

REPORT OF THE
TRAINING WORKSHOP ON IDENTIFICATION OF DEEP-SEA
BENTHIC MACROINVERTEBRATE VULNERABLE TO FISHING
GEAR

Samutprakarn, Thailand, 11-15 July 2011



Preparation and distribution of this document

The Report of the Training Workshop on Identification of Deep-sea Benthic Macroinvertebrate Vulnerable to Fishing Gear was prepared by the Coastal Fisheries Technology Division of the Training Department of the Southeast Asian Fisheries Development Center (SEAFDEC). The Document is distributed to the participants and resource persons of the Training, SEAFDEC Member Countries, SEAFDEC Departments and concerned institutions/organizations.

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CONTENTS

PART I

I. Introduction.....	1
II. Opening and introduction of the training workshop	1
III. Resource persons presentations	2
IV. Laboratory practice on macroinvertebrate identification	3
V. Discussion and recommendations	4
VI. Summary of the workshop evaluation	4
VII. Closing of the training workshop	4
Annex 1 List of participants and resource persons	5
Annex 2 Opening speech.....	12
Annex 3 Timetable.....	13
Annex 4 Evaluation summary	15
Annex 5 Closing remarks	17

PART II

Presentations and results of the identification

Annex 6 Introduction to the workshop on the deep-sea resources exploration in the Southeast Asian Region	19
Annex 7 Arrangement of activities during the workshop	26
Annex 8 Pattern in benthose	29
Annex 9 Sampling the benthos	37
Annex 10 Collection and identification of polychaete worms	47
Annex 11 Detecting change due to fishing	55
Annex 12 Introduction to the taxonomy of Gastropods and Bivalves	61
Annex 13 Introduction to the taxonomy of deep-sea echinoderms and porifera.....	76
Annex 14 Introduction to the taxonomy of deep-sea shrimps and lobster.....	90

Annex 15 Introduction to the taxonomy of deep-sea crab.....	97
Annex 16 Classification of deep-sea crab	101
Annex 17 Deep-sea crab fisheries	104
Annex18/1 Identification results of Group I.....	109
Annex 18/2 Identification results of Group II.....	112
Annex 18/3 Identification results of Group III.....	117
Annex 18/4 Identification results Group IV	121
Annex 18/5 Identification results Group V	127

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

11-15 July 2011, Samutprakarn, Thailand

PART I

**Report of the
Training Workshop on Identification of Deep-sea Benthic Macroinvertebrate
Vulnerable to Fishing Gear, 11-15 July 2011
SEAFDEC/Training Department, Thailand**

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I. Introduction

1. The training workshop on identification of deep-sea benthic macroinvertebrate vulnerable to fishing gear was organized by the SEAFDEC Training Department (SEAFDEC/TD) and financed by SEAFDEC through the Japanese Trust Fund. The Training Workshop was held at the SEAFDEC Training Department in Samut Prakan, Thailand from 11 to 15 July 2011.
2. The workshop was attended by researchers and specialists in the fields of marine biology, taxonomy, and benthic invertebrate identification from the SEAFDEC Member Countries. Support was provided by a benthic ecologist from UK, a professor, lecturer, graduate students, and undergraduate students from Kasetsart University (Bangkok, Thailand) and Burapha University (Chonburi, Thailand). The list of participants and resource persons appears as **Annex 1**.
3. This training provided knowledge on the identification of deep-sea benthic macroinvertebrates with emphasis on the species found during the fishery resources survey conducted from M.V. SEAFDEC 2 on the continental shelf and slopes of Southeast Asian waters. The training attempted to build the capacity of the participants to identify species captured at water depths between 100 and 400 m. The Workshop had the following specific objectives;
 - To enhance, through practical work the participants's ability to identify deep-sea benthic macroinvertebrate.
 - To identify to the lowest practical taxon benthic macroinvertebrate specimens collected from the fisheries resource survey by MV.SEAFDEC 2.

II. Opening and Introduction of the Training Workshop

4. The workshop was officially opened on July 11, 2011 at SEAFDEC/TD, Samutprakarn, Thailand. On behalf of the SEAFDEC Secretary-General, Mr. Bundit Chokesanguan, welcomed the participants and resource persons to the training workshop. He underlined the need to build human resources capacity in the region to support SEAFDEC member countries deep-sea fishery resources exploration efforts. He also expressed the wish of SEAFDEC for all participants to have strong interest in gaining knowledge and experiences in benthic macroinvertebrate identification. His Message appears as **Annex 2**.

5. The workshop was introduced by Mrs. Penjan Laongmanee, Fishing Ground and Fishery Oceanography Section Head of the SEAFDEC/TD. She provided the background of the project “Deep-Sea Fisheries Resources Exploration in the Southeast Asian Waters” including the progress of various activities particularly those conducted under the program since 2007. In order to respond the international concern on the impact of fishing on deep - sea ecosystem, the program of activity has been developed in line with the ecosystem - based approach. Within that approach, the “Training Workshop on Identification of Deep - Sea Benthic Macroinvertebrate Vulnerable to Fishing Gear” is a part of SEAFDEC’s commitment to assist the Member Countries in building their capability to support their deep-sea fishery resources exploration efforts. Her presentation appears as **Annex 6**.
6. The brief on workshop program and arrangement of the activities was made by Dr. Natinee Sukramongkol which appears as **Annex 7**.

III. Resource Person Presentations

7. The workshop was facilitated by six resource persons who professional in benthic macroinvertebrate identification and marine macrobenthic survey. The presentations made by resource persons provided the basic knowledge to guide participants identifying the group/species commonly captured in the South China Sea and Andaman Sea at the depths between 100 and 400 m. The presentations of the resource persons included;
 - 7.1 Dr. Mike Kendall, benthic ecologist and a consultant for Plymouth Marine Laboratory Applications at Plymouth, United Kingdom. His presentation consist of;
 - Patterns in the benthos (**Annex 8**)
 - Sampling the benthos (**Annex 9**)
 - Collection and identification of polychaete worms (**Annex 10**)
 - Analysis and synthesis (**Annex 11**)
 - 7.2 Mr. Teerrapong Duangdee, Assistant Professor at Department of Marine Science, Faculty of Fisheries, Kasetsart University, Bangkok, Thailand, gave a presentation on;
 - Introduction to the taxonomy of Gastropods and Bivalves (**Annex 12**)
 - 7.3 Dr. Sumaitt Putchakarn, Senior Scientist at Biodiversity Research Unit, Institute of Marine Science, Burapha University, Chonburi, Thailand, lectured on the topic;
 - Introduction to the taxonomy of Deep-Sea Echinoderm and Porifera (**Annex 13**)
 - 7.4 Dr. Suriyan Tunkijjanukij, Dean of Faculty of Fisheries, Kasetsart University, Bangkok, Thailand, gave a presentation on;
 - Introduction to the taxonomy of Deep-Sea Shrimps and Lobsters (**Annex 14**)

7.5 Ms. Puntip Wisespongpan, Assistant Professor at Department of Marine Science, Faculty of Fisheries, Kasetsart University, Bangkok, Thailand, lecture on three topics including;

- Guideline to identification of deep-sea crab (**Annex 15**)
- Classification of deep-sea crab (**Annex 16**)
- Deep-sea crab fisheries (**Annex 17**)

IV. Laboratory Practice on Macroinvertebrate Identification

8. During four days of practical work in laboratory, the participants worked in groups of 3-5 people. Each group was provided with specimens collected by beam trawl and otter-trawl from Brunei Darussalam Waters at depths between 100 and 400 m during the collaborative surveys aboard M.V. SEAFDEC 2 conducted between 2008 and 2010. The specimens for identification (both preserved in 70% ethanol and frozen were separated into five groups, i.e. Polychaete, Gastropods and Bivalves, Echinoderm and Porifera, Shrimps and Lobster, Crabs, for laboratory practice.
9. Participants were requested to identify the specimens up to family level or the lowest taxa. They practiced counting, measuring, and examining the pertinent external anatomical structures those necessary for identifying the specimens. All laboratory practice was supervised by the resource persons and assistant resource persons who are professionals in benthic macroinvertebrate identification and marine macrobenthic survey.
10. During the laboratory work (11-14 July), participants were able to; describe the family characteristic of Gastropods and Bivalves specimens under the supervision of Assist. Prof. Teerrapong Duangdee, identified the Polychaete specimens to the lowest taxa under the supervision of Dr. Mike Kendall and Assoc. Prof. Dr. Chittima Aryuthaka; identify echinoderms (i.e. sea cucumber, sea urchin, sea feathers, brittle stars, sea stars) and Porifera (sponges) under the supervision of Dr. Sumaitt Putchakarn, identified on a group of deep-sea shrimps and lobster to the lowest taxa under the supervision of Dr. Suriyan Tunkijjanukij and Assoc. Prof. Dr. Chittima Aryuthaka, and identified the crab specimens to the lowest taxa under the supervision of Assist. Prof. Puntip Wisespongpan.
11. Moreover, participants were also given experience on resin techniques for the preservation of crab specimens and the preparation of tissue (dermis) extracts technique using sodium hypochlorite (Clo- rox bleach) to observe the spicule forms that most important of the diagnostic characters for identifying holothurians.
12. All specimens identified by participants were photographed each group made a presentation on the results of their identification. Subsequently discussion and clarification, including

advice on the results was made among the resource person and participants. The results presentation appears as **Annex 18/1- 18/5**.

V. Discussion and Recommendations

13. Based on the discussion, the workshop suggested further activities for the “Deep-Sea Fishery Resources Exploration in the Southeast Asian Waters” program at the Regional/National levels for 2012 and beyond. There were;

- SEAFDEC should continue the deep-sea resource survey in the region and disseminate the information collected to the SEAFDEC member countries
- SEAFDEC should collaborate with the member countries on both exploration and identification (can be via an internet)
- Exploration/study should not only focus on species that potentially be fishery resources but also the sustainability of invertebrate resources
- Further study on both nutrition and marketable value (consider cost-effective) should be considered
- A multi-language field guide for the identification of deep-sea benthic macroinvertebrates suitable for use by non-experts should be developed. Such a guide might be in either print, CD or on-line format
- Information and dissemination on the results of the deep-sea survey should be shared through the website and database.

VI. Summary of Workshop Evaluation

14. The workshop evaluation was summarized based on seventeen evaluations from participants and appear as **Annex 4**.

VII. Closing of the Training Workshop

15. Certificates of achievements were presented to the participants and resource persons by Mr. Bundit Chokesanguan on behalf of SEAFDEC Deputy Secretary-General. After expressed his appreciation to the participants for their active participated and willingness to apply and contribution what the participants have learned from the workshop, he declared the workshop closed. His Message appears as **Annex 5**.

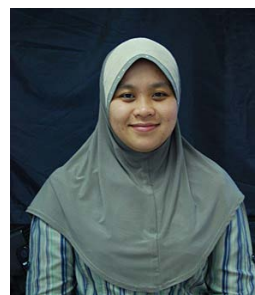
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OPENING SPEECH

By Mr. Bundit Chokesanguan on behalf of SEAFDEC Secretary - General

Distinguished Resources Persons, participants and staffs of the SEAFDEC Training Department,
A very good morning!

First of all, on behalf of SEAFDEC, I would like to welcome all of you to the SEAFDEC/Training Department. Following the information provided by the Course Director of this Training, Dr. Worawit Wanchana on the background, you may know that this Training/Workshop is one of the regional initiatives implemented under the Japanese Trust Fund program on “Deep Sea Fisheries Resources exploration in the Southeast Asian Waters”. Various activities have been conducted under this program since in 2007. However, there is still a need to build human resources capacity in our region with regards to marine invertebrate biodiversity. This is part of our commitment to assist the SEAFDEC Member Countries in building their capabilities to support their deep-sea fishery resources exploration efforts.

During this training program, I am pleased to inform you that we have invited well known experts as our resource persons. We have with us Dr. Mike Kendal, senior expert from England, Dr. Sumaitt Puchakarn, senior scientist from Institute of Marine Science, Burapha University, Assistant Professor Dr. Suriyan Tunkijjanukij, Associate Professor Dr. Chittima Aryuthaka, Assistant Professor Puntip Wisespongpan and Assistant Professor Teerapong Duangdee from Faculty of Fisheries, Kasetsart University. We are sure that with their expertise could provide our participants with the best knowledge in identification of benthic macroinvertebrate found in Southeast Asian water. Our resource persons are very pleased to share their knowledge and experiences with all of you during this training program.

So, even if you will have a hectic schedule during the next 5 days, I am sure you will enjoy the training with our experts and the staff concerned.

Ladies and Gentlemen, I wish to take this opportunity to express the wish of SEAFDEC for all participants to have strong interest in gaining knowledge and experiences in benthic macroinvertebrate identification. With that note ladies and gentlemen, I now declare this training/workshop on Identification of Deep-Sea Benthic Macroinvertebrate Vulnerable to Fishing Gear, open. Thank you and Good Day!

TIME TABLE

Date/Program	Details of Activity/Topic	Facilitator
Day 1, (Sunday 10 July)		
	<ul style="list-style-type: none"> Arrival of resource persons and participants Airport pick up arrangement will be provided 	SEAFDEC personnel
Day 2, (Monday 11 July): Opening, Introduction, and Lecture		
0900-0930 0930-0945 0945-1000	<ul style="list-style-type: none"> Opening ceremony/Group photo Introduction to the workshop Workshop program and arrangement of activities 	Mr. Bundit Chokesanguan (on behalf of the SEAFDEC Secretary-General) SEAFDEC personnel & Participants
1000-1015	<i>Break</i>	
1015-1230	Lecture on: <ul style="list-style-type: none"> Distribution and structure of benthic macroinvertebrate assemblages on the continental shelf and slopes Sampling methodologies 	Dr. Mike Kendall
1230-1330	<i>Lunch break</i>	
1330-1730	Lecture and practice on: <ul style="list-style-type: none"> Introduction to the taxonomy of Gastropods and Bivalves (emphasis on those found in the South China Sea and the Andaman Sea) Identification practice on Deep-sea Gastropods and Bivalves specimens in laboratory 	Mr. Teerapong Duangdee
Day 3, (Tuesday 12 July)		
0900-1230	Lecture and practice on: <ul style="list-style-type: none"> Introduction to the taxonomy of deep-sea Polychaete Identification practice on Polychaete specimens in laboratory (emphasis on those found in the South China Sea and the Andaman Sea) 	Dr. Mike Kendall and Dr. Chittima Aryuthaka
1230-1330	<i>Lunch break</i>	
1330-1730	Lecture and practice on: <ul style="list-style-type: none"> Introduction to the taxonomy of Deep-sea Echinoderm and Porifera specimens Identification practice on Echinoderm and Porifera specimens in laboratory 	Dr. Sumaitt Putchakarn
Day 4, (Wednesday 13 July)		
0900-1230	Lecture on:	Dr. Suriyan

Date/Program	Details of Activity/Topic	Facilitator
	<ul style="list-style-type: none"> Introduction to the taxonomy of Deep-sea Shrimps and Lobsters (emphasis on those found in the South China Sea and the Andaman Sea) 	Tunkijjanukij
1230-1330	<i>Lunch break</i>	
1330-1730	<ul style="list-style-type: none"> Identification practice on Shrimps and Lobsters specimens in laboratory 	Dr. Suriyan Tunkijjanukij
Day 5, (Thursday 14 July)		
0900-1230	Lecture on: <ul style="list-style-type: none"> Introduction to the taxonomy of deep-sea Crabs (emphasis on those found in the South China Sea and the Andaman Sea) 	Ms. Puntip Wisessongpand
1230-1330	<i>Lunch break</i>	
1330-1730	<ul style="list-style-type: none"> Identification practice on Crabs specimens in laboratory 	Ms. Puntip Wisessongpand
Day 6, (Friday 15 July)		
0900-1000	Lecture on: <ul style="list-style-type: none"> Detecting change due to fishing 	Dr. Mike Kendall
1000-1100	<ul style="list-style-type: none"> Results presentation of the works from laboratory practice 	Participants and Resource person
1100-1130	<ul style="list-style-type: none"> Discussion and conclusion 	Participants and Resource person
1130-1200	Closing ceremony	Mr. Bundit Chokesanguan (on behalf of the SEAFDEC Secretary- General) SEAFDEC personnel & Participants
Day 7, (Saturday 16 July)		
	Participants leave for their home countries	SEAFDEC Personnel

Evaluation Summary

Training Workshop on Identification of Deep-sea Benthic Macroinvertebrate Vulnerable to Fishing Gear, 11-15 July 2011, SEAFDEC/TD

This summary is based on the 17 evaluations received comprising of;

10 Biologists, 1 Administrator, 1 Student, 1 Researcher, 1 Officer, 1 Biologist/Policy Maker, 2 Non-specified

Highly favorable will rates = 5. Not so favorable will rates from 4 to 1;

Rating: 1 (lowest) to 5 (highest):	1	2	3	4	5	Comments
I. The training met my expectations			2	6	9	
II. I will be able to apply the knowledge learned			2	12	3	- Need more integrated info. To manage fishing gear
III. Do you have a better understanding of						
• Distribution of benthic animal, disturbance and benthic diversity			7	8	2	- Structure of distribution is very important
• Sampling the benthos	1		2	8	4	- Methods and gears maybe better if done actual
• Introduction to the taxonomy of Gastropod and bivalve		1	4	8	4	- Need more time - Should elaborate more during presentation
• Collection and identification of Polychaete worms	1		2	9	5	- Interesting with online identification
• Introduction to the taxonomy of Echinoderm and Porifera		2	3	6	5	- Should elaborate more during presentation
• Introduction to the taxonomy of Shrimps and Lobsters				11	3	
• Introduction to the taxonomy of Crabs				10	6	
• Biological and analysis decisions for detecting change due to fishing (on 15 July)		1	1	7	3	
IV. Overall, how would you rate the course?				12	4	
V. How much you can transfer knowledge gain from this training course?			3	11	1	- 75% - To be used as the basis to develop database and species identification

A. What did you like most about the course?

1. Diversification of specimens
2. The impact of fishing gears operation to benthic organism
3. The basis to identify the shrimp, lobster, crab, polychaete, gastropod
4. To improved knowledge and practical ability about identification of benthic macroinvertebrate
5. New subject for study the deep-sea specimens
6. The laboratory/actual works was very much helpful in learning process
7. The keys provided for shrimps and lobster as well as online key for annelids/polychaete were good

B. What presentations or topics were you expecting to hear, but were not presented?

1. Octopus identification
2. Taxonomy of marine fishes
3. Other group of Crustacean such as Isopod
4. Introduction to sensory organs of the animals in correspond to responsible fishing technology application
5. Corals (deep-sea) particularly endangered species under CITES
6. The existing deep-sea fisheries (shrimps and crabs) of the world (e.g. Alaska king crab fishing), the example on sustainable utilization

C. What would you recommend changing about the course?

1. Need more time (e.g. 2 weeks for the course or more than 5 days)
2. Technical terms is very important in taxonomy studies, should give priority and more time to this aspect
3. Morning session lecture and evening laboratory
4. Training materials should be collected earlier and distributed electronically to participants before the training course
5. More samples to practice will be better and the program will be perfect if participants can join during the collecting sample
6. Since time was limited in identification practice for five taxa groups. More emphasize may give to taxa groups w/c have fisheries potential/economic importance

D. Other comments, observations, suggestions for this course and the “Deep-Sea Fishery Resources Exploration in the Southeast Asian Water” program:

1. Deep-sea fishery resources exploration should be conducted to explore new resources and more information on deep-sea animals. Collaborative work among member countries is much helpful
2. The program should divided into 3 session;
 - Lecture
 - Identification of specimens together with the lecture use the same specimens
 - Self identification (sample provided by the lecturer)
3. Poor English ability may the problem to gained and transfer knowledge
4. Number of participants for this training should be at least two or three person/country
5. The exploration/study should focus on taxa/species with fishery potential. Palatability study, nutritional value, and other related experimentation on deep-sea shrimps, lobsters and crabs in comparison to market-available equivalents may be considered

CLOSING REMARKS

By Mr. Bundit Chokesanguan on behalf of SEAFDEC Secretary - General

Distinguished Resource Persons, participants, and staff of SEAFDEC Training Department,
Good afternoon!

First of all, I wish to inform you that I am most impressed by your active participation during the 5-day training workshop, especially your strong sense of interest and the efforts you exerted in both lecture and laboratory practice. I am wish this event is a first step of you to share/exchange and update the progress of macro invertebrate study that support future scientific base management in our region especially for deep-sea fishery.

As this regional training workshop comes to a close today, I would like to thank our resource persons and experts: Dr. Mike Kendal, Dr. Sumaitt Puchakarn, Assistant Professor Dr. Suriyan Tunkijjanukij, Associate Professor Dr. Chittima Aryuthaka, Assistant Professor Puntip Wisespongpan and Assistant Professor Teerapong Duangdee for sharing their knowledge and skills with the participants. We are also thankful to the organizing team for your efforts in providing the best support to this training workshop. We are also grateful for the continued financial support from the Japanese Trust Fund through SEAFDEC, for making this training workshop possible.

Ladies and gentlemen, our work does not end here. Please keep in mind that the realization of your respective activities on Deep Sea Fisheries Resources Exploration depends on your willingness and intention to apply what you have learned from this training workshop. On our part, SEAFDEC will make effort to provide you with the necessary support to ensure the success and sustainability of this important collaborative effort in the near future.

Finally, I wish you all the best and every success in your future challenges. May you have a safe journey back home. With that Ladies and Gentlemen, I now declare the Regional Training Workshop closed. Thank you very much.

**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



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

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)

- 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

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



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>

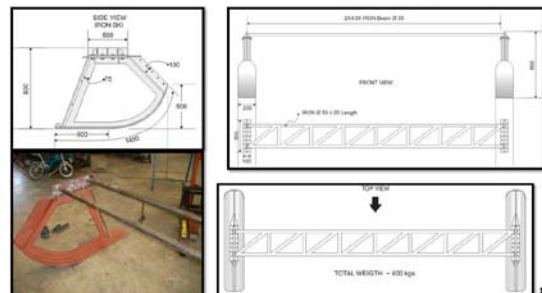


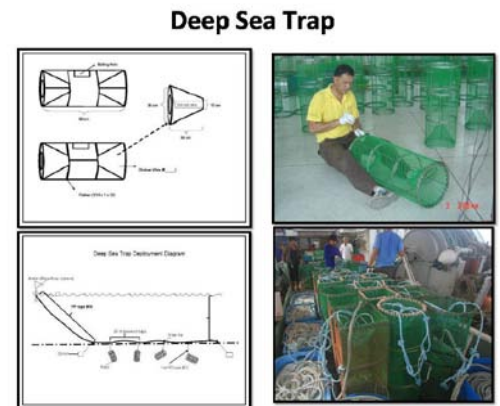
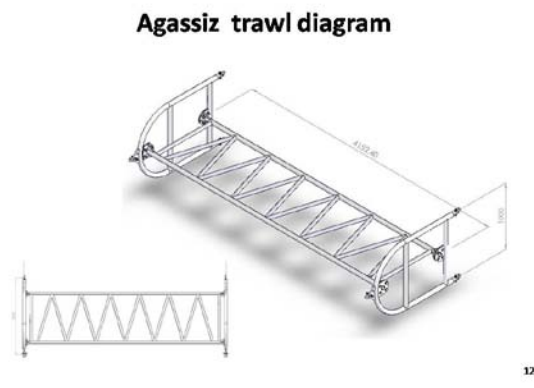
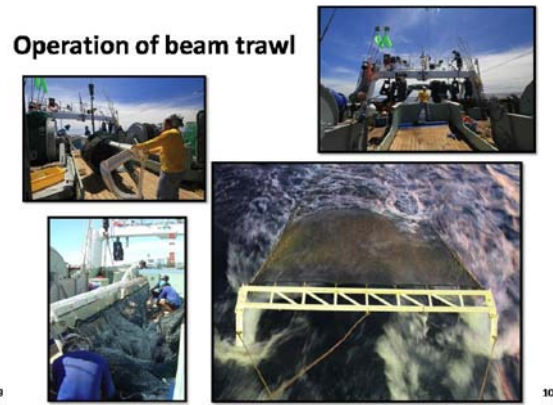
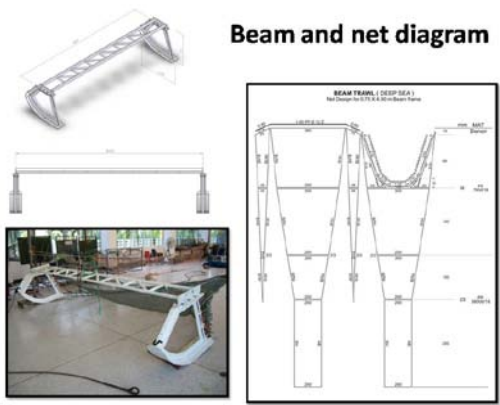
Activity 2: Development/Improvement of sampling gear and exploration methodology

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

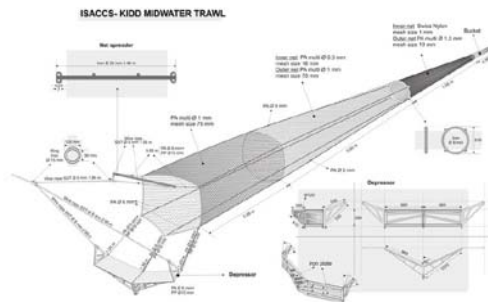
Beam trawl

Beam / Frame diagram



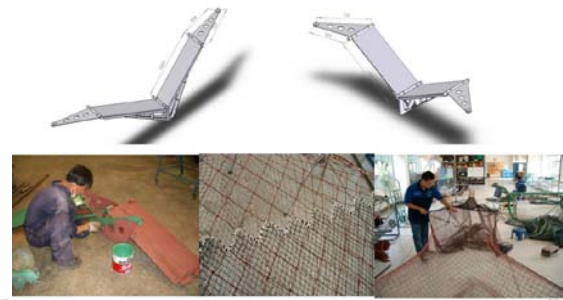


Isaccs-Kidd Midwater Trawl



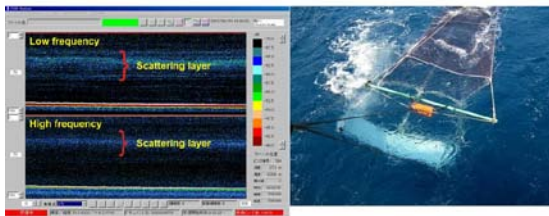
17

Construction of IKMT at SEAFDEC's workshop



18

IKMT Operation



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

Sample from IKMT



Mesopelagic fishes, mostly Myctophidae

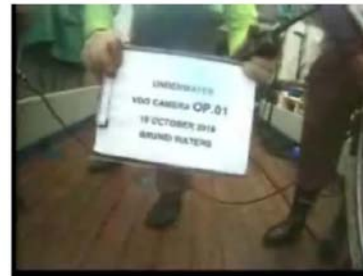
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Under water VDO camera



21

Under water VDO camera clip from Brunei water



22

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



23

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



24

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

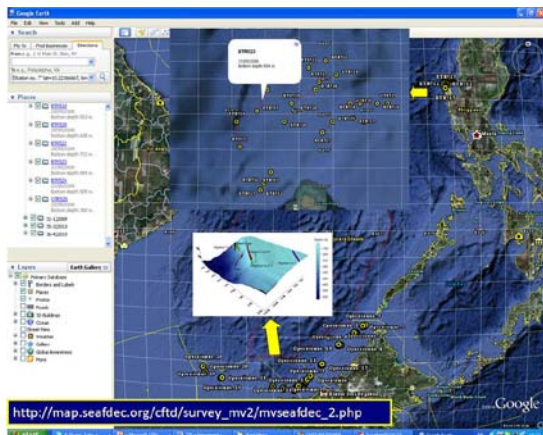


25

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



26



27

**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

28

**Activity4: HRD programs on Deep-sea fisheries
resources exploration**



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

- 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

29

- 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>

30

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



23

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>

32

Training Workshop on Identification of Deep-sea Fish



33

Training Workshop on Identification of Deep-sea Fish



34



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

35

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

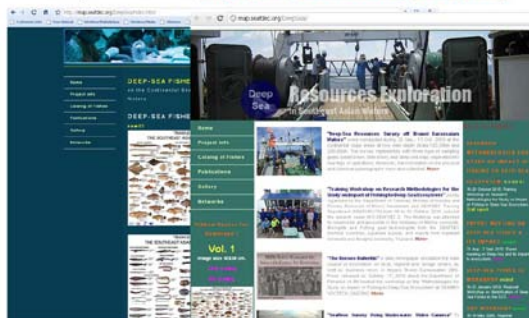
Read: Training report at

<http://map.seafdec.org/DeepSea/pub01.html>



Activity5: Information Dissemination

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



37

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

38

Activity5: Information Dissemination

Series of publication:

<http://map.seafdec.org/DeepSea/pub01.html>



39

Activity5: Information Dissemination



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

40

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/>

41

Activity5: Information Dissemination

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



42

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

43



Thank you

44

Annex 7: Arrangement of Activities during the workshop

By Dr. Natinee Sukramongkol

Arrangement of activities during the workshop

11 to 15 July 2011
SEAFDEC/TD

Training Workshop on Identification of Deep-sea Benthic Macroinvertebrate Vulnerable to Fishing Gear, 11-15 July 2011, SEAFDEC/TD, Samut Prakan, Thailand

Objectives

- ❖ HRD program to build up human capacity on identification of benthic macro-invertebrate for SEAFDEC member countries
- ❖ Establish the network/expert for taxonomy work through coordination and collaboration among the participants/experts of the workshop
- ❖ Support the future initiation on deep-sea resources exploration in the perspective of the ecosystem-based approach for the management of deep-sea fisheries that taxonomy/identification skill is required

Area of the Sampling Sites

Survey Area: Waters of Brunei Darussalam
Vessel: M.V. SEAFDEC 2
Cruise no: 29-2/2008, 31-1/2009, 36-4/2010
Sampling gears: Otter trawl, Beam trawl, Deep-sea trap, Agassiz trawl
Fishing depth: 100-388 m



Training & Group Assignment

- ❖ Participants (20 persons) will be separated into 6 groups (3-4 person/group) by voluntary basis
- ❖ Preliminary identification results will be present by participants during the laboratory work (5-10min/group) under supervise by resource person
- ❖ On Friday 15, each group is requested to present all identification results as well as any suggestion/comments to the workshop/program
- ❖ Resource person are requested to give additional comments to the workshop/program

Specimens using for identification Separated into 5 groups:

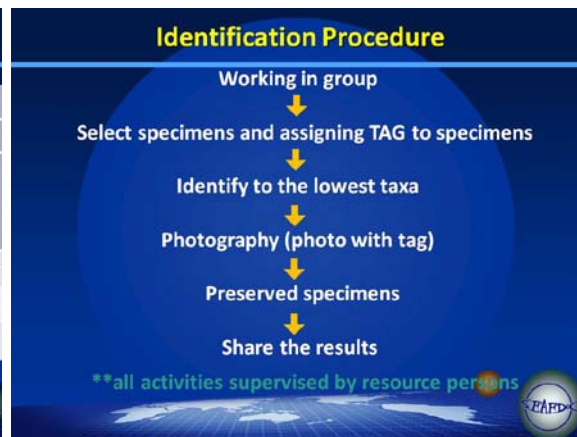
Gastropod & Bivalves	Polychaete	Echinoderm & Porifera	Shrimps & Lobsters	Crabs

Program & Activities Summary

Session	Day 1		Day 2	
	Morning	Afternoon	Morning	Afternoon
Topic	<ul style="list-style-type: none"> • Distribution and structure of benthic macroinvertebrate assemblages on the continental shelf and slopes • Sampling methodology 	<ul style="list-style-type: none"> • Introduction to the taxonomy of Gastropods and Bivalves • Identification practice 	<ul style="list-style-type: none"> • Introduction to the taxonomy of Polychaete • Identification practice on Polychaete 	<ul style="list-style-type: none"> • Introduction to the taxonomy of Echinoderm and Porifera • Identification practice on Echinoderm and Porifera
Facilitator	Dr. Mile	Mr. Teerapong	Dr. Mile	Dr. Sunait
Lecture	Lecture room 1	Lecture room 1	Lecture room 1	Lecture room 1
Practice	-	Laboratory 3 rd floor	Laboratory 3 rd floor	Laboratory 3 rd floor

Program & Activities Summary

Session	Day 2		Day 3		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.Suriyon	Dr.Suriyon/ Dr.Chittima	Ms.Panip	Ms.Panip	All participants & Resource person
Lecture	Lecture room 1	-	Lecture room 1	-	Lecture room 1
Practice	-	Laboratory 3 rd floor	-	Laboratory 3 rd floor	-

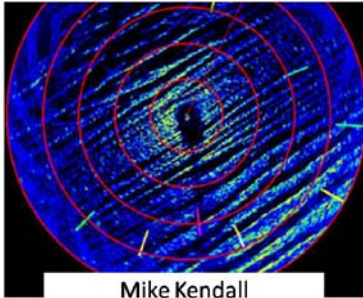


- ### Tag
- ❖ Ship name
 - ❖ Cruise number
 - ❖ Fishing method (Otter trawl, beam trawl, Agassiz trawl, Trap)
 - ❖ Locality (Lat, Long, depth)
 - ❖ Sampling Date
 - ❖ Scientific Name

Annex 8: Patterns in the benthos

By Dr. Mike Kendall

Patterns in the benthos



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

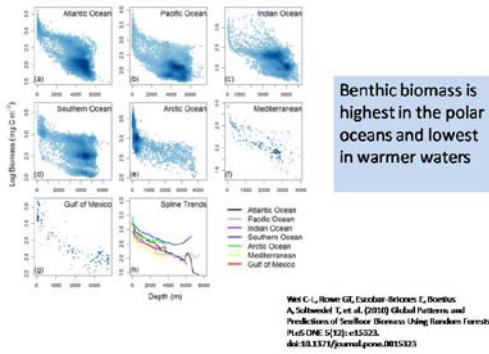
This is the megafauna.

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.

Latitudinal trends: Predictions of benthic biomass



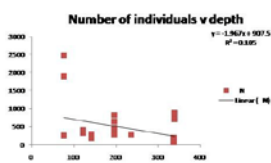
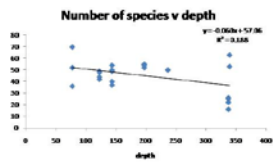
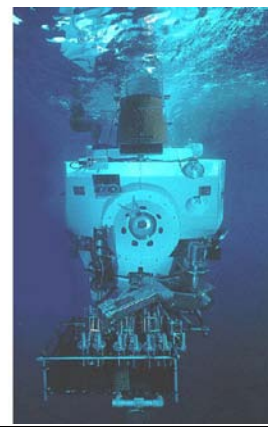
Body size

- 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

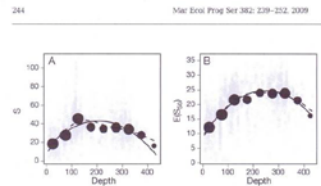
In general

- 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



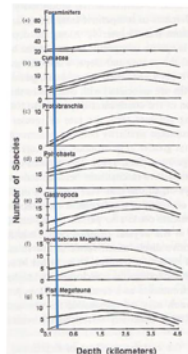
Own data from Polarstern cruise in Arctic.
• R2 small but just significant



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

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

Diversity and depth: ES(50)



Deep Sea study

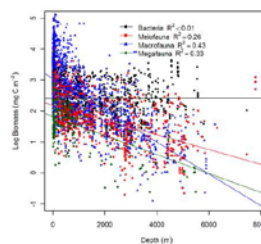
For most taxa the number of species in a sample of 50 individuals increases to 2.5 km and then declines.

BUT

The number of individuals in a sample also declines

From Thackan 1994

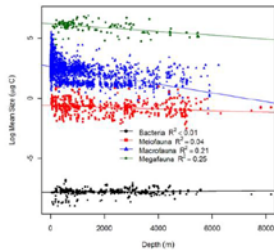
Biomass



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

Wet C., Rowe GJ, Escobar Becken L, Boettius A, Subramelli L, et al. (2010) Global Patterns and Predictions of Seafloor Biomass Using Random Forests. PLoS ONE 5(12): e15323. doi:10.1371/journal.pone.0153233

Size of individuals



The body size of mega- and macrofauna declines with depth

Ward C., Rowe C., Siciliano Blumens E., Norfian A., Subramanian C., et al. (2010) Global Patterns and Predictors of Surface Benthos Using Random Forests. PLoS ONE 5(12): e15533. doi:10.1371/journal.pone.0155333

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

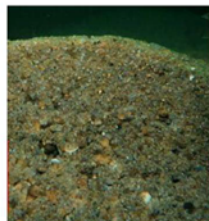
Sediment granulometry

- 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) than 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) than 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



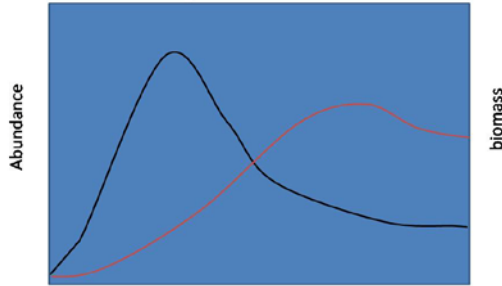
Photographs: John Gatt 1998

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.

PRODUCTIVITY DISTURBANCE AND BENTHIC DIVERSITY

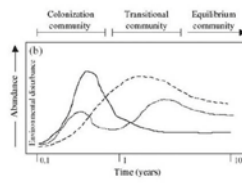
Colonisation following disturbance



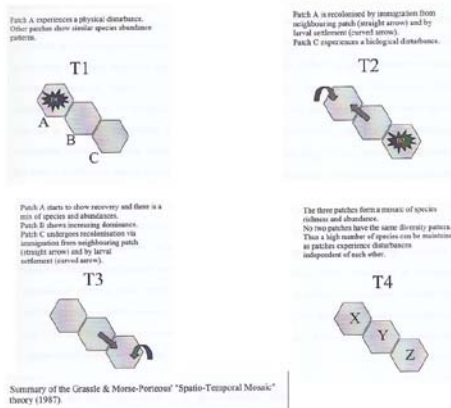
Time

You get the same sequence with distance from a point source of pollution

Properties of species

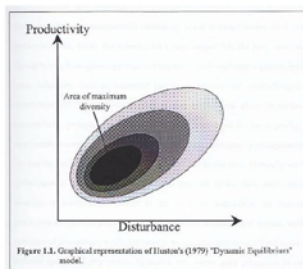


- Colonisation:**
- Low biomass
 - r-strategy species
 - Small body
 - Short life
 - High dispersal larvae
 - High reproductive output
- Equilibrium:**
- High biomass
 - k-strategy species
 - Larger body
 - Longer lived
 - Lower reproductive output
 - Low or high larval dispersal



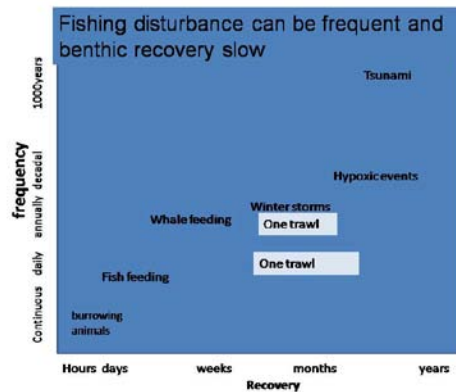
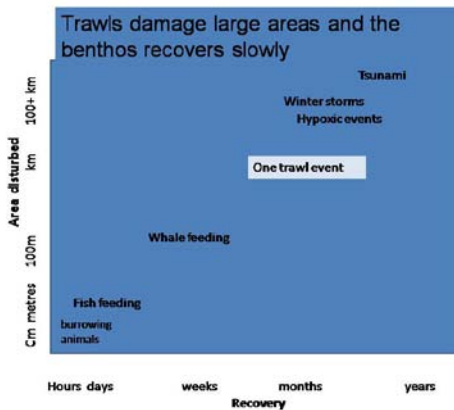
DISTURBANCE PROMOTES DIVERSITY

Productivity, disturbance and benthic diversity



- Benthic diversity increases with productivity but if productivity becomes too high it falls again (c.f. organic pollution).
- Benthic diversity increases as the frequency of disturbance declines but without disturbance a tendency dominance develops.
- At an intermediate level of disturbance, diversity is maximised

TRAWLING EFFECTS ON BENTHIC COMMUNITIES



Impacts of trawling on benthos

- Ecosystem form and function are changed
- Disturbance of seafloor and benthic assemblages
- Removal of critical species and the attraction of carrion feeders
- Physical modification of benthic habitat
- Creation of turbidity



Foot rope and bobbins



Otter board or trawl door

Otter Boards

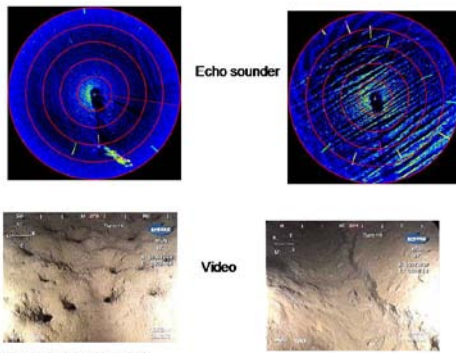
- Plough the seafloor
- Break fragile animals
- Bury other animals to a depth they cannot recover from.
- Create massive turbidity and inhibit filter feeding



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
 Frode Østgaard*, Melanie C. Austin, Martin T. Schrammer, Stephen Waldman and Mike A. Kendall

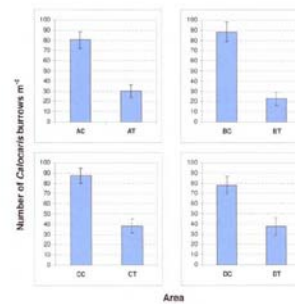
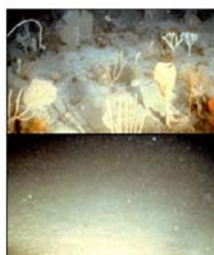


Fig. 34. Number of Calappa burrows in non-trawled and trawled areas (mean values and 95% confidence intervals). Data from 41-78 random frames from the video recordings within each area survey. Samples from trawled (eg. AT) and non-trawled control sites (e.g. AC) within the four areas A, B, C and D.

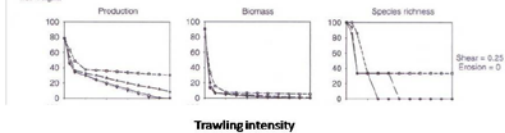


Trawling: Before and after



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 types as calculated by the model. Production, biomass, and relative species richness are given for two levels of shear stress (P10, two level of erosion level), 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:

Widdowson et al.

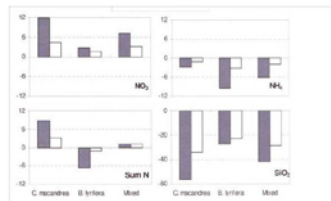


Fig. 3. Calculated effects of trawling on fluxes of silicate and nitrogen nutrients for the observed reduction in abundance for *C. macandoei* (from 41.5 to 14.5 ind.m⁻² in trawled areas) and for *B. lyrae*, or a mixed assemblage of the two species.

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

Faunal Changes

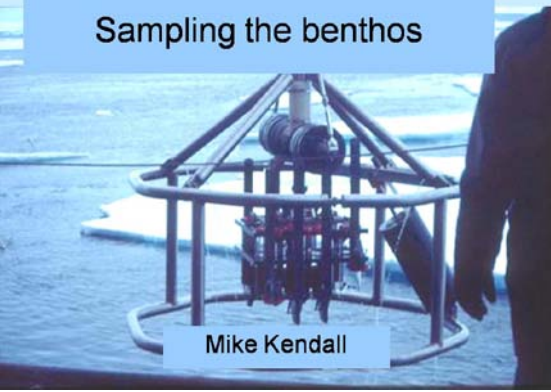
- Loss of shelled biota; worms replace molluscs
- Small opportunistic species may replace larger longer-lived animals
- Filter feeders much reduced or lost
- Temporary increases in megafaunal carrion feeders
- There is a substantial shift in benthic community structure following trawling.

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



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

Dredges and trawls

- Not quantitative
- Can be used on difficult ground or bad weather
- Some scope for statistical analysis

Grabs

- Can be used from smaller ships
- Easily transported
- Adequate for macrofauna
- Standard equipment

Box corers

- Large and heavy
- Standard in deep water and on big ships

Corers


- Take undisturbed samples
- Too small for macrofauna
- Meiofauna only




Beam Trawl



Mini Aggasiz



Van Veen Grab...open



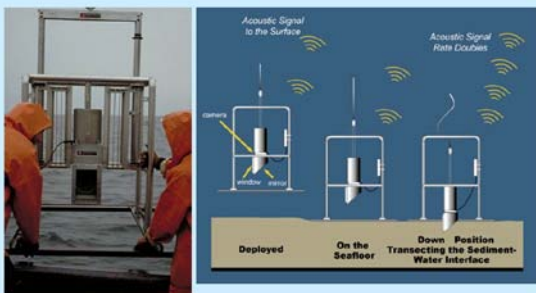
Van Veen closed



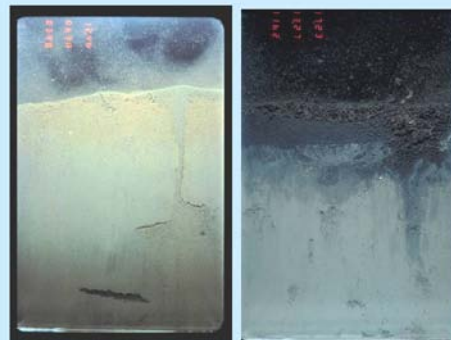
Grab photo PML-A



USNEL Box corer deployed



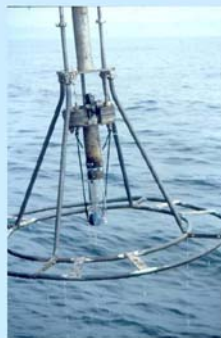
Sediment Profile Imagery....SPI



SPI images



Craib Corer



Craib



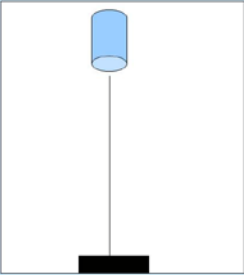
Multicorers



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

PHOTOGRAPHY

RESOLUTION

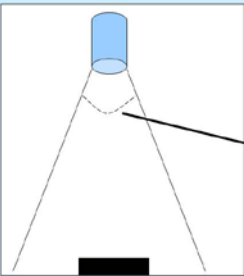


- What is the **smallest object** the camera can detect ?
 - Function of lens to object distance
 - Need to keep this distance constant for reliable recording
 - In digital photography a function of number of pixels in image.

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

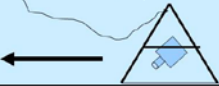
- Used from *slowly* drifting ship
- Trigger weight
- No control of where image is taken
- All normal photographic problems
- Image analysis available on high resolution pictures ++ pixels
- Needs no independent power supply
- Cheap



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

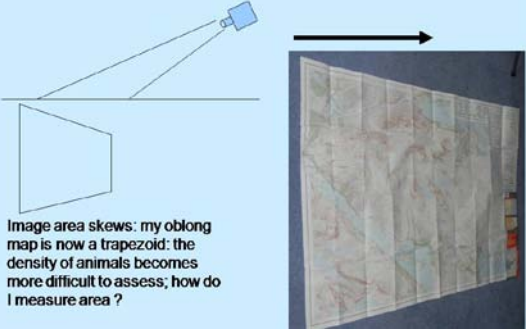


Image area skews: my oblong map is now a trapezoid: the density of animals becomes more difficult to assess; how do I measure area ?

Moving camera platforms: problems

Only part of the frame is in sharp focus; species counts more accurate at front than back of frame

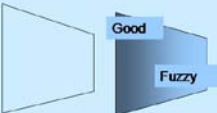



Image area Focus



Moving camera platforms: problems

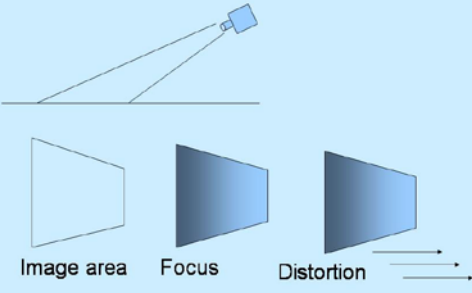
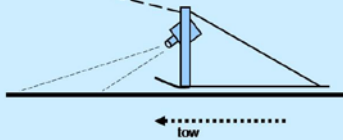


Image area Focus Distortion

Sleds stabilise the camera

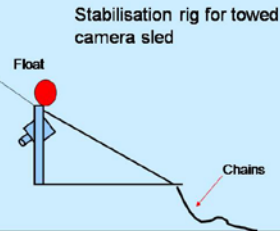
- Video: either on board or surface linked
- Shaky or jerky image
- Little control
- Easily lost



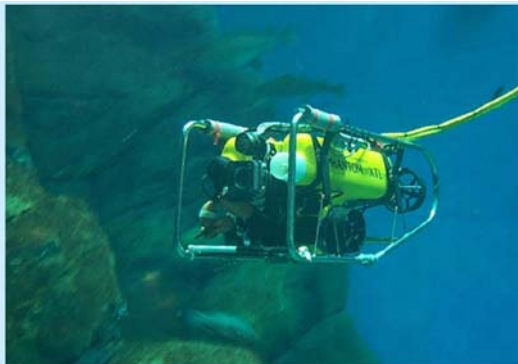
Fitted with £250 camera in £ 200 housing. Recorded to camera disk and to lap top

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.



Stabilised sled: high quality and cheap
See Sheehan et al. PLOS1 Biodiversity 5(12):e14461.



Remotely Operated Vehicle

ROV

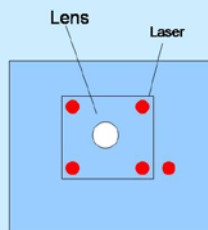
- Extended survey time
- Real time images
- Continuous and contiguous transects
- ± Works in currents
- May have manipulator



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

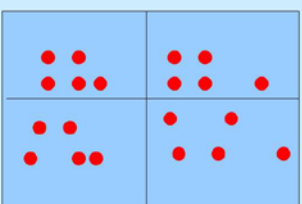
Image Correction




- Lasers can add information to image on
- Roll
 - Pitch
 - Height

Same rig can be used on sled cameras

Laser spots

Vertical Close to bottom		Vertical away from bottom	
Points backwards Close to bottom		Points forwards away from bottom	

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 ?

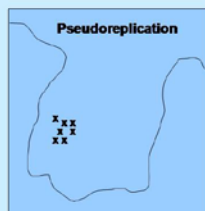


Some Considerations

- 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 areano single station studies please.
- The distribution of samples must match 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.

Regular **Random** = sand

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

Two way design One way design

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				
		0.5	5	10	50	1000
Precision	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

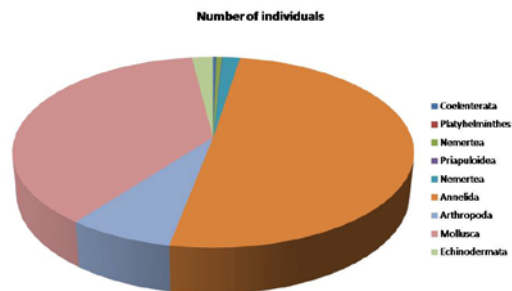
Collection and identification of polychaete worms

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

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 are not always available beyond FAMILY

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

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

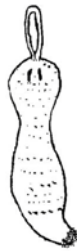
Nemertea



•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



Dissect tube

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

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

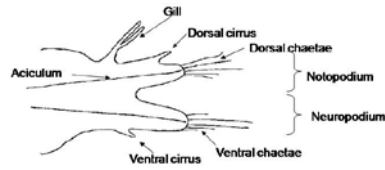
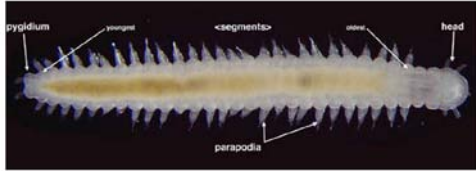
Useful Literature: general identification

- 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
- Taxif 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/PolyDB_N_su.html

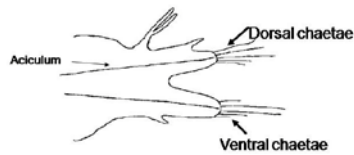
Polychaetes: Some Basic anatomy



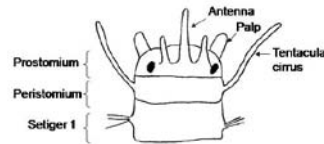
Parapodium

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

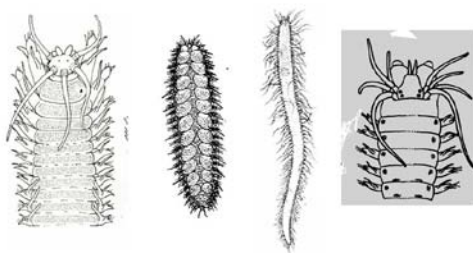
Errant or sedentary

An artificial but often used split

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

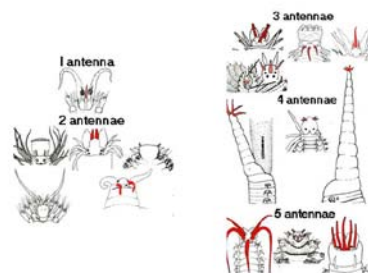


Picture: H. Tsutsumi



Typical errant worms

Antennae



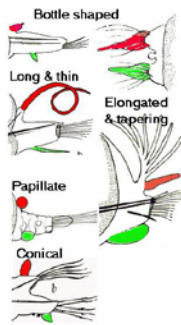


Palps

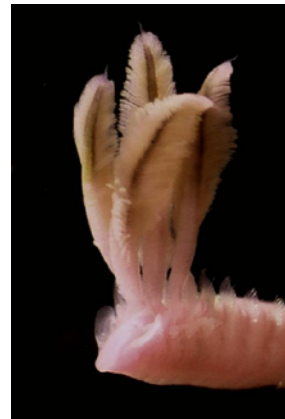
- Simple
- Bi-articulate



Jaws



Dorsal and Ventral cirri

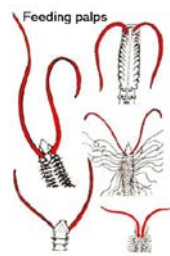
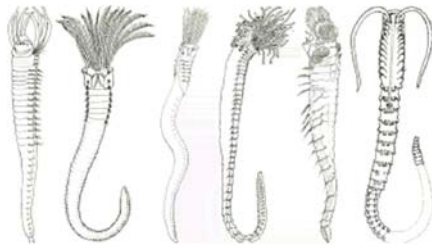


Sedentary

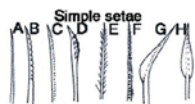
- Head may have feeding structures, feeding palps, branchial crown
- Parapodia weakly developed
- Body divided into 2 or more regions
- Lives in a tube or permanent burrow

Picture: H.Tsutsumi

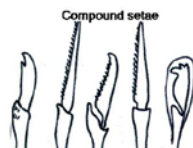
Typical sedentary worms



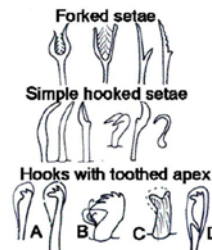
Feeding structures



Chaetae

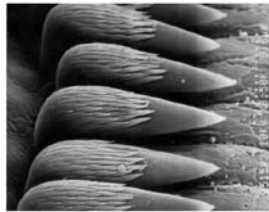


Chaetae



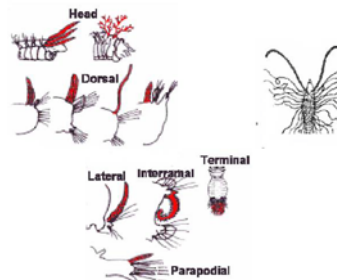
Uncini

- 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.

(continued)

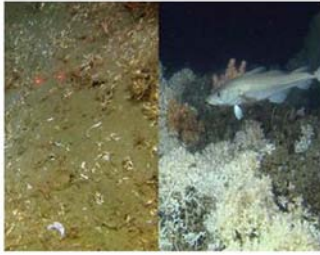
Annex 10

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 not 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

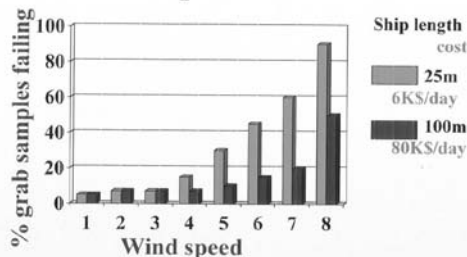
For a benthic sampling programme

Mobilisation -finding staff -Buying kit -Packing/transport	Costs ± 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

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**
 - Costs £1200
 - Takes at least 40 samples

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**

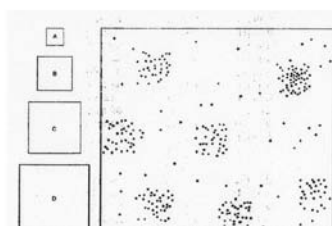
Reducing lab costs: overview

- 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.

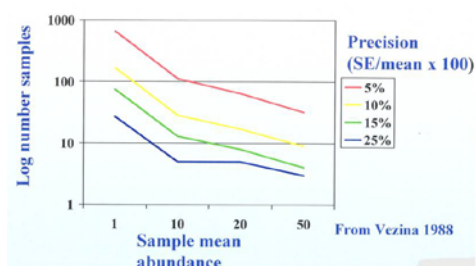
Changing sample size



Changing sample size impacts

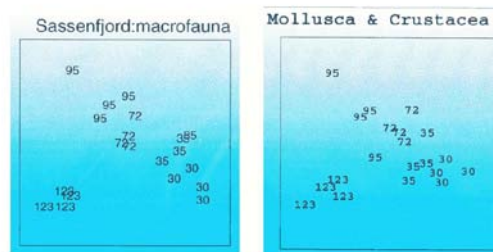
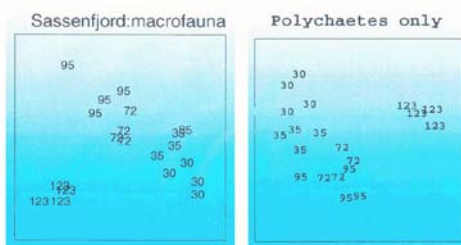
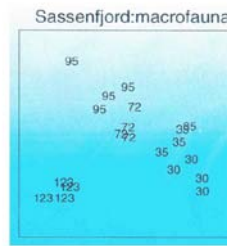
- 1) Impression of dispersion
- 2) Sample mean
- 3) Sample variance

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

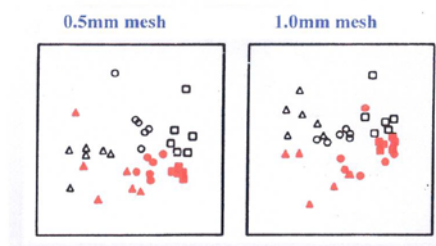
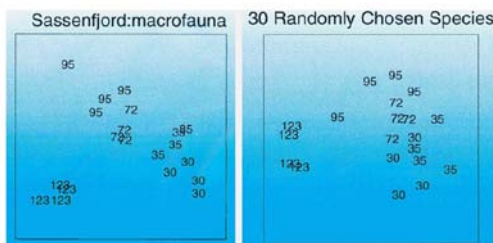


Multivariate

- 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



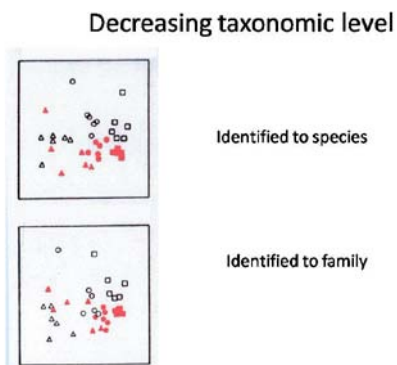
From James and Fairweather 1995

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 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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- **Introduction**
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Phylum mollusca

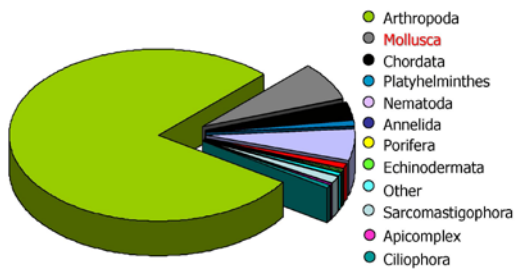
Phylum Mollusca includes snails and slugs, oysters and clams, and octopuses and squids.

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

Some gastropods and bivalves inhabit freshwater.

A few gastropods (slugs & snails) are terrestrial.

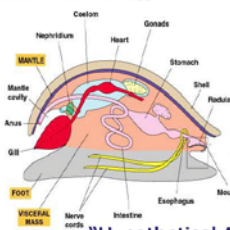
Numbers of species



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)



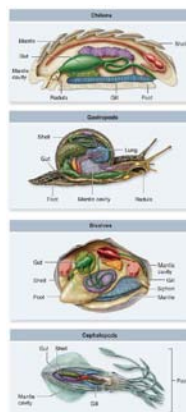
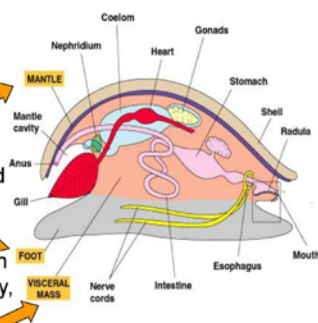
"Hypothetical Ancestral Mollusc"

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

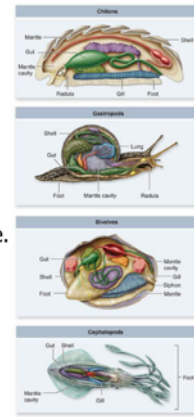
Characteristics

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

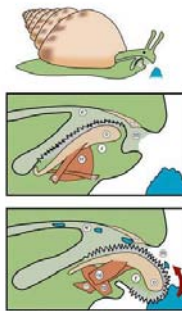
The space between the mantle and the visceral mass is called the **mantle cavity**.

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

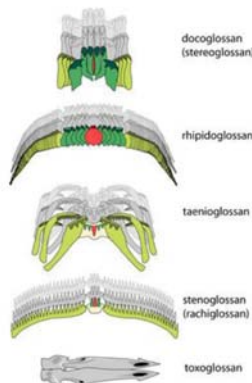
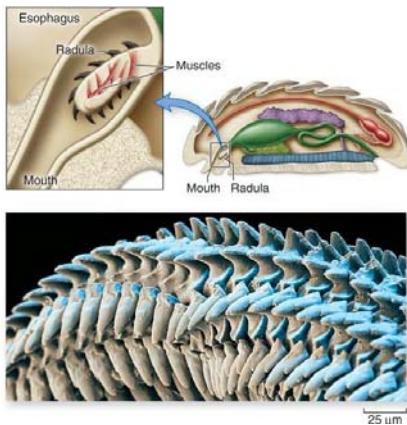


Characteristics

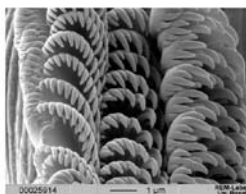
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3. **Mantle** (specialized tissue, secretes shell, may be involved in feeding, reproduction and respiration) – **mantle cavity**
4. **Radula** : a rasping, protrusible feeding structure found in most molluscs (not bivalves).
5. **Open circulatory system** (Cephalopods-Closed)
6. Respiratory System - gills, lungs, mantle, epidermis



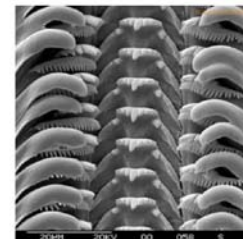
e = esophagus
 m = mouth
 ma = massita
 op = odontophore protractor muscle
 r = radula
 rp = radula protractor muscle
 rr = radula retractor muscle



Ptenoglossa



Rachiglossa



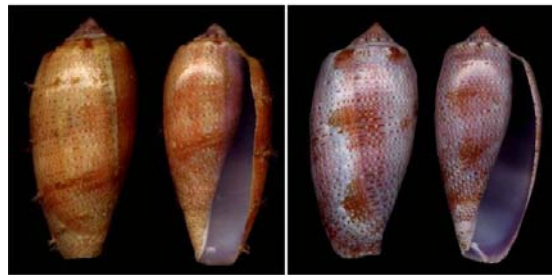
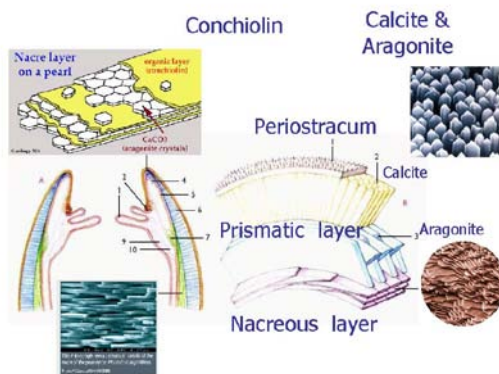
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Shells

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

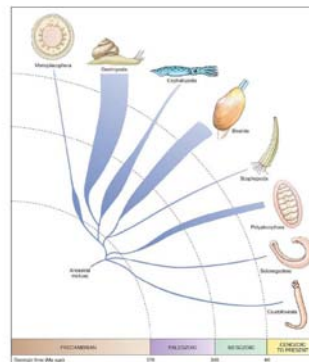
When present, the calcareous shell is secreted by the **mantle** and is lined by it. It has 3 layers:
Periostracum – outer organic layer helps to protect inner layers from boring organisms.
Prismatic layer – densely packed prisms of calcium carbonate.
Nacreous layer – iridescent lining secreted continuously by the mantle.





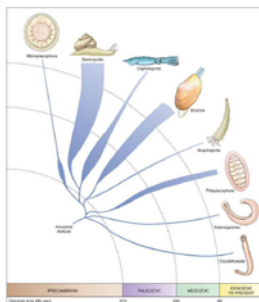
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Fossil records from precambrian period

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

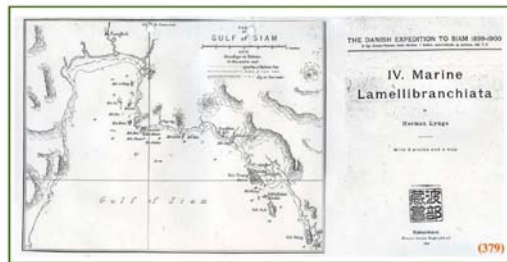
- Have **two shells** (valves), shell is closed by adductor muscles
- **No head or radula**
- Complex sheet of **gill** derived tissue for filter **feeding and respiration**
- Part of the mantle is modified to form incurrent and excurrent **siphons**



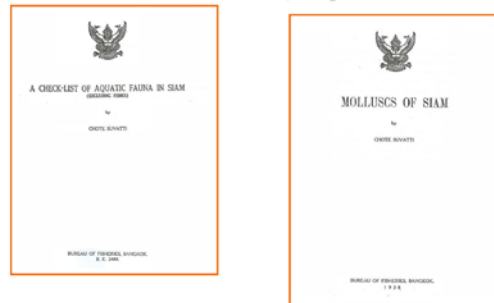
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Martens, E.C. von. 1860. On the Mollusca of Siam. *Proc. Zool. Soc. Lond.* 1860(28): 17-7



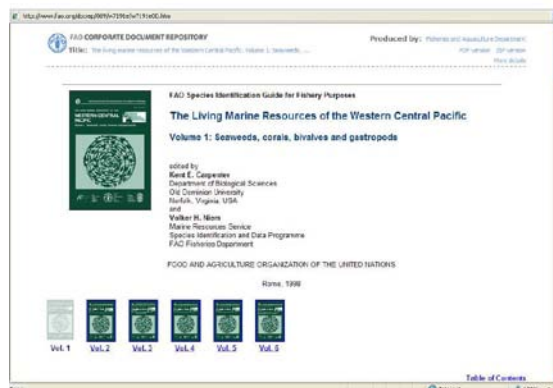
Suvatti, C. 1937. A Check-List of Aquatic Fauna in Siam. Bureau of Fisheries, Bangkok. 372

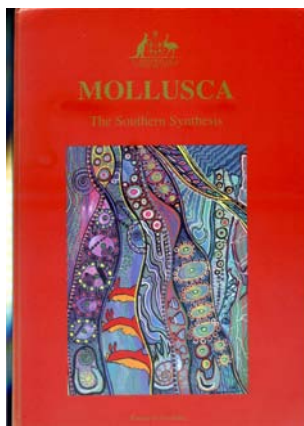


Suvatti, C. 1938. Molluscs of Siam. Bureau of Fisheries, Bangkok. 533

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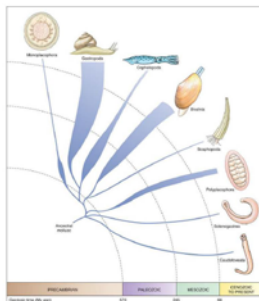




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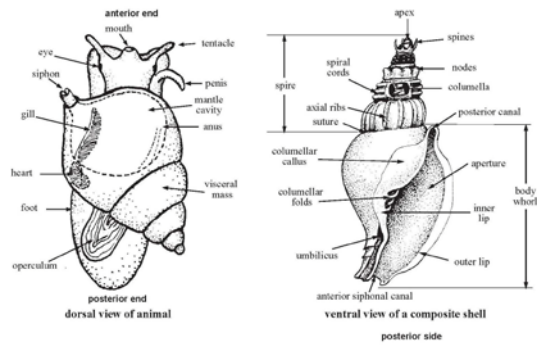
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Classification of Molluscs



SUBPHYLUM AMPHINEURA
 CLASS APLACOPHORA
 CLASS POLYPLACOPHORA
 SUBPHYLUM CONCHIFERA
 CLASS MONOPLACOPHORA
 CLASS **GASTROPODA**
 CLASS **BIVALVIA**
 CLASS SCAPHOPODA
 CLASS CEPHALOPODA

Gastropods:



Callus



Columella



Cancellate



Lirae



Operculum

Posterior canal

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, spine, 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; spine concealed under body whorl, or reduced and not protruding Figure F
- 6b. Aperture not stretching along the whole shell length, or spine 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

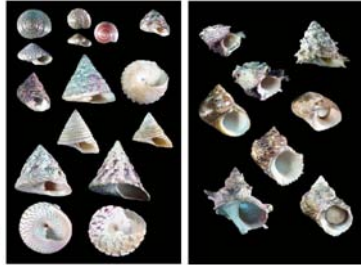


Figure G.

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 decidedly larger Figure I



Figure H.

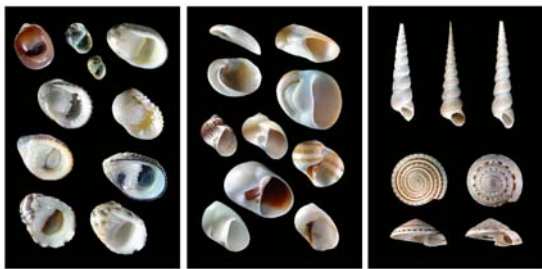


Figure I.

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

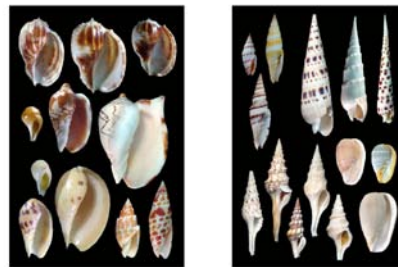


Figure K.

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



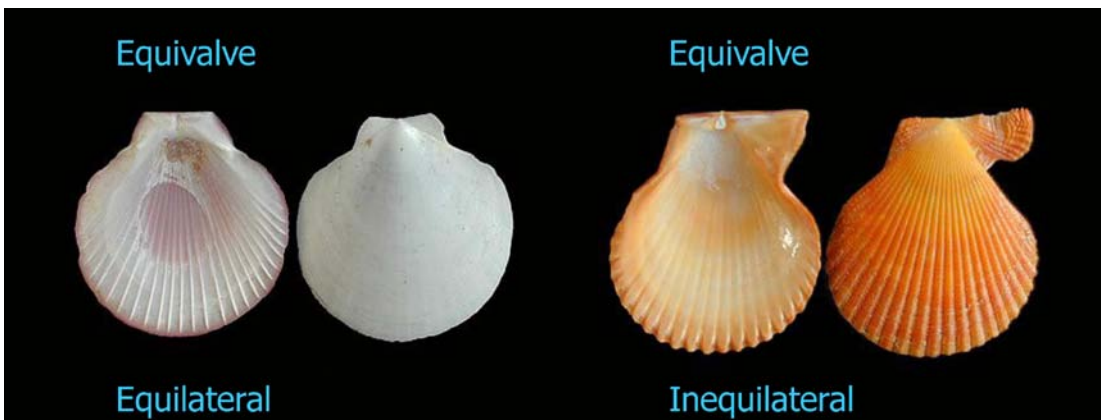
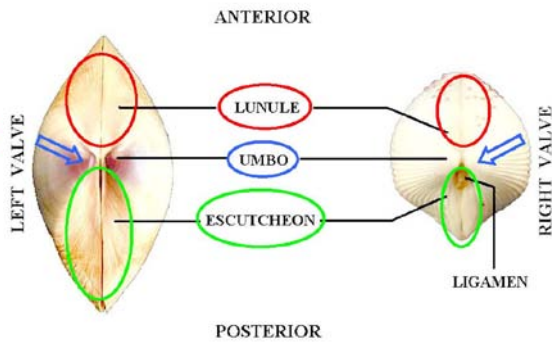
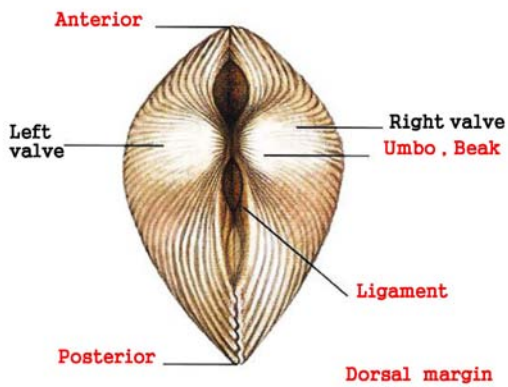
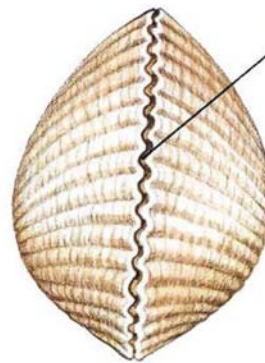
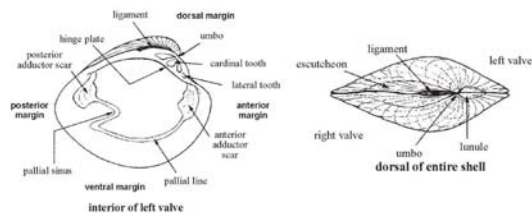
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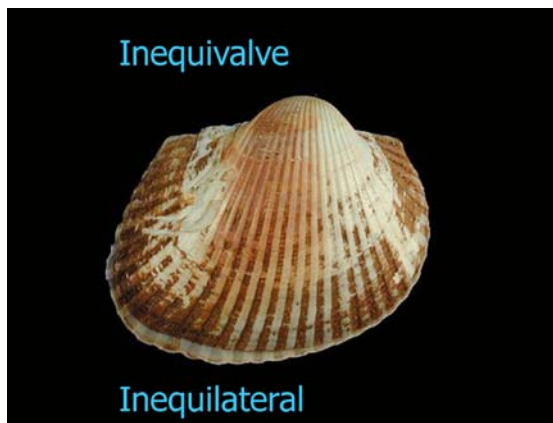
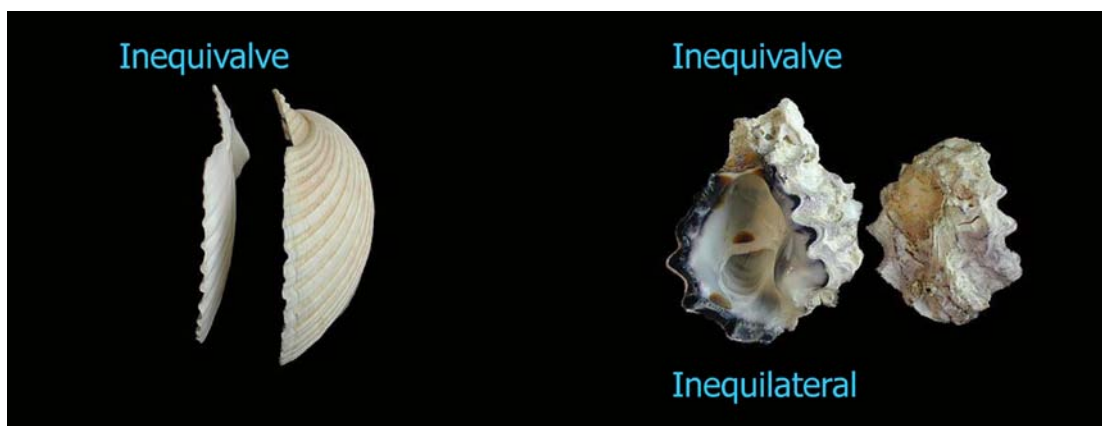
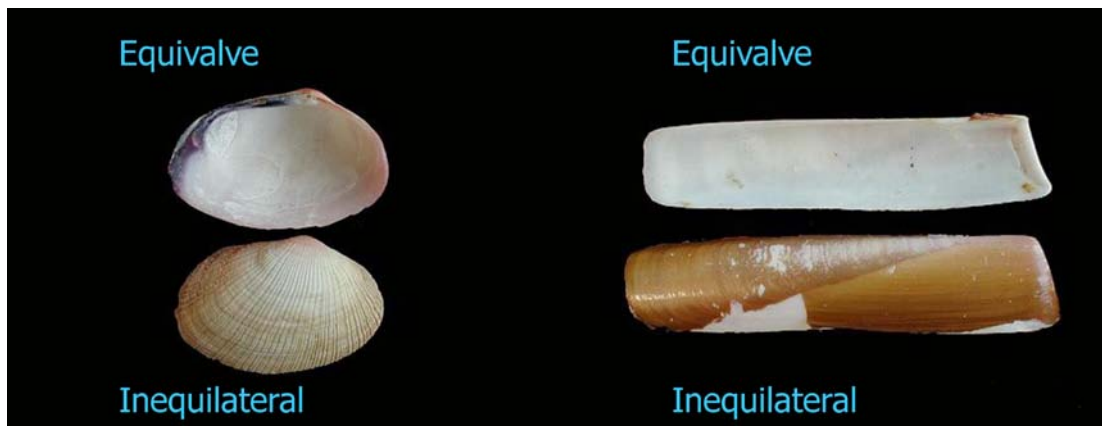


Figure P.

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.





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 Terecinidae.

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, occurring 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 - differentiated 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 (demibranchs) suspended to a dorsal axis (ctenidial axis), each demibranch may be either single 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 asymmetrical.

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.

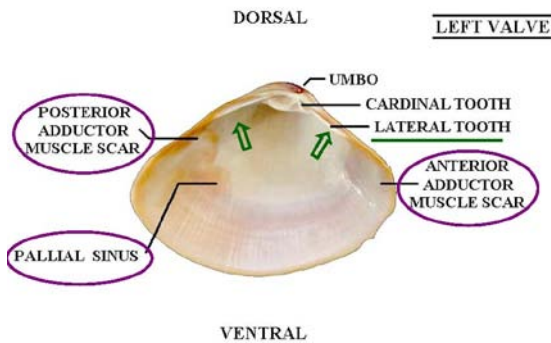
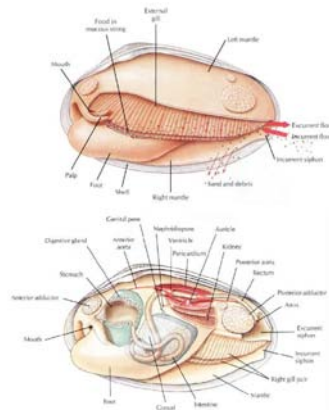
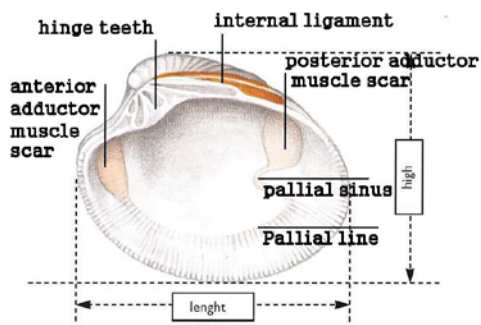
Nymph - narrow plateform extending behind umbo along dorsal margin, to which the external ligament is attached.

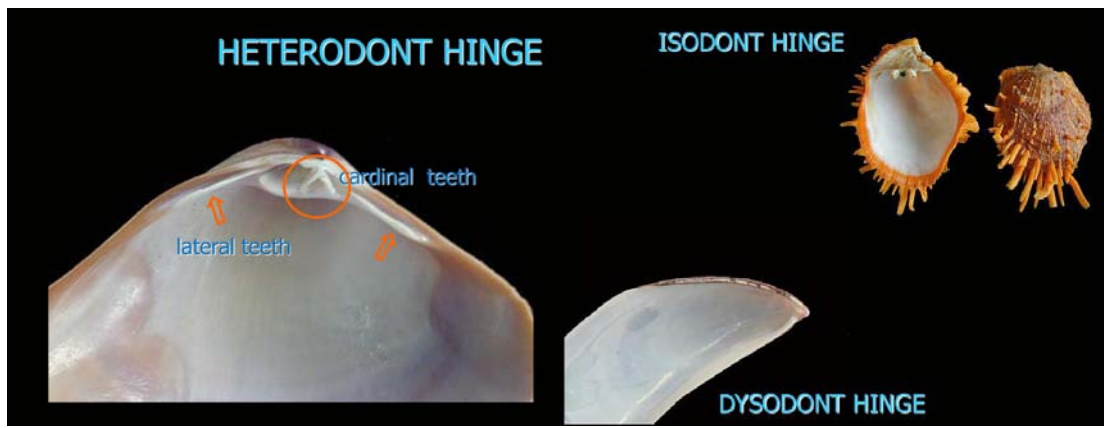
Opisthogyrate - the condition of a shell when umbones are directed posteriorly.

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 close the burrow opening when siphons are retracted in the Terebrinidae.
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.
Porcelainous - 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 closely 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 Terebrinidae.
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

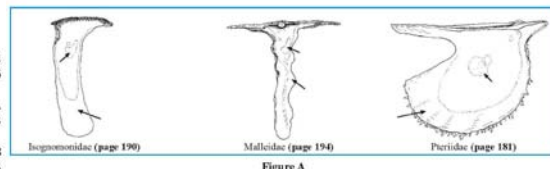


Figure A:

Isognomionidae: 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.

Malloidae: 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.

Pteridae: 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.

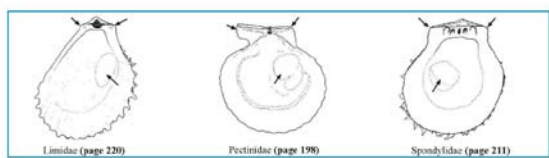


Figure B:

Limidae: shell inequivalve, 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.

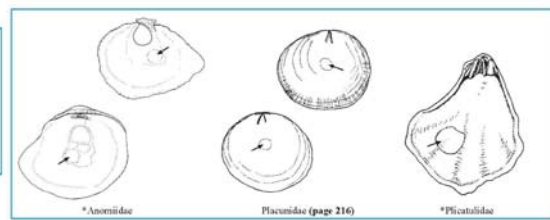


Figure C:

*Anomniidae: 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.

Plicunidae: 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.

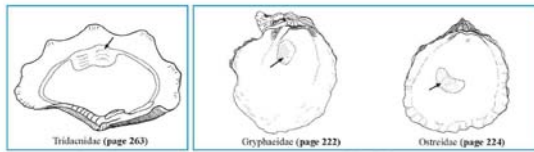


Figure D:

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

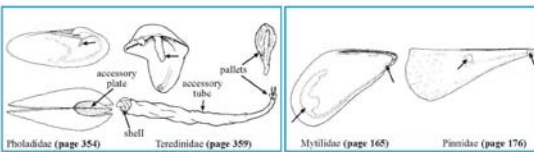


Figure F:

Pholadidae: shell subequivalve, gaping. Dorsal margin forming an umbonal reflexion. 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 reflexion. 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.

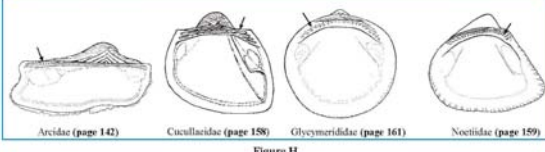


Figure H:

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.

Cucullariidae: 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 lent-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.

Noctuidae: 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.

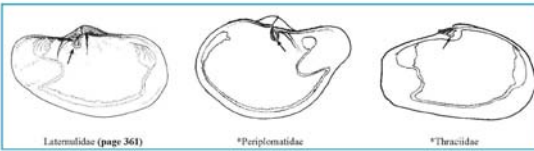


Figure I:

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.

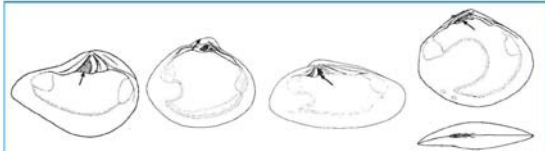


Figure J:

*Crasatellidae: 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

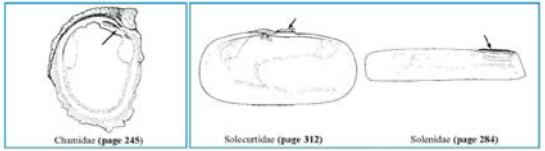


Figure K:

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.

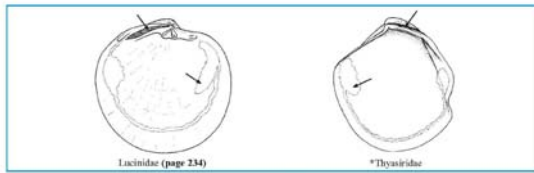


Figure M

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.

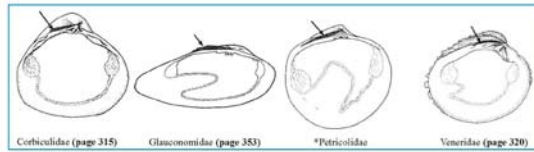


Figure N

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.

Glaucomnidae: 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.

*Ptericoidae: 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.

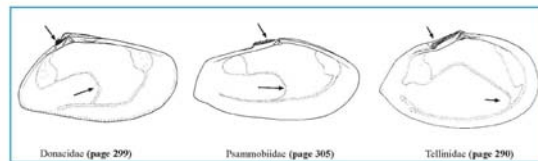


Figure O

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 inequilateral, 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.

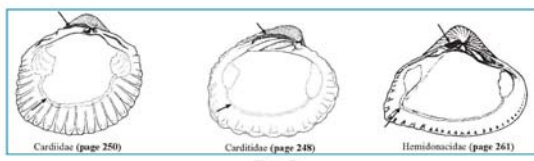


Figure P

Figure P:

Carditidae: shell equivalve, inflated, oval to subovate, 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.

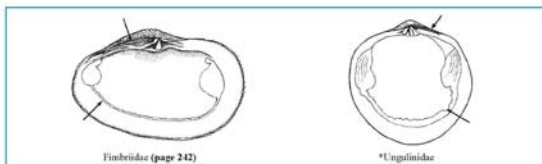


Figure Q

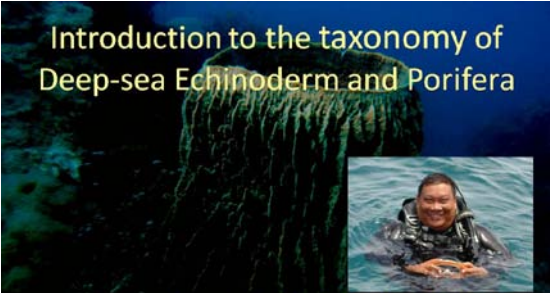
Figure Q:


Fimbridae: 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


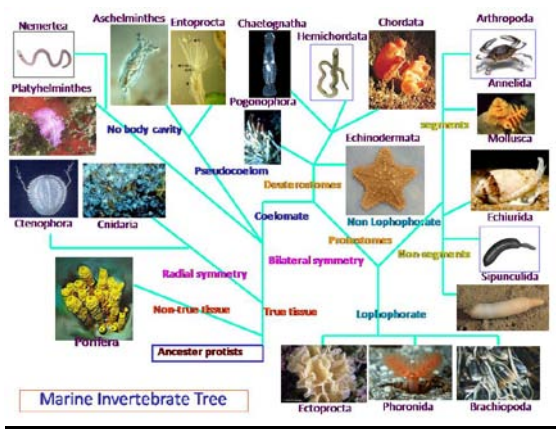
Introduction to the taxonomy of Deep-sea Echinoderm and Porifera





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 Burapha University, Bangsaen, Chon Buri 20131 Thailand
 E-mail: sumatt@hotmail.com, sumatt@buu.ac.th


Invertebrate is animal without backbone
 Including 95% of all living animals both marine freshwater and terrestrial.


Phylum Porifera, sponges

Sponges as human use value and sources of marine natural products

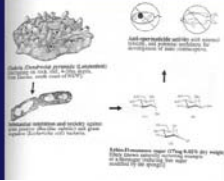
Bath sponges



Insert sanitary napkin

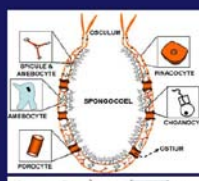
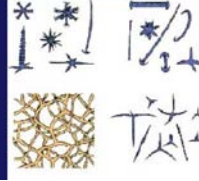


Marine natural products

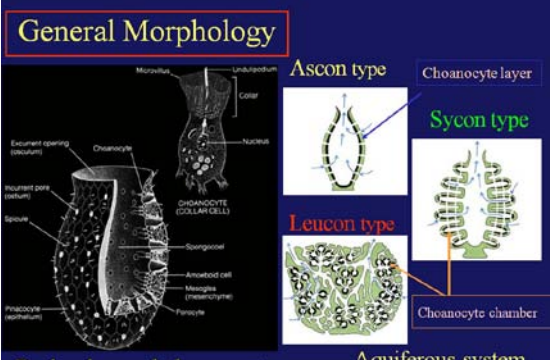


General Biology

- 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 extant species and more 900 genera are fossils

General Morphology

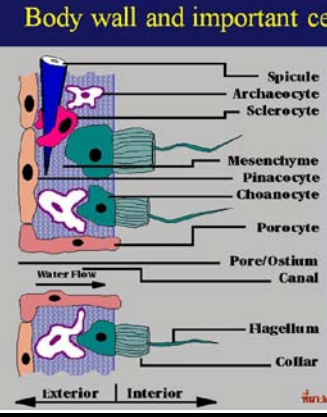


Body plan and choanocyte

Aquiferous system

Sources: www.ideo.columbia.edu/does/water/idea/slides/phylo/sponge.pdf; http://corona.epi.gift.edu/www_GPS/courses/GEO1200/lab3/structure.htm

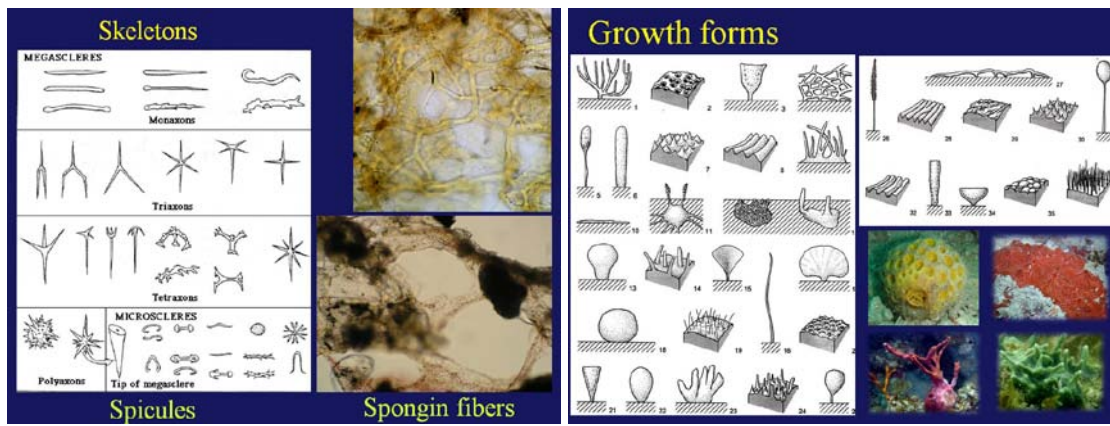
Body wall and important cells



Totipotency

Exterior | Interior

http://www.zoo.uq.edu.au/~jg/postscript/porifera.html



Sponges classification

Symplasma 1 - Hexactinellida - Glass sponges

Porifera --- Sclerosponges - Lithistid sponges

Celularia 2

3 - Calcarea - Calcareous sponges

4 - Demospongiae

Systematics of Porifera

- 1 = silica spicules, hexactins, ryncytium, sycon or leucon type
- 2 = pericytes, transport of sperm to egg via choanocyte
- 3 = calcareous spicules, no silica spicules, 3 types of water canal
- 4 = silica spicules, tetraaxons, spongyocytes & spongin fiber, leucon type
- ... = leucon type, silica & calcareous spicules, spongy spongin fiber

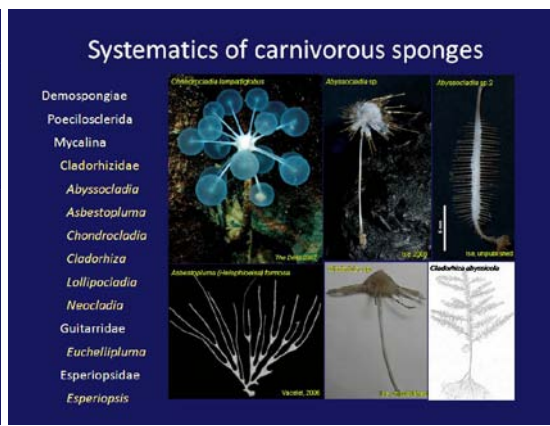
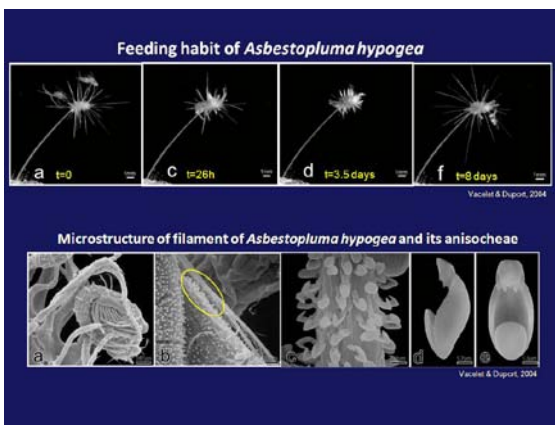
URL: <http://www.biology.ualberta.ca/courses/bp2002/50/Classes/14603-Porifera.htm>

Class Hexactinellida: Glass sponges



Class Calcarea: calcareous sponges

Class Demospongiae: Demosponge



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

Body forms: star-like (Asterozoidea, Ophiurozoidea, Crinozoidea); oval & hemispherical (Echinozoidea) & Cylindrical (Holothurozoidea)

General Morphology

Body form by arrangement of Ossicles

Ossicles

Spicule of Sea cucumber

General Morphology

water vascular system for movement and exchange gas

The water-vascular system (here: Asterozoidea)

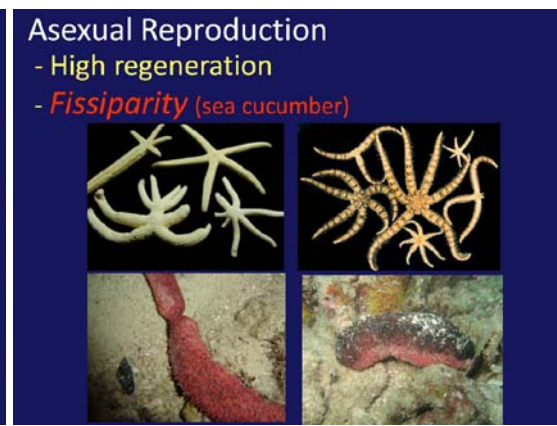
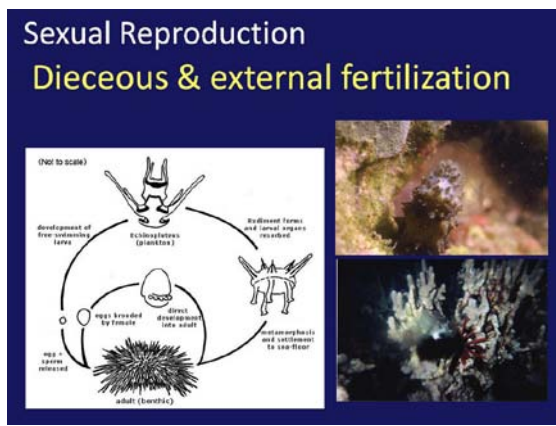
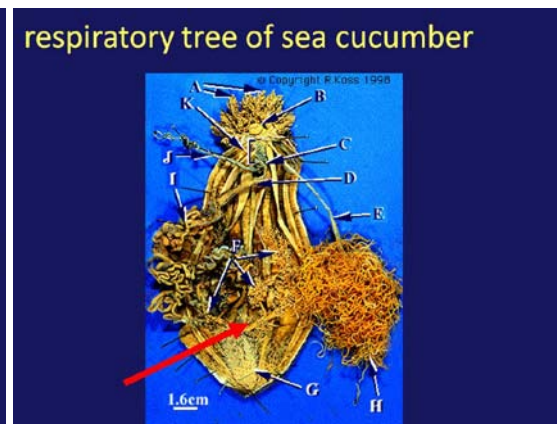
General Morphology

Pedicellariae

Pedicellariae

Pedicellariae

Respiratory uses papulae (Asterozoidea), gill (some sea urchin) and respiratory tree (Sea cucumber)



Morphological character

A

B

Morphological character

Oscicle arrangement of arm

a

b

c

Pedicellariae

Class Asteroidea
Order Paxillosida

- Aboral side Paxilliform
- Tube feet knobbed, not sucker

Order Paxillosida

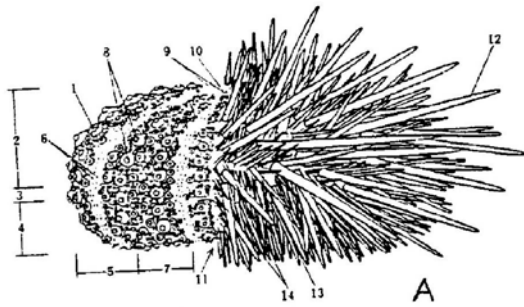
- Marginal plate paxilliform
Family Luidiidae
- Marginal plate not paxilliform
Family Astropectinidae



Order Valvatida

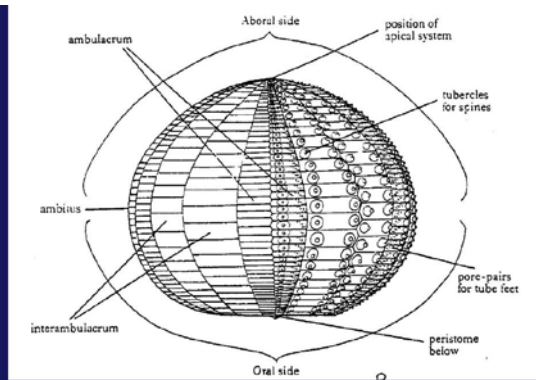
- Marginal plate well develop
- Tubefeet sucker



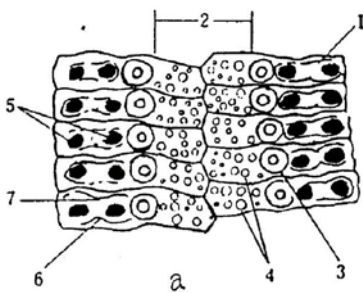


A: ลักษณะภายนอกของเม่นทะเล

- 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.

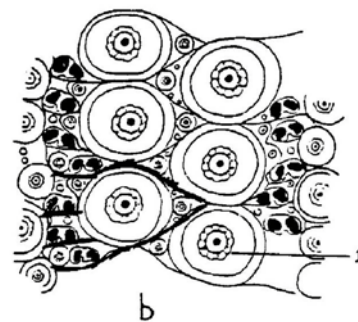


ลักษณะของเปลือกเม่นทะเล (Echinoidea)

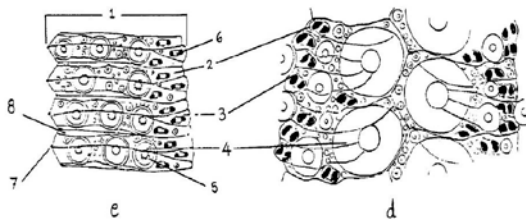


a) ambulacrum ที่มี ambulacral plate แบบขรุขระมตา

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



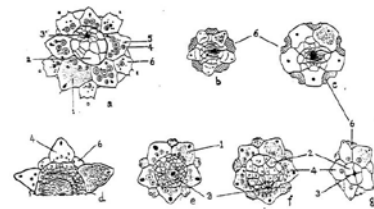
b) ambulacrum ที่มี ambulacral plate แบบแผ่นผสม Diademato type ที่มีแผ่นสมบูรณ 3 แผ่น; 1) crenulation.



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

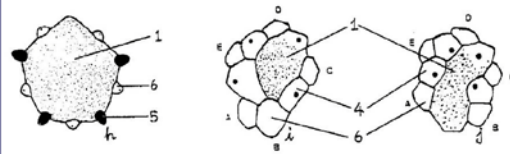
- 1) ambulacral plate; 2) primary plate; 3) demiplate; 4) primary tubercle; 5) crenulation; 6) pore pair; 7) angular pore; 8) pit.

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



ภาพที่ 11 แสดงลักษณะของ apical system แบบต่างๆ ของเม่นทะเล

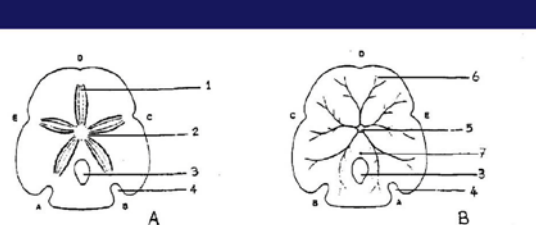
- a) ลักษณะทั่วไป: 1) madreporite; 2) periproctal plate; 3) anal opening; 4) genital plate; 5) genital pore; 6) ocular plate; 7) periproct.
 b) แบบ monocyelic ที่ ocular plate ติดกับ periproct.
 c) แบบ diacyelic ที่ ocular plate ไม่ติดกับ periproct จนทำให้เกิดเป็นวงแหวนของแผ่นหินปูน 2 วง
 d) แบบ monocyelic ของ *Echinothrix calamaris*
 e) แบบ diacyelic ของ *Salmacis virgulata* ที่มี anal opening อยู่ตรงกลาง
 f) แบบ diacyelic ของ *Salmaciella dussumieri* ที่มี anal opening อยู่ชิดขอบของ periproct
 g) แบบ diacyelic ของ *Parasalenia gratiosa*



ภาพที่ 11 แสดงลักษณะของ apical system แบบต่างๆ ของเม่นทะเล

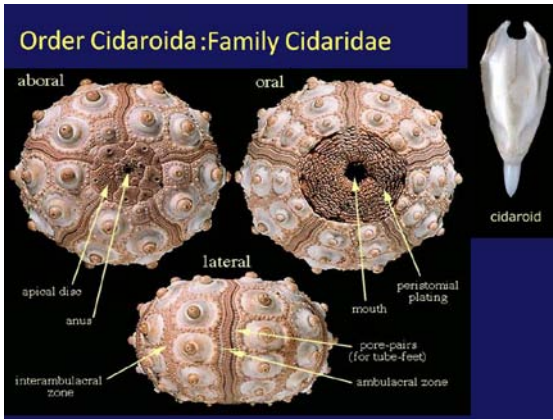
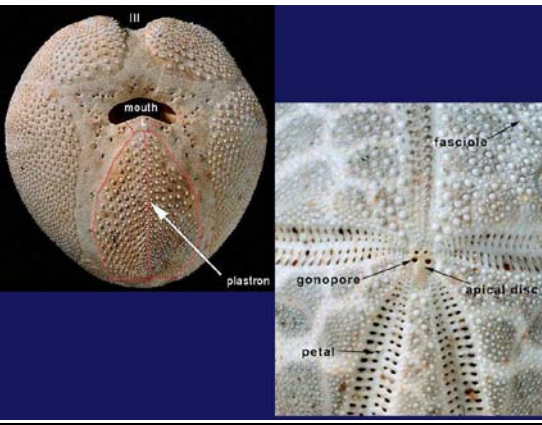
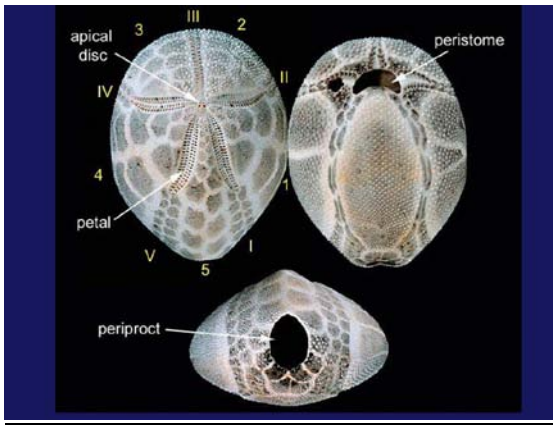
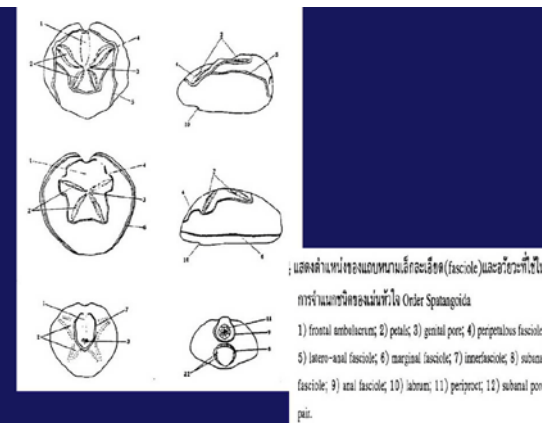
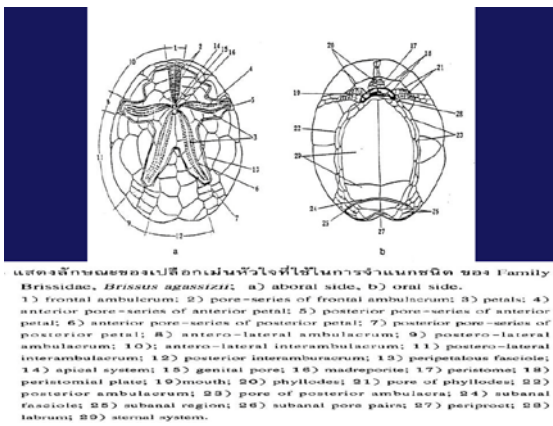
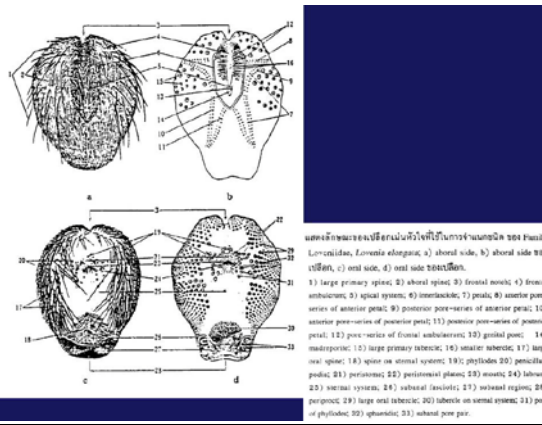
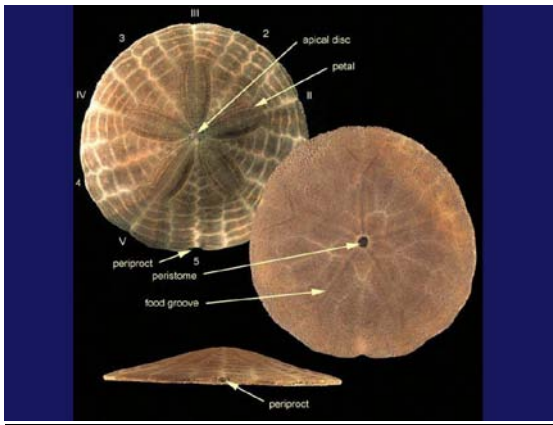
- a) ลักษณะทั่วไป: 1) madreporite; 2) periproctal plate; 3) anal opening; 4) genital plate; 5) genital pore; 6) ocular plate; 7) periproct.

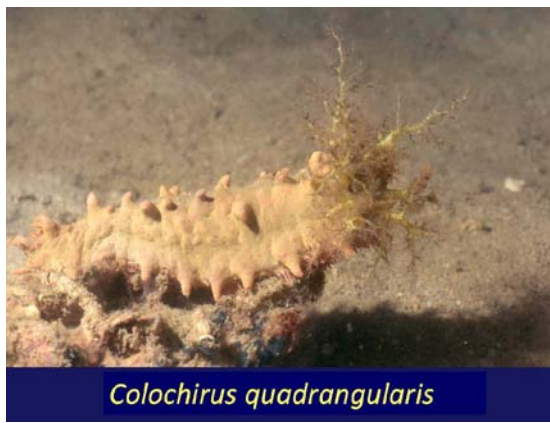
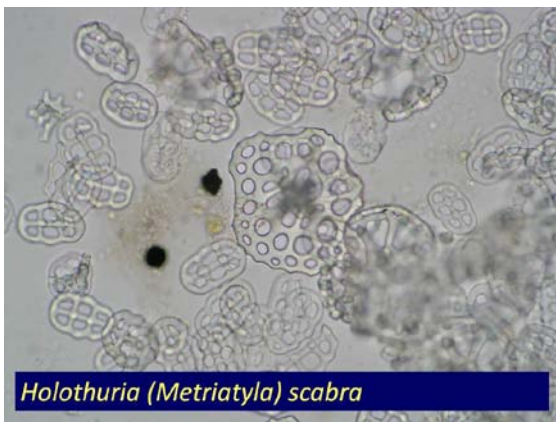
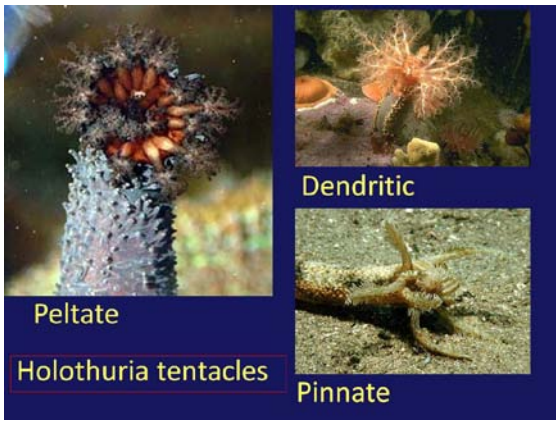
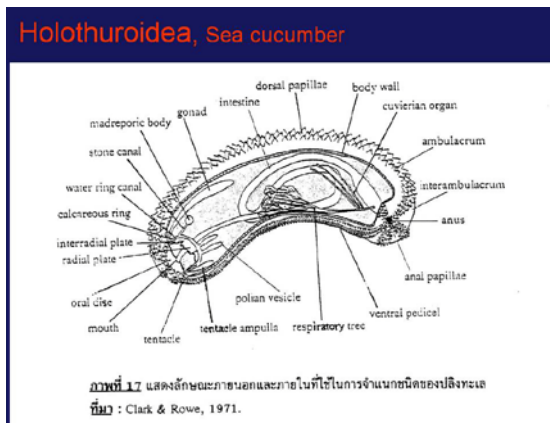
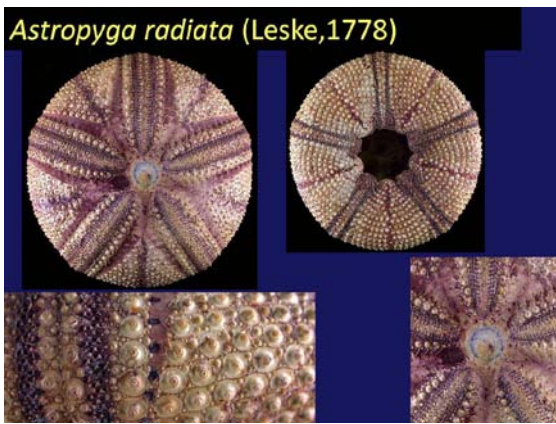
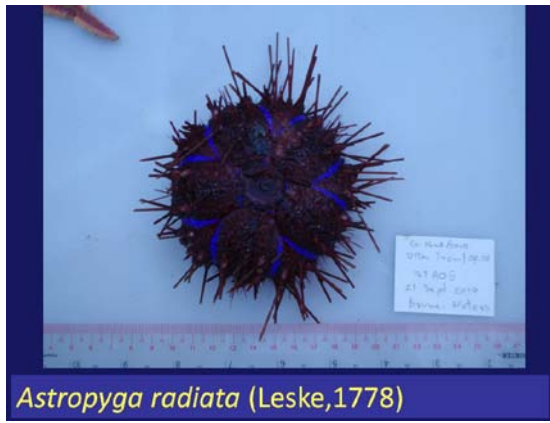
- h) apical system ของหริษญทะเล, *Arachnoides placenta* ตัวแทนใน Order Clypeasteroidea ที่ genital plates เชื่อมรวมกันเป็นท่อตะแกรงน้ำ (madreporite)
 i) แบบ ethmophract ของเม่นหัวใจ ใน Order Spatangoida ที่ ocular plate บรรจุกับ
 j) แบบ ethmolytic ของเม่นหัวใจ ใน Order Spatangoida ที่ท่อตะแกรงน้ำมีขนาดใหญ่และแยก ocular plate ออกจากกัน



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

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







Synaptula recta



Acaudina molpadioides



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 Brunnich, 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')

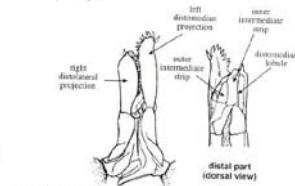
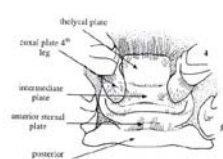
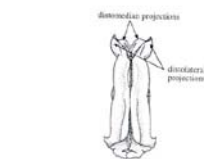
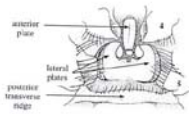
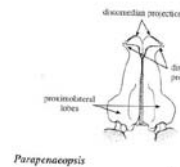
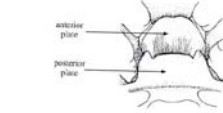
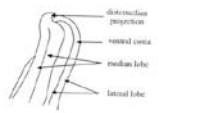
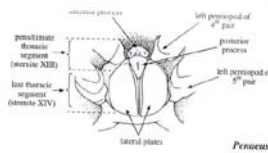
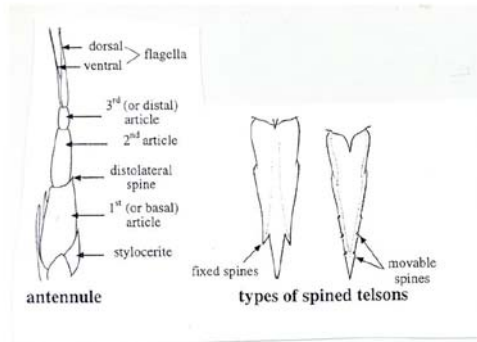
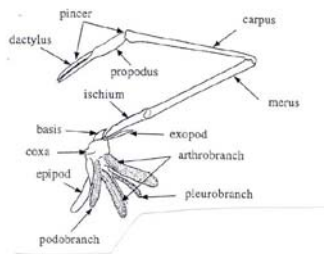
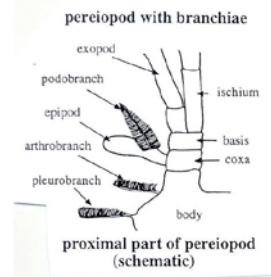
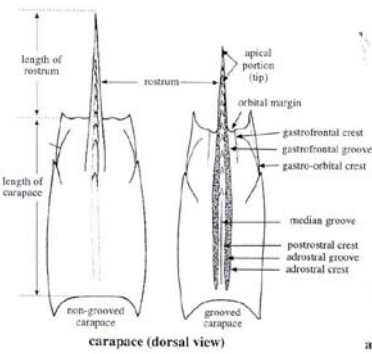
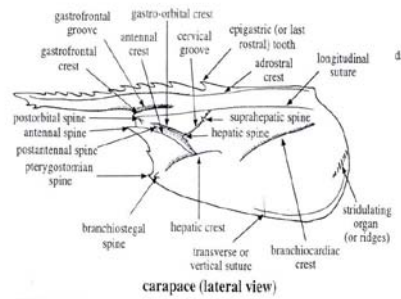
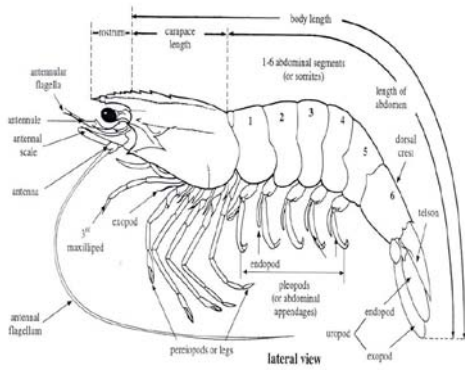
Class Malacostraca

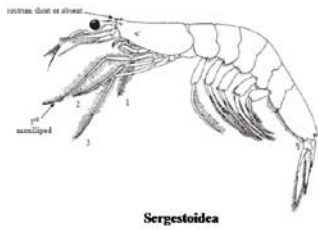
Subclass Hoplocarida Order Stomatopoda	Subclass Eumalacostraca Superorder Eucarida Order Decapoda	penaeid shrimps	lobsters & other shrimplike
Mantis shrimps	Crabs, shrimps, lobsters	dendrobranchiate gills	trichobranchiate gills
		body laterally compressed	phyllobranchiate gills
the second pair of thoracic appendages large and subchelate called "raptorial leg"	- carapace fused with thoracic segments - gills located near base of thoracic appendages - 1 st three pairs of thoracic appendages are maxillipeds - eyes stalked	1 st three pairs of legs are chelate but not with enlarged chelipeds	
		Suborder Dendrobranchiata	Suborder Pleocyemata
		Order Decapoda	

stenopodid shrimp	caridean shrimps	crayfish and lobster with large claws	spiny lobsters, slipper lobster
trichobranchiate gills	phyllobranchiate gills	abdomen well developed & flattened dorsoventrally	abdomen well developed & flattened dorsoventrally
1 st three pairs of legs chelate and one be enlarged	- 1 st two pairs of legs chelate or subchelate, either first or second pair heavier or longer than the others - 3 rd pair chelate	- 1 st three pairs of legs chelate and - 1 st pair greatly enlarged	- legs may be chelate or subchelate, but - 1 st pair in most species not enlarged
- Pleura of 2 nd abdominal segment not overlapping those of the first	- Pleura of 2 nd abdominal segment overlapping those of the first and third		
Infraorder Stenopodidea	Infraorder Caridea	Infraorder Astacidea	Infraorder Palinura
Suborder Pleocyemata			

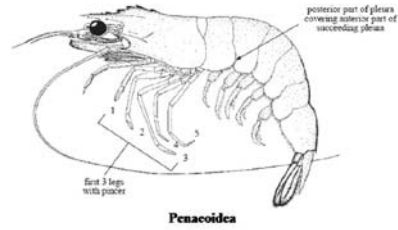
Shrimps and prawns

by T. Y. Chan

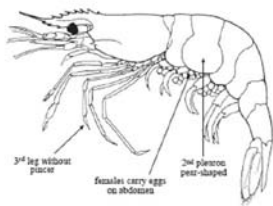




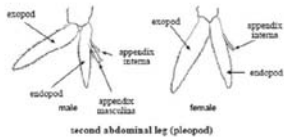
Sergestoidea



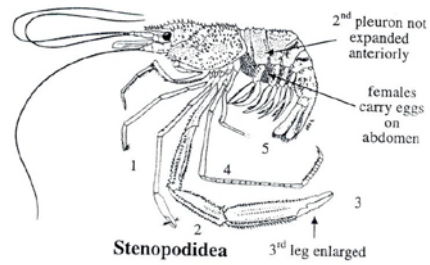
Penaeoidea



Caridea



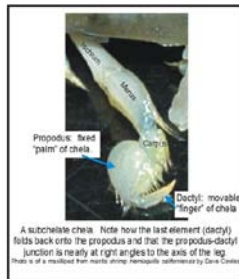
second abdominal leg (pleopod)



Stenopodidea



A chelate chela. Note how the 0th 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 fluvialis* by Dave Collins



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 modified front margin shrimp *Hemigrapsus* (unidentified) by Dave Collins

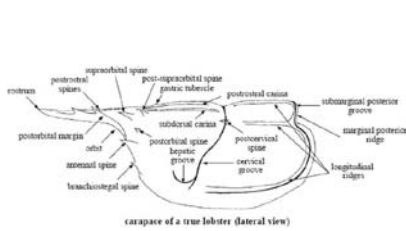
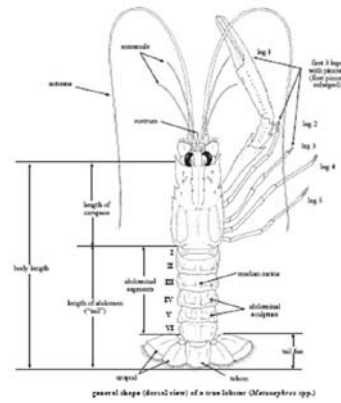
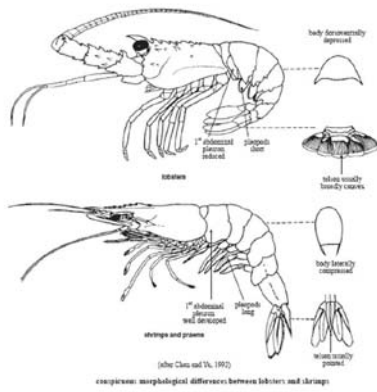


ridgeback shrimp *Solenocera choprai* Nataraj, 1945
comp shrimp *Solenocera pectinata* (Bate, 1888)



Lobsters

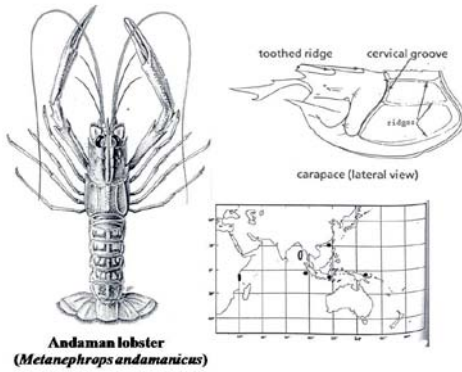
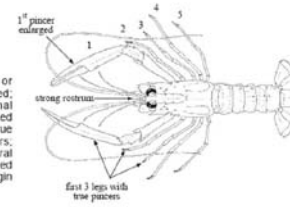
by T. Y. Chan



NEPHROPIDAE

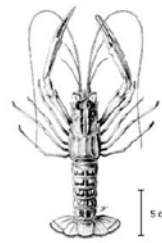
True lobsters and lobsterettes

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*)

FIG. 1 Fisheries Department



Andaman lobster (*Metanephrops andamanicus*)

Diagnosis:

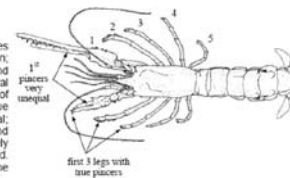
Carapace smooth between ridges and large spines. Postorbital carinae with three teeth. Chebce of first pereopods heavily ridged and spinulose, without large spines. No prominent basal spine on outer edge of movable finger of large chela. Inner margin of morae of first pereopod weakly spinulose. Surface of abdominal tergites conspicuously sculptured. Raised part 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 plicura. 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.



THAUMASTOCHELIDAE

Pincer lobsters

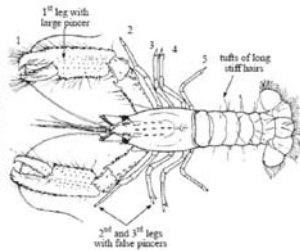
Body slightly depressed dorsoventrally, eyes strongly reduced, cornea lacking pigmentation; rostrum well developed; antennae long and thread-like; antennal scale bearing several large teeth along inner margin; first 3 pairs of legs (occasionally also fifth legs) with true pincers, first pair large but 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

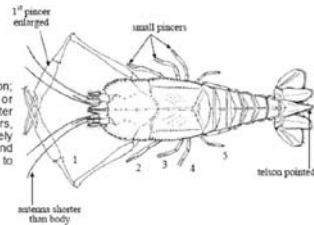
Body tubular and distributed with tufts of long stiff hairs; carapace with a well-developed rostrum; antennae long and thread-like, antennal scale with inner margin unarmed and curved; first pair of legs as large pincer, second and third legs slender and forming false pincers; abdominal pleura more or 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

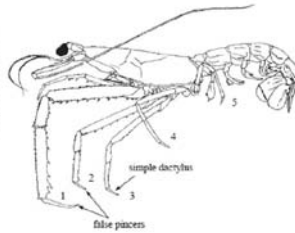
Eyes small, cornea lacking pigmentation; carapace box-like, rostrum absent or rudimentary; antennae thread-like, shorter than body; first 4 or all legs with true pincers, first pair long and slender; tail fan entirely hardened, telson pointed. All species found in very deep waters and of no interest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



GLYPHEIDAE

Fenix lobsters

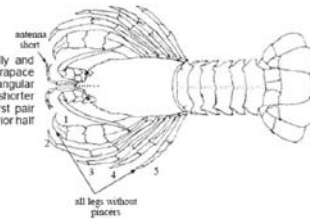
Body somewhat flattened dorsoventrally; eyes large and black, inserted on a median elevation of cephalon; carapace with a well-developed rostrum; antennae long and thread-like; first 2 legs forming false pincers, first pair very strong; uropods of tail fan entirely hardened. A single deep-water species,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



SYNAXIDAE

Furry lobsters

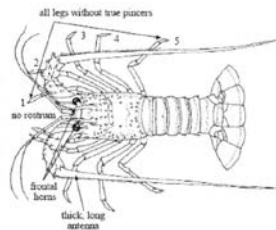
Body somewhat flattened dorsoventrally and very hairy, without enlarged spines; carapace laterally angular, with a broad and flat triangular or rounded rostrum; antennae whip-like, shorter than carapace; legs without pincers, first pair much more robust than the others; posterior half of tail fan soft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



PALINURIDAE

Spiny lobsters, langoustes

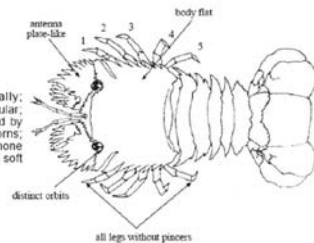
Body tubular or slightly flattened dorsoventrally; hairs, if present, few and scattered; rostrum absent or reduced to a small spine; carapace subcylindrical or prismatic, laterally rounded or straight, surface spiny and with a pair of large frontal horns above eyes; antennae very long and rather thick, 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

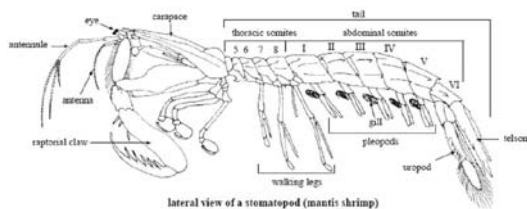
Slipper lobsters

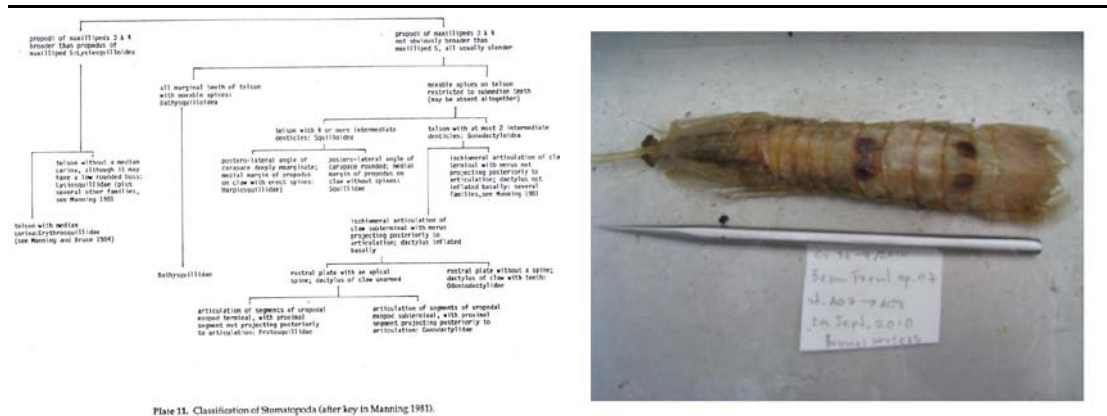
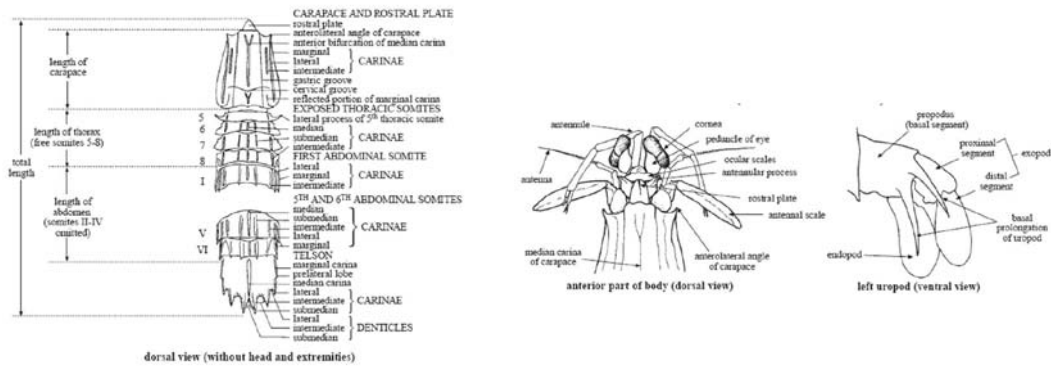
Body strongly flattened dorsoventrally; carapace depressed and laterally angular, rostrum absent or minute; eyes enclosed by distinct orbits and without large frontal horns; antennae plate-like; legs without pincers, none of them enlarged; posterior half of tail fan soft and flexible.



Stomatopods

by R. B. Manning





Thank you for your kind attention



Annex 15: Guideline to identification of Deep-Sea crabs

By Assist. Prof. Puntip Wisespongpan

**GUIDLINES TO IDENTIFICATION
OF DEEP-SEA CRABS**


Assist.Prof. Puntip Wispongpan
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

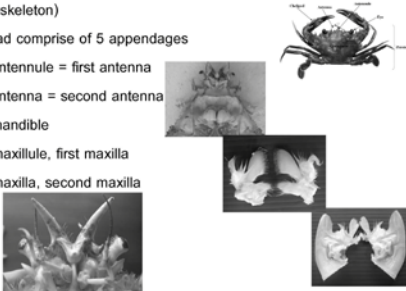


- ☞ Visible on the underside of a crab are the mouthparts or buccal cavity, sternum and abdomen
- ☞ Crabs are decapod crustaceans = ten jointed legs
- ☞ Two large claws = the symbol of crab
- ☞ 2 eyes which protrude from the front of the carapace
- ☞ 2 pair of sensing organs, antennule and antenna



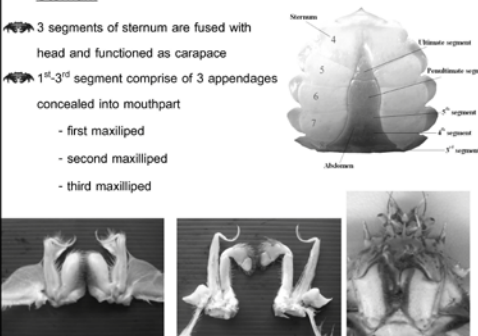
Head

- ☞ 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

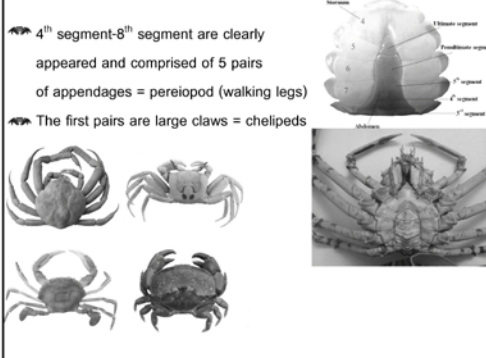


Sternum

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



- ☞ 4th segment-6th segment are clearly appeared and comprised of 5 pairs of appendages = pereopod (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

Hepatopancreas :

1. secretion of digestive enzymes,
2. absorption and
3. storage of digested food.

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.

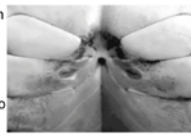
Feeding





-  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 1¼ 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 opilio*.












The importance of crab

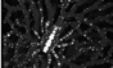

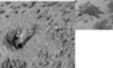

Human...

-  Crab...food, economic living resources, Fisheries, Aquaculture
-  Canning industry, Freezing industry, Chitosan, Ecotourism

Marine ecosystem

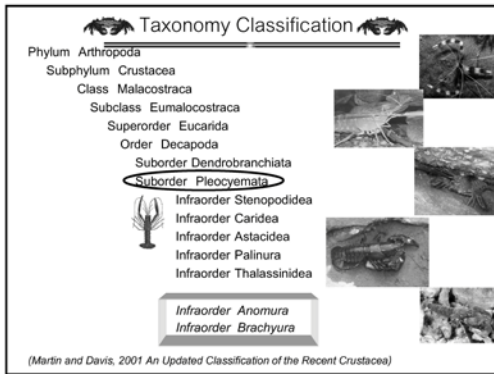
-  Crab... As predator and prey in food web
-  Crab...various habitat from coastal area to deep sea so various lifestyle
-  Crab...living together with many animals
-  Crab...environment service (decomposer, feeding, burrowing)

Annex 16: Classification of Deep-Sea crabs

By Assist. Prof. Puntip Wisespongpan



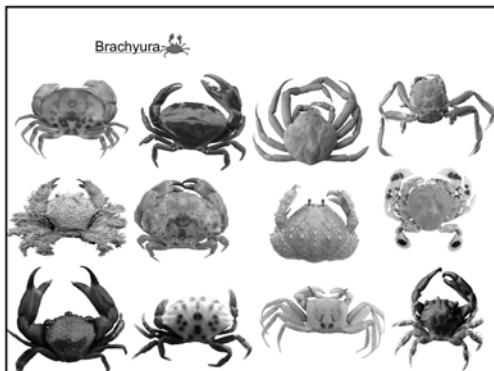
Anomura

- ☞ 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

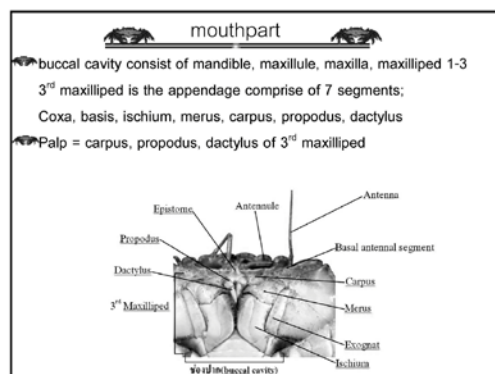
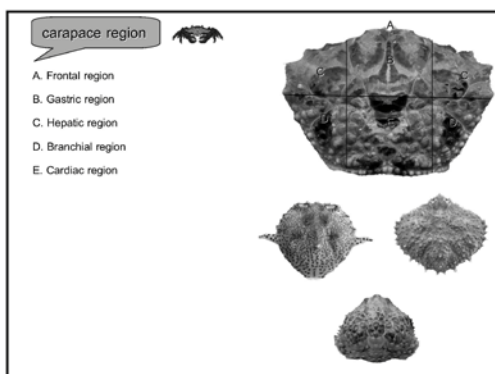
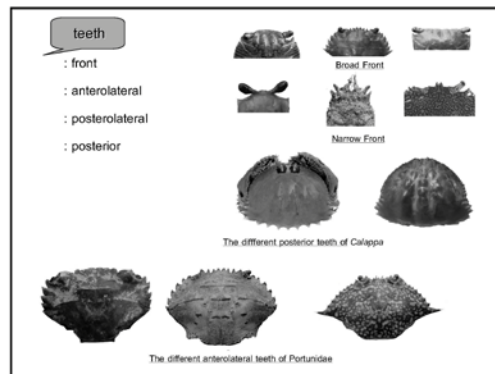
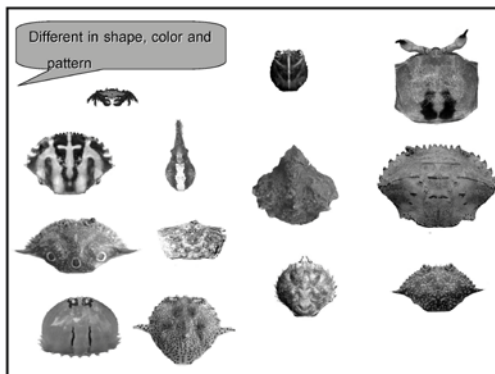
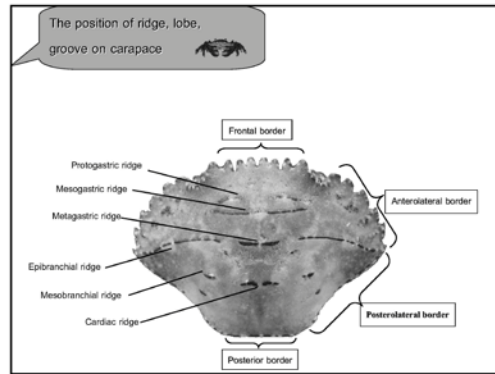
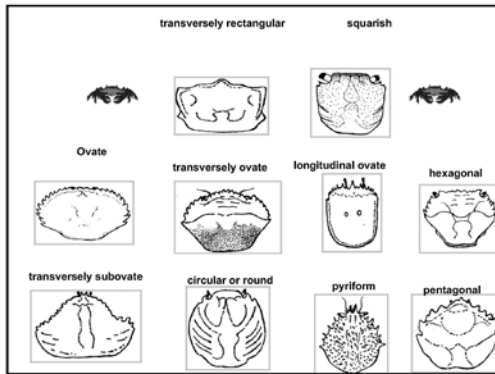
- ☞ Brachyuran crabs are true crabs
- ☞ Brachyura (Greek: *brachy* = short, *ura* = tail)
- ☞ The body is squat, broad and compact
- ☞ Carapace is symmetry, dorsoventral compressed and lateral expanded
- ☞ Abdomen is reduced and entirely fold down under the carapace
- ☞ The first pairs of carapace is 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



Carapace

- ☞ Carapace is chitinous
- ☞ Carapace width measures from left anterolateral margin to right anterolateral margin
- ☞ 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



Annex 17: Deep-Sea crabs fisheries

By Assist. Prof. Puntip Wisespongpan

Deep Sea Crab Fisheries



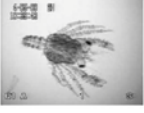
Deep sea crab

- 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 depth, they are like 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

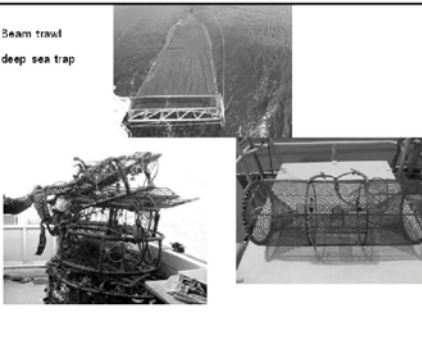
Deep-sea crab Fishery

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.

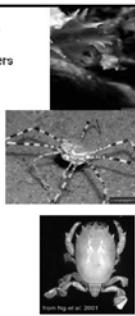
ANNCTATED CHECKLIST OF BRACHYURA (CRUSTACEA: DECAPODA) PRINCIPALLY OBTAINED DURING THE BIOSHELF SURVEY OFF WESTERN THAILAND FROM 1996-1998

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 :** *Latrollopsis totraspinosa* the first record of a Homolidae from Thai waters
- Family Latreillidae :** *Latreillia valida* the first formal record of the species and family for Thailand.
- Family Raninidae :** *Notoscoetes serratifrons*
- Family Dorippidae :** *Dorippoides nudipes* a new record for Thailand



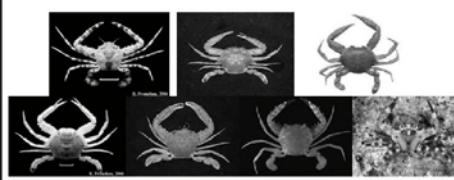
- Family Leucosilidae :** *Arcania quinquespinosa* new record, *Ixa pulcherrima* new record *Ixoides cornutus* new record *Myra fugax*, *Pariphticulic mariannae*, *Randallia eburnea*



- Family Calappidae** *Calappa lophos*, *Calappa pustulosa*




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



74 A Thai-Japanese SEAFDEC joint oceanographic and fishery survey
In 1987

75 Vessel M.V.Paknam, deep sea trawl at 300 m. from the Andaman
off Thailand

New crab *Daikoiros seafdeci*



76 Deep-sea crab from South China sea

77 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* (Mejidae),
C. largoi, new species, and *C. murrayi*,
C. horrida, and *C. echinata*



78 A new deep sea crab *Chaceon karubar*,
the first species of the genus *Chaceon*
to be recorded from Indonesian waters



79 California Academy of Sciences 2011 marine survey in the Philippines.
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).

80 Its pincers are lined with needle-like teeth.

81 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. doffeini* and *P. truncatispinosa* are reported from
these islands for the first time

82 Deep-sea crab from Brunei (South China sea)

83 Deep-sea crabs from Waters of Brunei
Darussalam 15 September – 25 October 2010

84 Vessel M.V. SEAFDEC 2


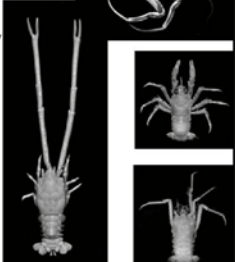


85 Fishing gear bottom trawl
(otter-board trawl and beam trawl)
deep-sea trap









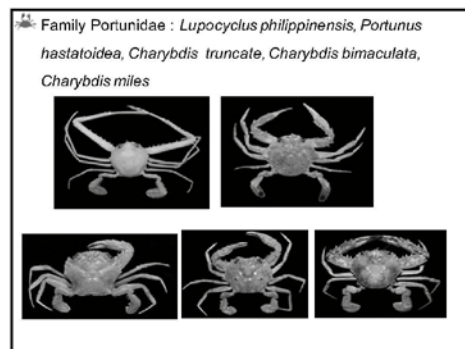
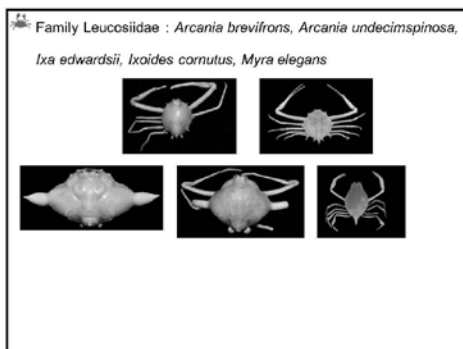
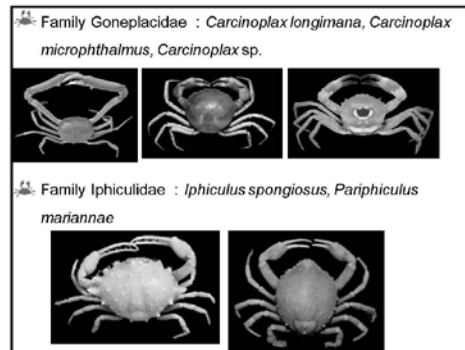
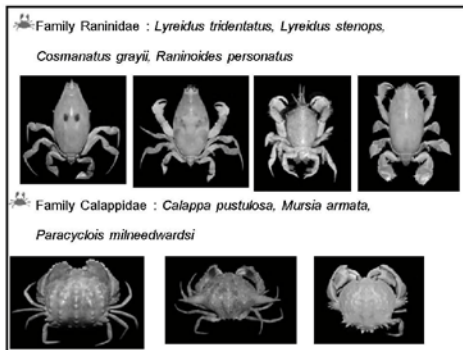
86 Family Parapaguridae :
Sympagurus affinis

87 Family Galatheididae :
Munidopsis cylindrophthalma,
Munida andamanica,
Agonida incerta

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



Annex 18/1: Results presentation of Group I
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 SL 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



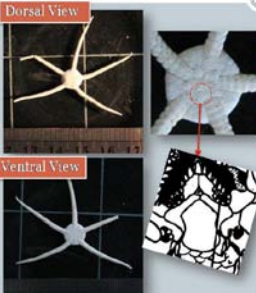
Dorsal View

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.
*paracetae 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 *Ophiotylus cf. leucus*
- Character: tooth can identify to F.Ophiuridae.

Echinodermata: Ophiuroidea: Brittle stars

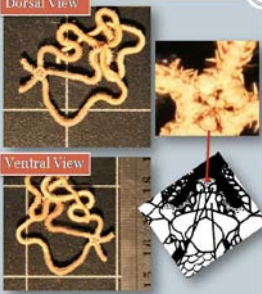


Dorsal View

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.Ophiuridae.
Arm combs can identify to *Ophiura cf. kinbergi*

Echinodermata: Ophiuroidea: Brittle stars

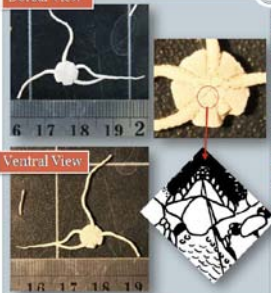


Dorsal View

Ventral View

- RV.Seafdec 2
- Cruise Cr.36-4 / 2010
- Fishing method Beam trawl op. 07 sl. A 07
- Locality 5 03.70N 114 02.00E Brunei water
- Depth 97 m.
- Sampling date 26 Sep. 2010
- Family name Amphipruridae
- Scientific name -
- Character: tooth can identify to F. Amphipruridae.

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 Ophicomidae
- Scientific name -
- Character: tooth can identify to F. Ophicomidae.

Shrimps & Lobsters

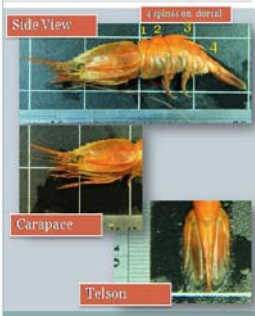


Dorsal View

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 pereopod not subdivided
 - first pereopod subchelate.

Shrimps & Lobsters




Side View

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

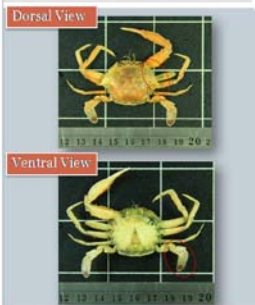


Dorsal View

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 pereopod with true pincers.

Deep-sea crabs

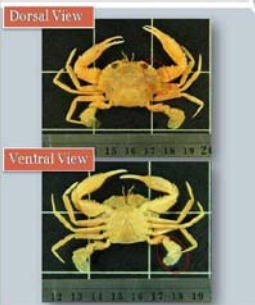


Dorsal View

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

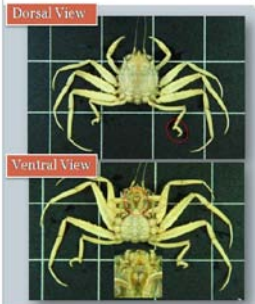


Dorsal View

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 *Paramokypsis* sp.
- Character: -Menus 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.



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.

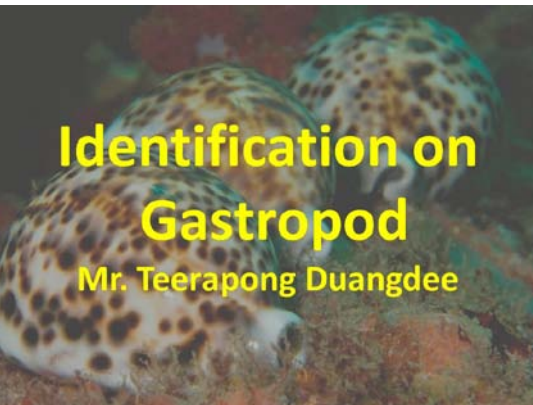
Commonly captured in the South China Sea at the sea depth between 100 and 300 meter such as :

- 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 solid, large body whorl, notch at outer lip
b. operculum corneous, claw-like

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).




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

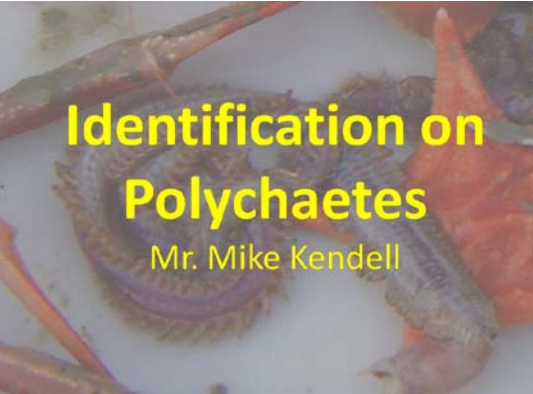
FAMILY NAME : MURICIDAE

- Shell variably shaped, generally with a raised spire (a) and strong sculpture with axial varices (b), spines (c).
- Aperture with well-marked siphonal canal (d).



Identification on Polychaetes

Mr. Mike Kendall




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*

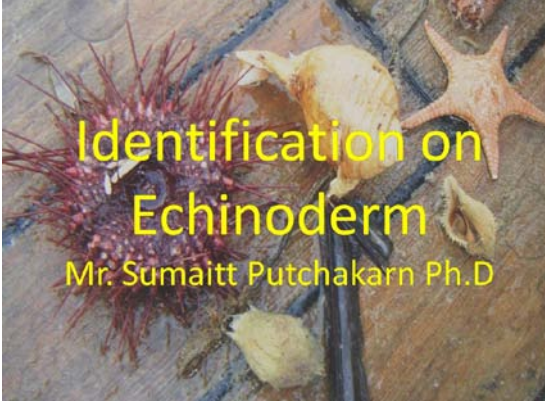
- Body short and oval-shaped



Ventral chaetae
 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 : Paxillosoida
 Family : Astropectinidae
 Genus : *Persephonaster*
 Species : *Persephonaster euryactis*

- Marginal plate not paxilliform
 - Tube feet knobbed, not sucker



Aboral side
 Oral side



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 : Paxillosoida
 Family : Astropectinidae
 Genus : *Persephonaster*

- 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
 Genus : *Stellaster*

- Marginal plate well-developed
 - 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-developed
 - 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



Identification on Shrimps & Lobsters

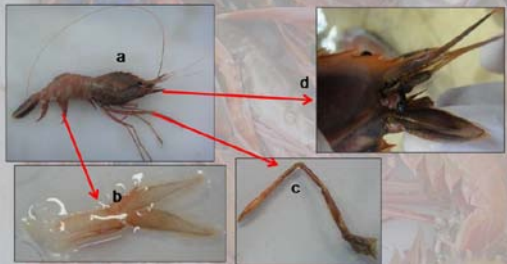
Dr. Suriyan Tunkijjanukij



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 : Malacostraca
 Infaorder : Caridae
 Order : Decapoda
 Suborder : Pleocyemata
 Family : Pandalidae
 Genus : *Pandalus*
 Species : *Pandalus propinquus*

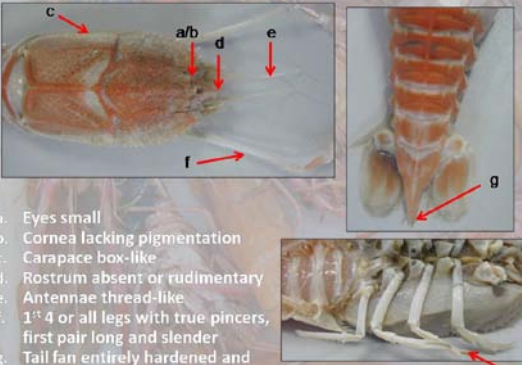



a. Rostrum as long as, or longer than carapace and curving upwards
 b. Maxilliped 3 without an exopod
 c. Carpus of pereopod 2 right comprises five segments.
 d. Scaphocerite narrows towards tip, with outer border slightly concave

LOBSTER

Ship Name : MV SEAFDEC II
 Cruise No : 36-4/2010
 Fishing Method : Beam Trawl Op.LD
 Locality : Lat 05° 07.10' N
 Long 113° 52.60' E
 Depth : 264 m
 Sampling Date : 30 Sept 2010

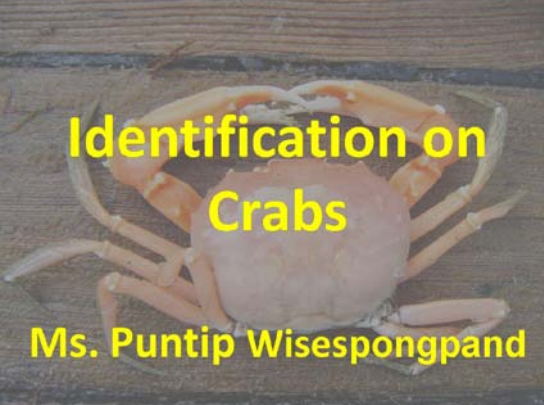
Phylum : Arthropoda
 Subphylum : Crustacea
 Class : Malacostraca
 Superorder : Eucaribia
 Order : Decapoda
 Suborder : Pleocyemata
 Infraorder : Palinura
 Superfamily : Eryoniidae
 Family : Polychelidae

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 Wisespongpan



CRAB

Phylum : Arthropoda
 Class : Malacostraca
 Infaorder : Caridae
 Order : Decapoda
 Suborder : Brachyura
 Family : Goneplacidae
 Genus : *Carcinoplax*





CRAB

Phylum	: Arthropoda
Class	: Malacostraca
Infraorder	: Caridea
Order	: Decapoda
Suborder	: Brachyura
Family	: Homolidae
Genus	: <i>Homalomannia</i>
Species	: <i>H. acclusa</i>

a. Pseudorostral spines distally unidivided with spines along margin, shorter than maximum carapace width.

b. Maxilliped 3 operculiform, almost fully covering buccal cavity.



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

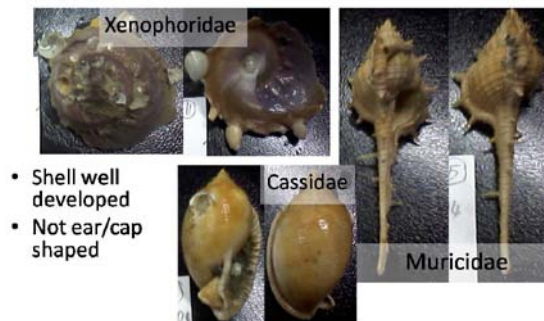
Identification Results

- Gastropods
- Polychaetes
- Sponges
- Crabs

Abbreviations

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

Gastropods



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



- 6 ray spicules
- Include discohexasters



Order Lyssacinosa
Fam. Euplectellidae

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

Class Demospongiae



- 4 ray spicules
- Small conical shapes



Order Spirophorida
Fam. Tettilidae

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

Crabs



Fam. Portunidae



Fam. Calappidae



Portunidae

- M. genital opening on coxosternal & 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
- Righth chaela with forceps-like
- 3rd maxiliped merus not triangular
- Ambulatory legs almost uncovered by carapace



Calappa pustulosa

(continued)

Annex 18/3



For This Program

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

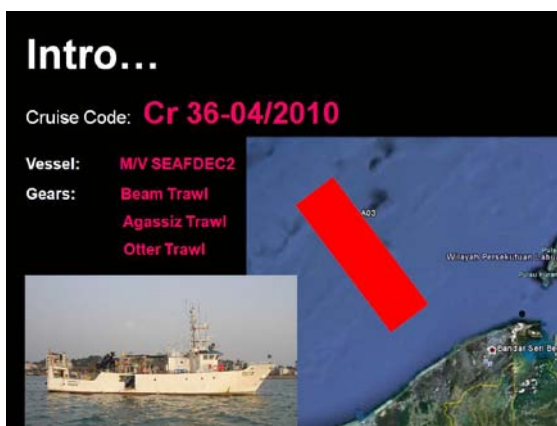
Annex 18/4: Results presentation of Group IV

By Mr. Joeren Yleana

Mr. Val Borja

Ms. Ngo Thi MauThu

Ms. Ngo Thi Thanh Huong



Results...

Group	Family	Genus sp.	No.
Gastropoda	Turridae	—	1
	Epitonidae	—	1
	Personidae	<i>Distorsio reticularis</i>	1
	Ovulidae	<i>Volva volva</i>	1
Polychaeta	Aphroditidae	<i>Laetmonice sp.</i>	1
Echinodermata	Cidaridae	<i>Goniocidaris sp.</i>	4
	Echinothuriidae	<i>Calveriosoma sp.</i>	6
	Schizasteridae	<i>Linopneustes sp.</i>	1
	Diadematae	<i>Chaetodiadema sp.</i>	4

Results...

Group	Family	Genus sp.	No.
Crustacea	Squillidae	<i>Oratosquilla sp.</i>	1
	Aristeidae	<i>Aristeus virilis</i>	1
	Solenoceridae	<i>Haliporoides sibugae</i>	1
	Nephropidae	<i>Metanephrops sinensis</i>	1
	Calappidae	<i>Paracyclois mineedwardsi</i>	1
	Raninidae	<i>Lyreidas tridentatus</i>	1
	Portunidae	<i>Carybdis acuta</i>	1

TOTAL Specimen.....27





Major keys

- Siphonal canal relatively long
- Outer sculpture w/o axial 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**

Station:
Cr 36-4/2010
Beam Trawl op.04
28 Sept 2010
Brunei Water




Major keys

1. Color- White to grayish white
2. Length- 2-3cm
3. Width- 1-1.5 cm
4. Aperture- slightly rounded
5. Axial ribs- Present! with few spiral coils

Taxonomic Classification:
Class: **Gastropoda**
Family: **Epitonidae**
Genus: **Epitonium**

Epitonidae 6
Cr 36-4/2010
Beam Trawl op.04
28 Sep 2010
Brunei water 5


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 cornerous
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



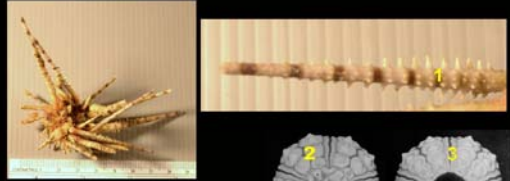
Palp

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 96-4/2010
 Otaru trawl 02
 18 Oct 2010
 Brunel Waters


Echinodermata



Family: Cidaridae
 Genus: **Goniocidaris sp.**

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 circumference is round


Station:
 Cr 96-4/2010
 Otaru trawl 02
 23 Sept 2010
 Brunel Waters



Family: Echinothuriidae
 Genus: **Calveriosoma sp.**

Major keys
 -Test large and flattened
 - Circumference is round
 - Ambulacral pores...


Station:
 Cr 96-4/2010
 Otaru trawl 04
 23 Sept 2010
 Brunel 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 96-4/2010
 Otaru trawl 04
 Sep 05
 23 Sept 2010
 Brunel 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 96-4/2010
 Otaru trawl 02
 23 Sept 2010
 Brunel Waters

Crustacea

Mantis Shrimps

Order: Stomatopoda
Family: Squillidae
Genus: Oratosquilla sp.

Station:
 Cr 96-4/2010
 Otaru trawl 07
 29 Sept 2010
 Brunel Waters

Major Keys

Thoracic somites

Abdominal somites

Propodus of claws with blunt pectinations

Lateral process double

Order: **Penaeoidea**
 Family: **Aristeidae**
 Sci. Name: **Aristeus virilis**

Station:
 Cr 36-4/2010
 Agassiz Trawl 03
 19 Oct 2010
 Brunel 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
 Brunel 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
 Brunel Water

Major Keys Metanephrops sinensis

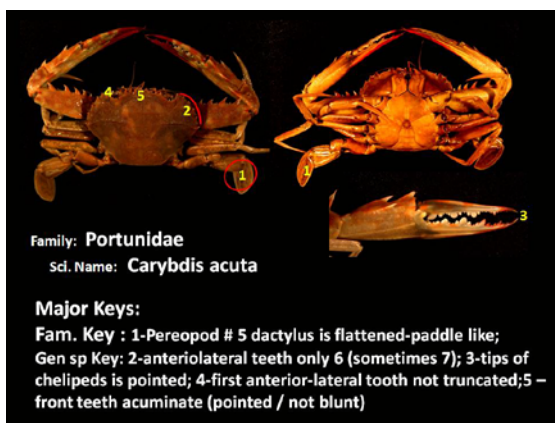
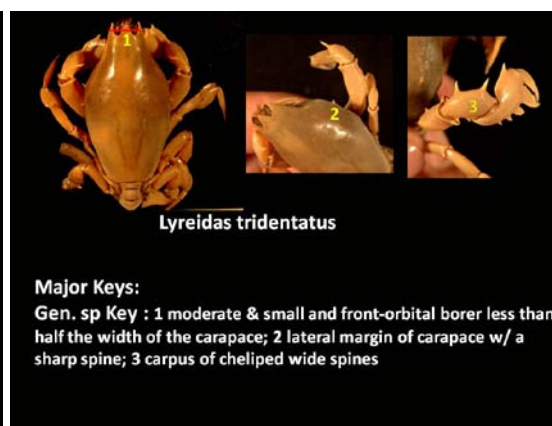
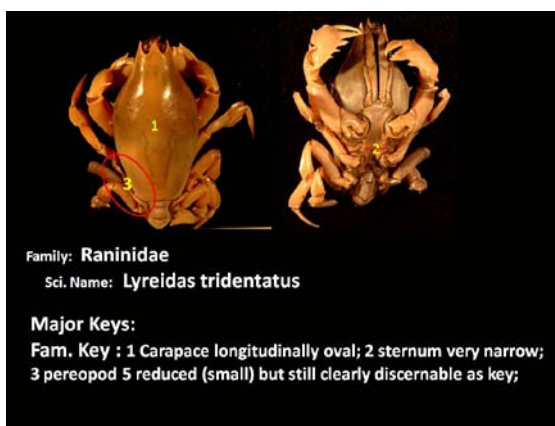
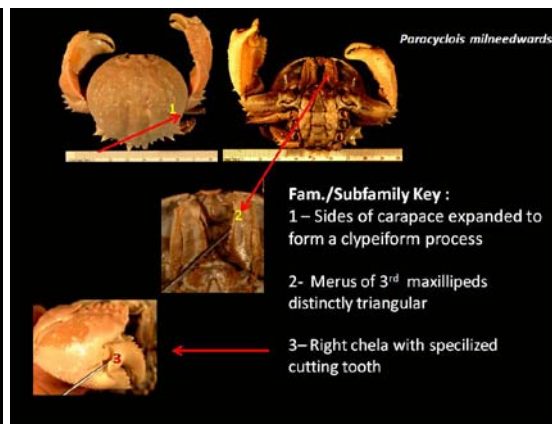
Fam. Key : 1 - rostrum strongly convex (broken)
 2 - First three pairs of legs with true pincers, first pair much larger than others
 3 - Tail fan entirely hardened, telson armed with fixed spines

Gen sp Key : 1 - exopod and uropod are armed with distolateral spine

Major Keys Metanephrops sinensis

Gen sp Key : 1 - Eyes large & black, antennal scale present, body provided with some spines but never uniformly spinulose

Species Key : 2 - Large pincer smooth or weakly ridged with outer border always angular
 3 - Abdomen smooth or with narrow transverse groove on the 1st segment



Annex 18/5: Results presentation of Group V

By Ms. Halimah Mohamed

Mrs. Noparat Nasuchon

Dr. Ahmadi

Mr. Suwat Jutapruet

Mr. Soe Win

<h2 style="margin: 0;">IDENTIFICATION OF DEEP-SEA BENTHIC MACROINVERTEBRATE VULNERABLE TO FISHING GEAR SEAFDEC/TD</h2>	<p>Gastropods: (4) Olividae, Personidae, Fasciolaridae, Turridae</p> <p>Polychate: (2) Ophelidae Sigalionidae</p> <p>Echinoderm: (2) Antedonidae Metacrinus rotundus</p> <p>Sea Cucumber: (2) Eumolpadia sp Acaudina molpadoides</p> <p>Shrimp, Lobster, and Stomatopods</p> <p>Shrimp: (4) Aristaeomorpha foliacea, Metanephrops sinensis, Caridea sulcirostris, Palaemon adspersus.</p> <p>Lobster: (1) Puerulus angulatus</p> <p>Stomatopod: (2) Chloridopsis immaculata, Lysiosquilla sulcirostris</p> <p>Crabs: (8) Carcinoplax microphthalmus, Medaeops granulosis, Paracyclois milneedwardsi, Mursia amata, Iphiculus spongiosus, Calappa pustulosa, Latreillopsis bispinosa, Ixa edwardii.</p> <p>No. Specimen Identified = 25</p> <p>Caught by : -Beam trawl and -Agassiz traw</p> <p>Location: Brunei waters</p>
<p style="text-align: center;">Group Members</p> <p style="text-align: center;">Halimah Mohamed Noparat Nasuchon Dr. Ahmadi Mr. Suwat Jutapruet Mr. Soe Win 11-15 July 2011</p>	

Identification of Gastropods

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: *Calloused with oblique grooves anteriorly.*
 Operculum : *Absent*

Suture : The continuous line where 2 adjacent whorls join

Gastropod

Family: Personidae

Sample: Cr-36-4/2010
 Agassiz 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 teeth.*
 Inner lip : *with an extensive callus.*
 Siphonal canal *recurved.*
 Operculum: *corneous.*

Gastropod

Family: Fasciolaridae

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

Sinus

Siphonal canal relative long

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


Cr. BTR5
 Beam trawl
 17 Oct. 2010
 Lat 05°40' 90N
 Long 114°24' 00 E
 Sample depth 305 m.
 Brunei Waters

Identification of Polychate

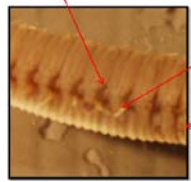
POLYCHEATE Family: **Opheliidae**

Cr. 36-4/2010
Beam trawl 09
29 Sept. 2010
Brunei Waters
Family: Opheliidae


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 chaetae




Small parapodia
Jaws: absent
Ventral groove



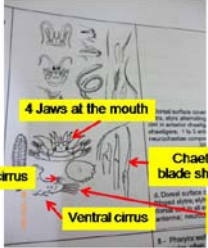
POLYCHATE Family: **Sigalionidae**

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.




antenna




4 Jaws at the mouth
Dorsal cirrus
Ventral cirrus
Chaetae blade shaped
Composite setae


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.




No discoidal


Cr. 36-4/2010
Beam trawl 02
28 Sept. 2010
Brunei Waters

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 to 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: **Molpadidae**
Genus: **Eumolpadia**

Tentacles with lateral digits, or claw-shaped. Tentacle ampullae long





Tail with long fusiform rods



S. Hedling. *Holothurioides*. I. Pl. VII.


Echinoderm Species: *Acaudina molpadoidea*

Sample: Cr-36-4/2010
Agassiz trawl 09
18 October 2010
Brunei 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: *Aristaeidae*
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

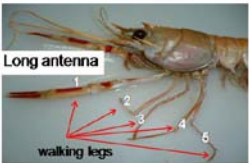
Telson : sharp
Long rostrum and >= 5
Rostrum armed,
Short upper antennular flagellum

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




Rostrum well developed and strong




Teeth

Carididae sulcirostris



Long rostrum and curved up




Sharp walking leg


Cr. 36-4/2010
Otter trawl op.08
23 Sept. 2010
Brunei Waters
Family: *Carididae*
Species: *Carididae sulcirostris*

Second pleural cover the first and the third pleural (Overlapping)


Palaemon adspersus



Long rostrum and curved up with 8 teeth



Long walking leg



Single spine on dorsal

Cr. 36-4/2010
Beam trawl op. 10
23 Sept. 2010
Brunei Waters
Family: *Palaemonidae*
Species: *Palaemon adspersus*

First walking leg have a fork

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 somite lacking any dark color

Rounded carapace

Cr. 36-4/2010
Beam trawl 07
29 Sept. 2010
Brunei Waters
Family: Squillidae

telson lacking longitudinal carinae on surface

Single spine

Stomatopod

Daetylus of raptorial claw with 8 teeth

Sharp horn
Rostron

Rounded carapace

Smooth body

Cr. 36-4/2010
Beam trawl op.04
28 Sept. 2010
Brunei Waters
Family: *Lysiosquillidae*
Species: *Lysiosquilla sulcirostris*

Identification of Crabs

Crabs

Family : Goneplacidae
Species : *Carcinoplax microphthalmus*

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)

Crabs

Family : Xanthidae
Genus : *Medaeops*
Species : *Medaeops granulosis*

Habitat: rocky or stony shore, at and below the tide mark.
Distribution: China, Japan, Korea, Australia, South coast of Africa

Carapace shape: Transversely Hexagonal

Cheliped : asymmetrical

4 teeth at anterolateral

Movable finger

Immovable finger

Cp. 1.5 times as broad as long

sternum

Crabs

antenna antennule

eye eye

Third maxilliped

sternum

Telson

6-Segment

VI
V
IV
III
II
I

Posterior

Male abdomen pagoda shaped

Crabs

Family: *Calappidae*
Species: *Paracyclois mheedwardsi*


8 teeth

Rounded carapace

Spine on posterolateral

Spine on posterior

Crabs




Family: *Calappidae*
Species: *Mursia armata*

Long spine

Carapace expanded to a clypeiform, pentagonia

Crabs



4 sharp teeth


Anterolateral margin with 4 sharp spines

Family: *Iphiculiidae*
Species: *Iphiculus spongiosus*

Chelipeds covered with short hairs

Fingers slender

Crabs




Family: *Calappidae*
Species: *Calappa pustulosa*

Carapace subcircular. There are 5 obtuse teeth around the clypeiform expansion. Posterior border is bounded by an indistinct tooth on either side.

5 obtused teeth

Surface tuberculated

Crabs



Family: *Calappidae*
Species: *Latreilopsis bispinosa*

Carapace with 2 hepatic spines

Maxilliped 3 merus with bluntly rounded outer distal angle

Crabs

Species: *Ixa edwardii*



Carapace rhomboidal, Upper surface covered with granules, more densely on lateral spine and posterolateral part

Anterolateral margin as long as posterolateral margin.




Thank you...





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