

## **Report of Working Group 23 on Comparative Ecology of Krill in Coastal and Oceanic Waters around the Pacific Rim**

The annual meeting of the Working Group on *Comparative Ecology of Krill in Coastal and Oceanic Waters around the Pacific Rim* (WG 23) was convened in Khabarovsk, Russia, at 0900 h on October 16, 2011. Only 6 of 17 members were able to attend, and 4 observers participated (*WG Endnote 1*). Most of those who could not attend sent their regards to the U.S. Co-Chairman, Dr. William Peterson. The meeting agenda can be found in *WG 23 Endnote 2*.

### AGENDA ITEM 2

#### **Status of posting references and papers**

The meeting began with a discussion of the status of posting of references and pdf copies of published papers to our ZOTERO web-page. ZOTERO is a web-based bibliographic site where documents can be stored and shared openly with WG members. The idea is that representatives of the member countries will post publications, reports and theses to this website focusing on works available in their own country that are not available (or have limited availability) to those from other PICES member countries. Ms. Tracy Shaw established the personal WG 23 page on ZOTERO; she also did a live demonstration of how to access the site over the internet, and showed members how to view the content. Presently there are ~ 125 references listed on the site. David Checkley mentioned that they had tried to use ZOTERO in SPACC at the recommendation of Dr. Patricio Bernal but they never got going on the idea.

### AGENDA ITEM 3

#### **Country reports**

Detailed reports were presented by Japan, Korea and Russia. Each report summarized work carried out during the past year along with a comment on status of posting references to ZOTERO and the potential for future collaboration on research cruises.

#### *a. Canada*

No report.

#### *b. China*

No report.

#### *c. Japan*

Attempts to improve krill biomass estimates from the MOHT were described and were reported on a poster presented at PICES-2011. A major feeding experiment was carried out in June 2010 during which grazing by krill and copepods was measured. Clearance rates for krill ranged from 54 to 736 ml per euphausiid-hour. Highest filtration rates were on “flagellates”. There are more than 100 papers published by Japanese scientists on krill that will soon be posted to ZOTERO. Sixty-four papers are in English with about an equal number in Japanese. What remains is to translate at least the abstract, figure captions and table legends of the more important papers written in Japanese.

#### *d. Korea*

Future cruises have been scheduled for April and August 2012–2015. They could include collaborators. Bi-monthly time series of zooplankton data from 1976 show a gradual increase in zooplankton biomass since 1990 but copepod biomass has declined since 2005. Recent increases in biomass are due to increased biomass of salps. A total of approximately 30 on-board live-animal experiments were conducted during cruises in 2010 and 2011. The brood size of *E. pacifica* was studied, and research on krill diets based on lipid, stable isotope,

and gut content was summarized. On two cruises specimens were collected for genetic analysis and were sent to the Peterson lab in Newport, Oregon. During the April 2011 cruise, plankton net sampling was carried out along with an acoustic survey to derive better estimates of krill biomass. Tracy Shaw (U.S. member of WG 23) participated in the August 2011 cruise.

*e. Russia*

A summary of the work done by TINRO-Center from 1985–2010 was described. Thousands of plankton samples have been collected and processed for biomass of krill and other zooplankton. Information was presented on the catchability of different plankton nets, which is necessary to understand so that samples collected by different nets can be compared. Overviews of sampling in four regions were provided including the total quantity of zooplankton, the role of every taxonomic group in the structure of plankton community, the species composition and some information about their biology, features of their spatial distribution, vertical distribution, seasonal and inter-annual dynamics of the abundance of major groups, standing stocks of zooplankton and estimates of the volumes of zooplankton consumed by nekton. A list of papers by Russian scientists that could be added to the ZOTERO web-site was provided.

*f. U.S.A.*

The report from the U.S.A. was in the form of a talk by Tracy Shaw on the synthesis paper, “*Comparison of brood sizes of Euphausia pacifica, pan-Pacific*”. This talk generated a debate about the degree to which krill were more like fishes than copepods, as suggested by Dr. David Checkley and Peterson. Dr. Sonia Batten described krill as being like chickens. Dr. Peterson reported briefly on progress of a study of the population genetics of krill. A graduate student has begun to sequence the DNA of *Euphausia pacifica* specimens from Korea and Oregon. Results will likely be reported at PICES-2012 in Hiroshima, Japan.

AGENDA ITEM 4

**Presentations**

Dr. Michael Dagg reviewed feeding behavior of krill with a focus on *Euphausia pacifica* and asked the question, “What is it about feeding behavior that allows *E. pacifica* to populate wide-spread regions of the North Pacific?” He reviewed the literature on several topics including studies of filter feeding (and mesh size of feeding baskets) and gut contents, predatory feeding, the digestive system, gut passage times and assimilation efficiency. Overall, he concluded that *E. pacifica* is able to eat just about anything (phytoplankton, microzooplankton, mesozooplankton, detritus including marine snow and phytodetritus, and perhaps benthos), within a broad size range from small (a few mm) to large (copepods) and over a very wide range of concentrations – its feeding behavior is flexible, adaptive, and opportunistic. Because it has such dietary flexibility and also has the ability to feed over a very wide range of food concentrations, it is seldom starving, but because it has such high upper levels of ingestion it is seldom satiated or ‘full’ (*i.e.*, it is almost always at least a little hungry).

Xiuning Du is a Ph.D. student from Ocean University in Qingdao, China, who worked in Dr. Peterson’s lab in Newport for 1½ years. Among other things, she performed experiments on grazing by adult *Euphausia pacifica* using the “disappearance of particles” technique, both through microscopic counts and “disappearance of chlorophyll” using size-fractionation of natural seawater and fluorometry. A summary of her work is as follows: selective feeding does occur in *E. pacifica*. Long-chain diatoms were sometimes avoided when they had especially high density. As for diatom prey, adaptive and opportunistic feeding could be seen; ciliates were the preferential prey when they had substantial biomass before the upwelling season or during the decay of upwelling blooms. In the late upwelling season in August, ciliates were preferred though in low abundance, likely because of opportunistic feeding or seasonally physiological needs like essential nutrients. Smaller flagellates were positively selected when better foods were lacking. Large dinoflagellates or ciliates were predominantly preferred to their smaller types. Questions were centered on the significance of “selectivity”.

AGENDA ITEM 5  
**General Discussion**

There was interest by everyone in continuing the Working Group activities, especially the collaborations that have been established. The members present also felt that it would be useful to try to establish a new working group. It was suggested that the Working Group Final Report could be used to introduce a new set of questions that would form the basis of the new working group. WG 23 resolved to continue discussions on the potential of forming a new working group that would focus on one of two topics: (a) euphausiid vital rates, a topic needed to improve models – will require new experimental work, (b) basin-scale comparison of the role small pelagics in ecosystems (krill, anchovies and sardines) and how their roles might be modified by a changing climate – will require some new thinking.

**WG 23 Endnote 1**

**WG 23 participation list**

Members

Michael J. Dagg (U.S.A.)  
 Natalia Dolganova (Russia)  
 Se-Jong Ju (Korea)  
 Yuji Okazaki (Japan)  
 C. Tracy Shaw (U.S.A.)  
 William T. Peterson, (U.S.A., Co-Chairman)

Observers

Sonia Batten (Canada, representing David Mackas)  
 David Checkley (U.S.A.)  
 Vladimir Kulik (Russia)  
 Ryan Rykaczewski (U.S.A.)

**WG 23 Endnote 1**

**WG 23 meeting agenda**

1. Welcome and introduction
2. Agenda additions and/or changes
3. Status of posting references and papers
4. Country reports
5. Presentations (M. Dagg, X. Du)
6. General discussion