Zooplankton biodiversity in Southeast Asia: An overview

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Tethyan origin (200 MYA)

Complex geologic history
- eustatic sea-level change
- continental fusion/fission

Island chains, marginal basins

South China Sea
Sulu Sea
Celebes Sea
Banda Sea
Java Sea
Flores Sea
MUSORSTOM Expedition (1976, 80, 84)
- Living fossil: *Neoglyphea* “Jurassic shrimp”
- Benthos and demersal fish 600 spp., > 80 new species

Indo-Malay Archipelago
Pelagic copepods: ca. 550 spp. (1/4 of world total)

Living fossil: Coelacanth (1998)
Biodiversity-crisis hotspot
- Eutrophication
- Pollutants: BTs, PCBs, HMs
- Destruction: Coral reef, mangrove forests, seagrass beds
- Overfishing

Status of knowledge
- Based largely on historical expeditions (Challenger etc.)
- Many undescribed species expected
- Faunal lists: incomplete
- Community structure: poorly known
- Taxonomic experts: “endangered”
Biodiversity of Zooplankton in Southeast Asia

Census of Marine Zooplankton (CMarZ/CoML): 2004-2010

JSPS Program - Coastal Marine Science: 2001-2010

Sites for
- General Sampling
- Community-structure Study
- Taxonomic Survey

Thailand
Malaysia
Indonesia
Philippines
Vietnam
Japan

Nha Trang
Port Dickson
Tioman Island
Manado
Lombok Island

Hakuho-Maru Cruises
- Sulu Sea
- Celebes Sea
- South China Sea

Census of Marine Zooplankton (CMarZ/CoML): 2004-2010
Aims of research

Goals
- Past- and present status of zooplankton communities
- Mechanisms of generation/maintenance of biodiversity
- Functional role of biodiversity
- Future of the marine ecosystem

Approaches
- Fulfill basic knowledge of biodiversity at species/community levels
- Utilize genetic tools for biodiversity analysis
- Establish databases
- Have training courses on methods of ecology and identification
Major accomplishments

1. Discovery of new species
2. Community structure
3. Genetic diversity (incl. East Asian Region)
4. Education and outreach
5. Database (CMarZ-Asia Database)

43 scientific papers describing 1 new family, 6 new genera And 82 new species

- Mysids: 2 new gen. & 37 n. spp.
- Copepods: 4 new gen. & 38 n. spp.
- Other Crustacea: 5 n. spp.

Still >> 50 species are waiting for description

Specific habitats
- estuaries
- benthic-pelagic zone
- coral reefs
- marginal basins
Tortanus (Atortus) vietnamicus
Nishida & Cho, 2005

- Simple collection from a pier with a small plankton net
- Night-time sampling
- Representing pristine habitat: coral-reef area of Nha Trang
Zoogeography of *Tortanus (Atortus) : Tropicus*-subgroup

- > 10 species in the Indo-pacific
- Highly allopatric pattern of distribution
- Isolation of populations through eustatic sea-level changes
  - by emergence of
    - land barriers
    - deep-ocean barriers
- Discovery of many more species expected
- A good model for allopatric speciation
2. Community structure in characteristic habitats

- Mesopelagic communities in marginal basins (Sulu, Celebes, and South China Seas) by Jun Nishikawa

- Monitoring in the Straits of Malacca by Othman B.H. Ross

- Comparison between coral and sea-grass habitats by Ephrime B. Metillo

- Collaborative Jellyfish research in Vietnam and Indonesia by J. Nishikawa & coworkers
Jellyfish fisheries in the north of Vietnam

To know...
- Target species
- Fishing gear
- Processing method
- Economic and Ecological aspects
  (Nishikawa et al. 2008)

- PI: Nguyen Thi Thu (IMER)
- Funded by: Vietnam Academy of Science and Technology (VAST)
- Years: 2006-2007
- JSPS collaborator: Jun Nishikawa
An on-going bilateral research project
“Biodiversity and Ecological Roles of Medusae and Ctenophores in Indonesian Waters”
2008-2010
LIPI-JSPS
S. Ohtsuka and Mulyadi (Co-PIs)
R. Machida, J, Nishikawa, S. Nishida, J. Hiromi, D.J. Lindsay, Y. Miyake and 3 Indonesian Scientists

- Taxonomy, ecology, life history, behavior
- Edible giant jellyfishes
3. Genetic biodiversity (including other regions)

- Barcoding of copepods and chaetognaths (ca. 120 species)
- Zooplankton community genomics by Ryuji Machida
- Re-evaluation of chaetognath taxonomy by molecular tools by Hiroomi Miyamoto
- Identification by molecular tools discovered large mid-water populations of *Clalanus sinicus* (Nonomura et al. 2008)
Geographical distribution of *Calanus* in the western North Pacific

In central Sagami Bay: *Calanus* CVs are abundantly distributed in the mesopelagic zone (Shimode et al., 2006)

The species of these *Calanus* CVs has been unknown

*Calanus sinicus*  2 mm

*Calanus jashnovi*  3 mm
Genetic variation of *C. sinicus*, *C. jashnovi*, *C. pacificus*

<table>
<thead>
<tr>
<th></th>
<th>srRNA</th>
<th>ITS1</th>
<th>ITS2</th>
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<tbody>
<tr>
<td><em>C. sinicus</em></td>
<td>&lt;0.002</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Between spp.</td>
<td>0.119-0.149</td>
<td>0.010-0.014</td>
<td>0.005-0.010</td>
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</tbody>
</table>

Genetic distance within *C. sinicus* and between *C. sinicus* *C. jashnovi* and *C. pacificus*

Regions: srRNA (456-458bp)、ITS1 (366bp)、ITS2 (185-186bp)

Three species of *Calanus* can be identified at three regions
Calanus spp.: Vertical distribution and genetic identification

0-200m
4 layers

Small CV: *C. sinicus*

Large CV: *C. jashnovi*

200-1000m
4 layers
**C. sinicus**

A large population of CV *C. sinicus* was present in the mesopelagic zone.

**C. jashnovi**

*C. jashnovi* was much less abundant, with only shallow CIV and mesopelagic population of CV.
4. Education and outreach

- Training courses in SE Asian countries, 2003-09
- Cruises for high-school students: “Let’s study the ocean on a research vessel!”, 2006-09
Training Courses on Methods of Zooplankton Ecology and Identification

Lectures (2 days)
- What is plankton?—A general introduction
- Methodology of zooplankton ecology
- Introductions to
  - Crustacea, gelatinous plankton, other animal groups

Practices (4 days, including field sampling)
- Sample processing and primary sorting
- Identification of major taxonomic groups:
  - Copepoda, Chaetognatha, Mysidacea, Cnidaria, Tunicata, Demersal plankton

2003: Chulalongkorn University, Thailand
2004: University of the Philippines, Philippine
2005: Institute of Marine Environment and Resources, Vietnam
2006: Univresiti Putra Malaysia
2007: Research Center for Biology, Indonesia
2008: “Advanced course”, Universiti Kebangsaan Malaysia
2009: “Advanced course”, Burapha Univ., Thailand
Dr. Sawamoto’s lecture on sampling methods

Training Course in Indonesia, 2007
Plankton sampling off Port Dickson

Training Course in Malaysia, 2006
Dr. Ohtsuka demonstrating copepod dissection

Training Course in Indonesia, 2007
5. CMarZ-Asia Database: www.cmarz-asia.org/db
List of selected samples

Sampling metadata
Species search

Species database

- Photographic image
- Taxonomic illustration

Species name

Distribution

Sample details

DNA sequence database & link to blast search
Title: Census of Marine Zooplankton in Southeast Asia

Goal: Establishing present status of marine biodiversity in SE Asia, through quantitative analysis of communities based on the taxonomic background established through the CMarZ project (-2010), as a basis for monitoring of effects of human impacts, such as fisheries and pollutants, and environmental changes.
Collaborating countries
- Indonesia
- Malaysia
- Philippine
- Thailand
- Vietnam

CMarZ-JSPS (2001-2010)

Additional sampling
(All members + collaborators)

Sample-collection database
(Foreign collaborators)

Sample analysis
- Taxonomy (All members)
- Community structure (Nishida, collaborators)
- Genetic analysis (Nishida)
- Pollution (Nishida, collaborators)

- New species
- Species’ list
- ID Manual

Zooplankton database for SE Asia (Nishida)

This Research (2010-2013)

CMarZ-OBIS
謝謝大家！
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