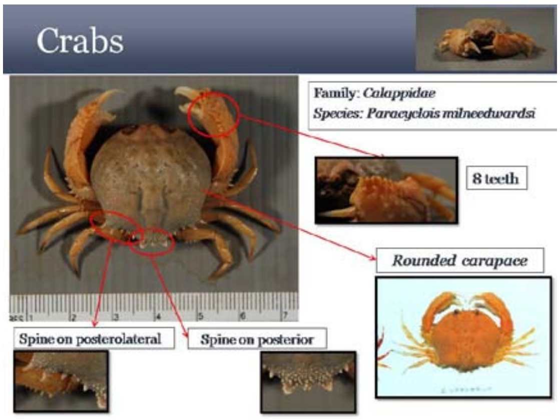

Stomatopod
Dactylus of raptorial claw with 8 teeth
Sharp horn Rostron
Cr. 36-4/2010
Beam trawl op.04
28 Sept. 2010
Brunei Waters
Family: Lysiosquilladae
Species: Lysiosquilla sulcirostris
Rounded carapace
Smooth body


Identification of Crabs

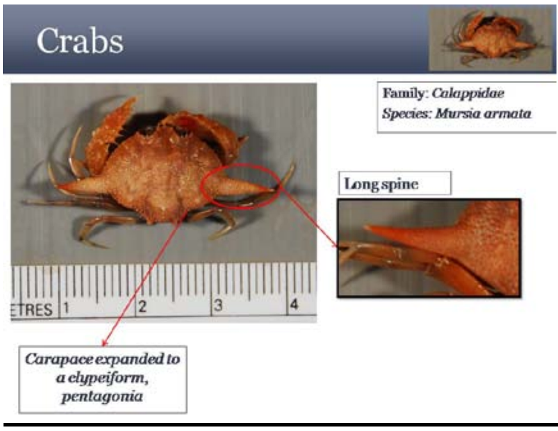

Crabs
Family : Goneplacidae
Species : *Carcinoplax micropthalmus*
Without exorbital tooth and with the other teeth hardly marked
Carapace type :Circle or round
Male abdomen pagoda shaped
Chelipeds type :
Movable finger
Immovable finger
Gonopod (2 pairs)

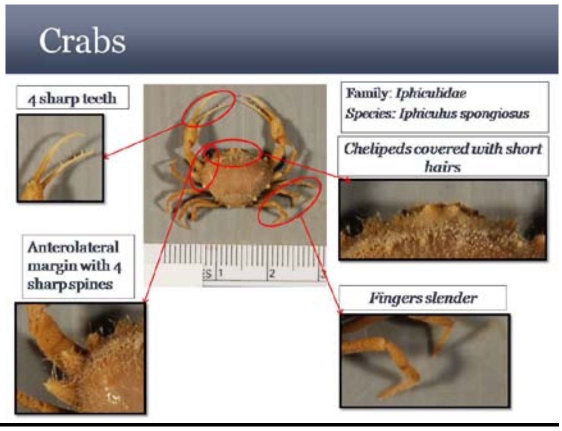

Family : Xanthidae
Genus : Medaeops
Species : *Medaeops granulosus*
Habitat: rocky or stony shore, at and below the tide-mark.
Distribution: China, Japan, Korea Australia, South coast of Africa
Carapace shape: Transversely Hexagional
Cheliped : asymmetrical
4 teeth at anterolateral
Movable finger
Immovable finger
Cp. 1.5 times as broad as long
sternum

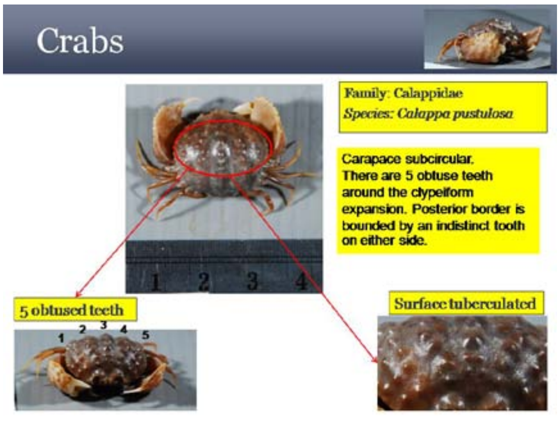

antenna
antennule
eye
eye
Third maxilliped
sternum
6-Segment
Telson
VI
V
IV
III
II
I
Male abdomen pagoda shaped
Posterior

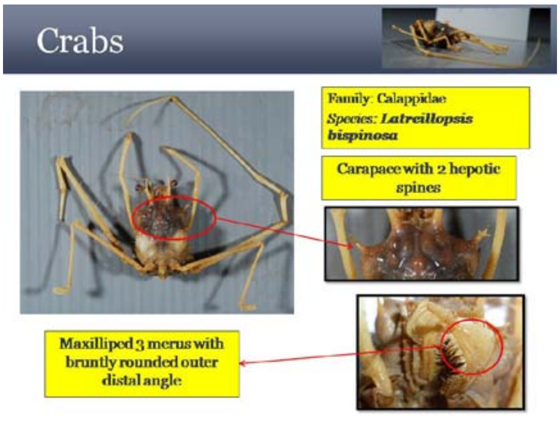

Crabs
Family: Calappidae
Species: Paracyclois milneedwardsi
8 teeth
Rounded carapace
Spine on posterolateral
Spine on posterior

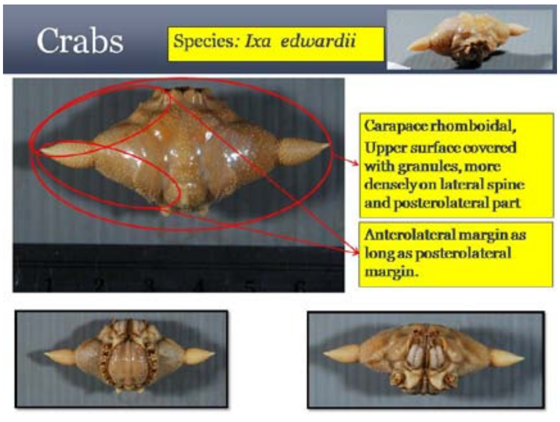
(continued) **Annex 18/5**











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