Arctic Ocean Diversity (ArcOD)

A Census of Marine Life Project

Rolf Gradinger, Univ. Alaska Fairbanks

With Bodil Bluhm, Russ Hopcroft, Katrin Iken, …

Census of Marine Life

www.coml.org

- Goal: to assess and explain diversity, distribution & abundance of marine life

Arctic Ocean Diversity (ArcOD) – Why?

Arctic Ocean Diversity (ArcOD) – Why?

Arctic warming: Less ice, warmer temperatures

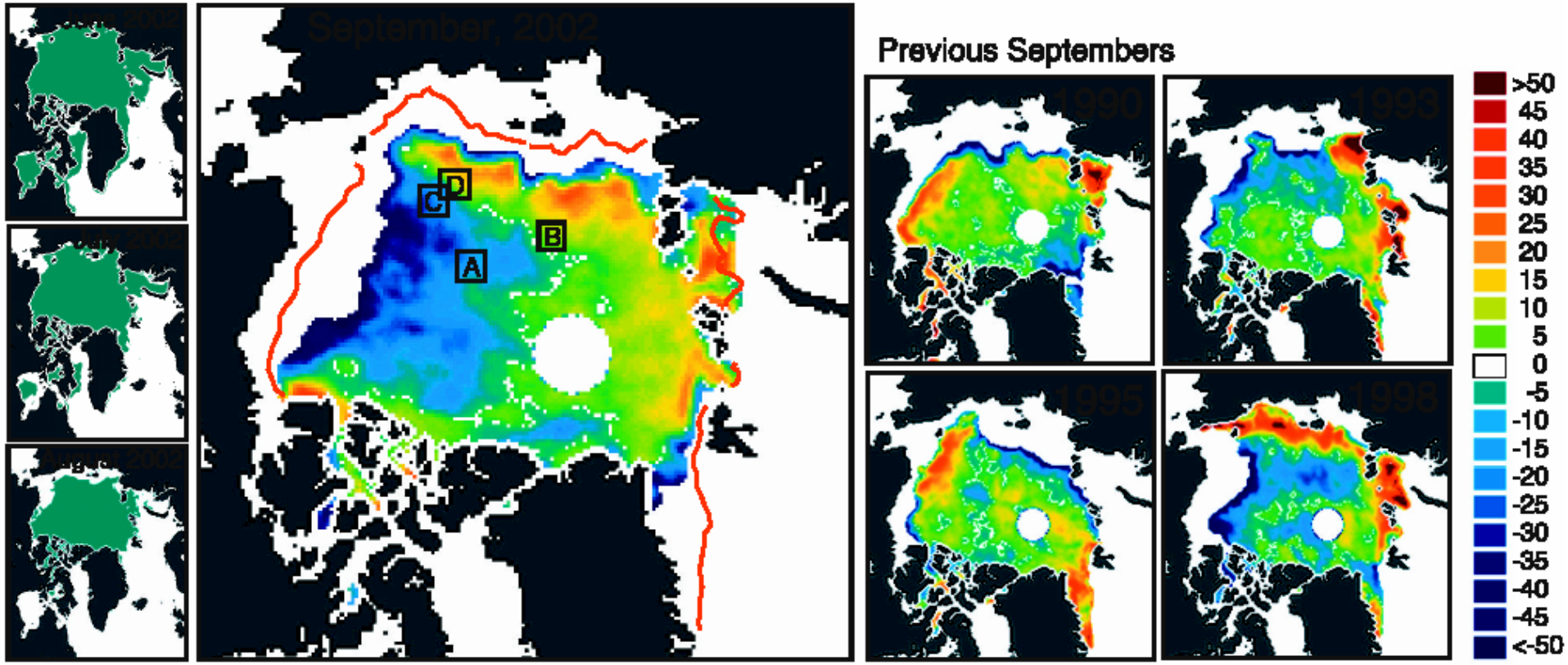
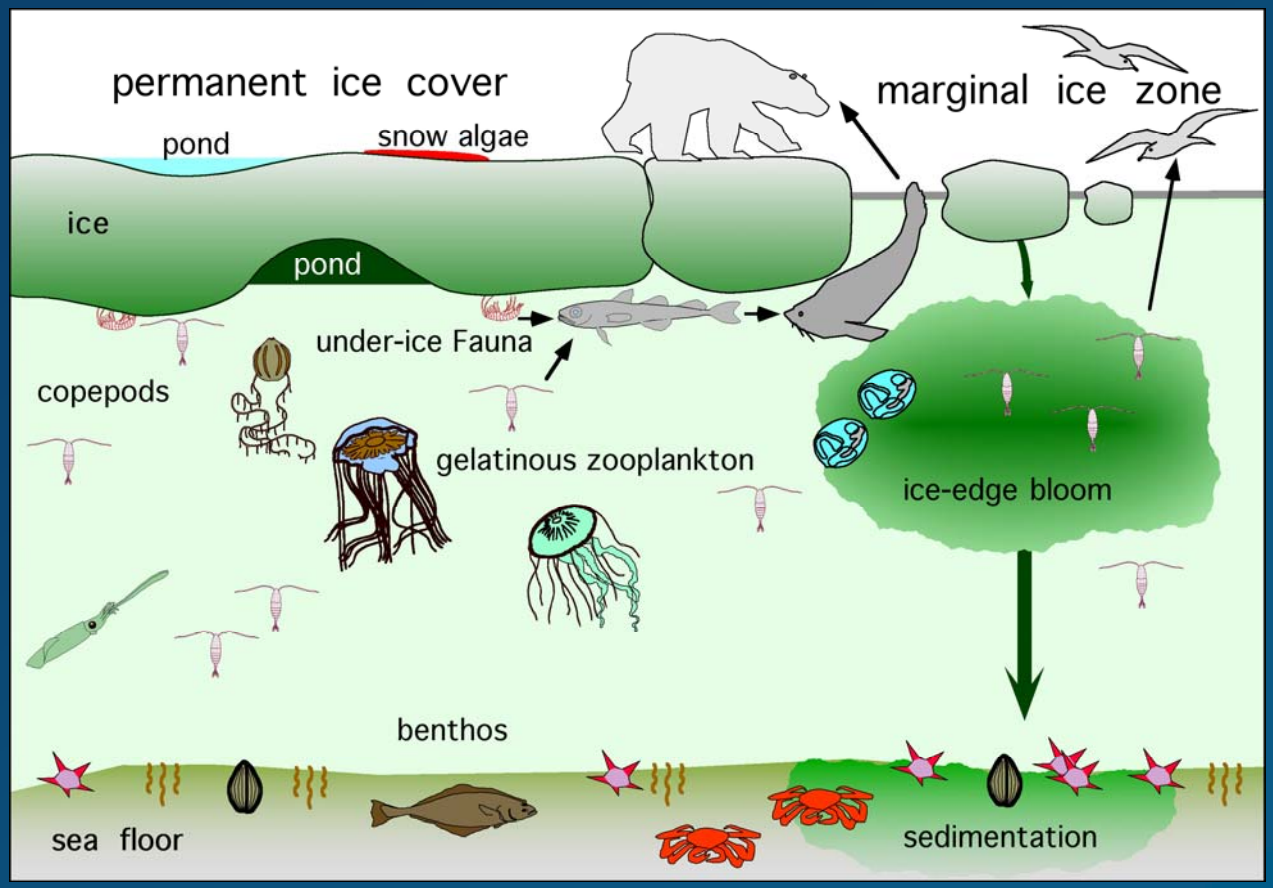


Figure 1. Large panel: NRTSI-derived sea ice extent and concentration anomalies (in %, see color bar) relative to NASA Standard Team means for 1988–2000. Median ice extent over the same period is shown by the red line. Four boxes (A, B, C, and D) show MODIS validation areas (see Figure 2). Ice extent in the months leading to the September minimum are shown at left. At right, September sea ice extent and concentration anomalies for the four previous minimum extent years.

Arctic Ocean Diversity (ArcOD) – Why?



- Urgency
- Geographic gaps
- Taxonomic gaps
- Data gaps

Overarching questions

- Species inventory of the Arctic
  - Species drive processes
  - Latitudinal biodiversity clines?
- Bio-geographic affinities and barriers
  - Atlantic - Pacific - Arctic – cosmopolitan
  - Climate-driven range extensions?
- Relationships: species distribution patterns – environmental conditions
  - Species / communities as indicators
  - Ecosystem approach

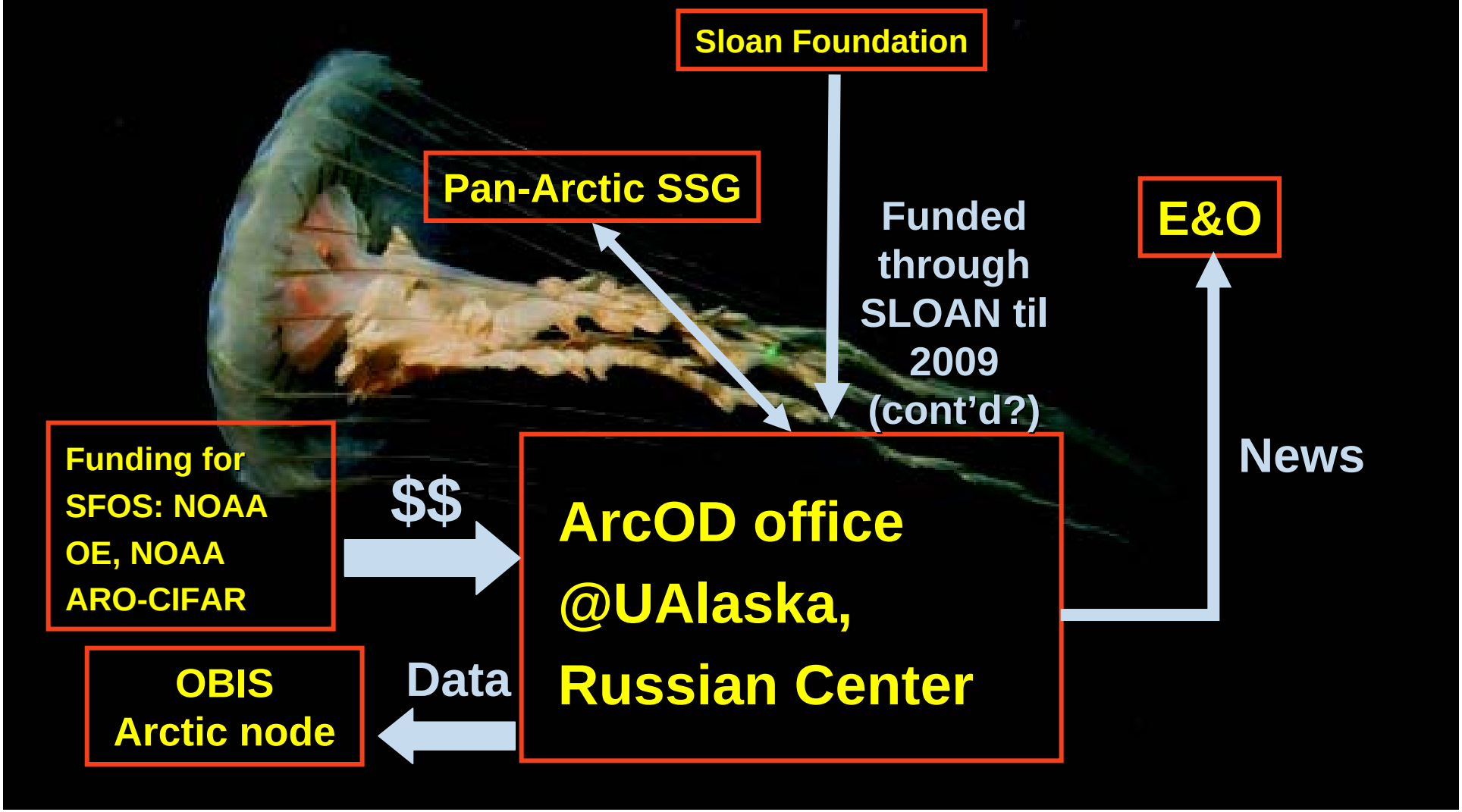
Framework: Arctic warming

ArcOD SSG

- Rolf Gradinger, Bodil Bluhm, Russ Hopcroft, Project Office, UAF
- Jackie Grebmeier, Dave Kirchman – USA
- Andrey Gebruk, Boris Sirenko – Russia
- Paul Wassmann – Norway
- Don Deibel – Canada
- Torkel Nielsen – Denmark/ Greenland
- Pedro Martinez – Germany
- Jan Marcin Weslawski - Poland

ArcOD Structure

ArcOD is an umbrella for existing and new efforts



ArcOD Mission

2 Major Missions:

- **Explore the current state of the Arctic diversity**
- **Make this information available for the long term**

ArcOD Mission

NOAA OE Contribution:

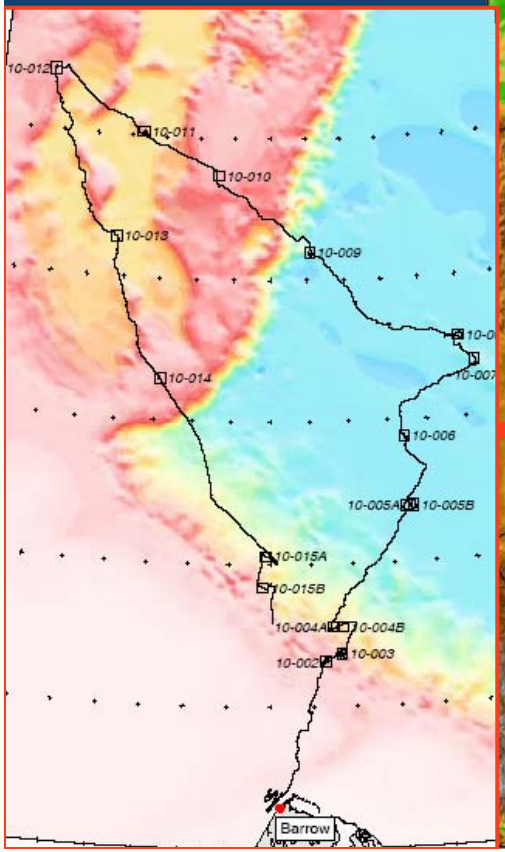
2 major Arctic expeditions in 2002 and 2005

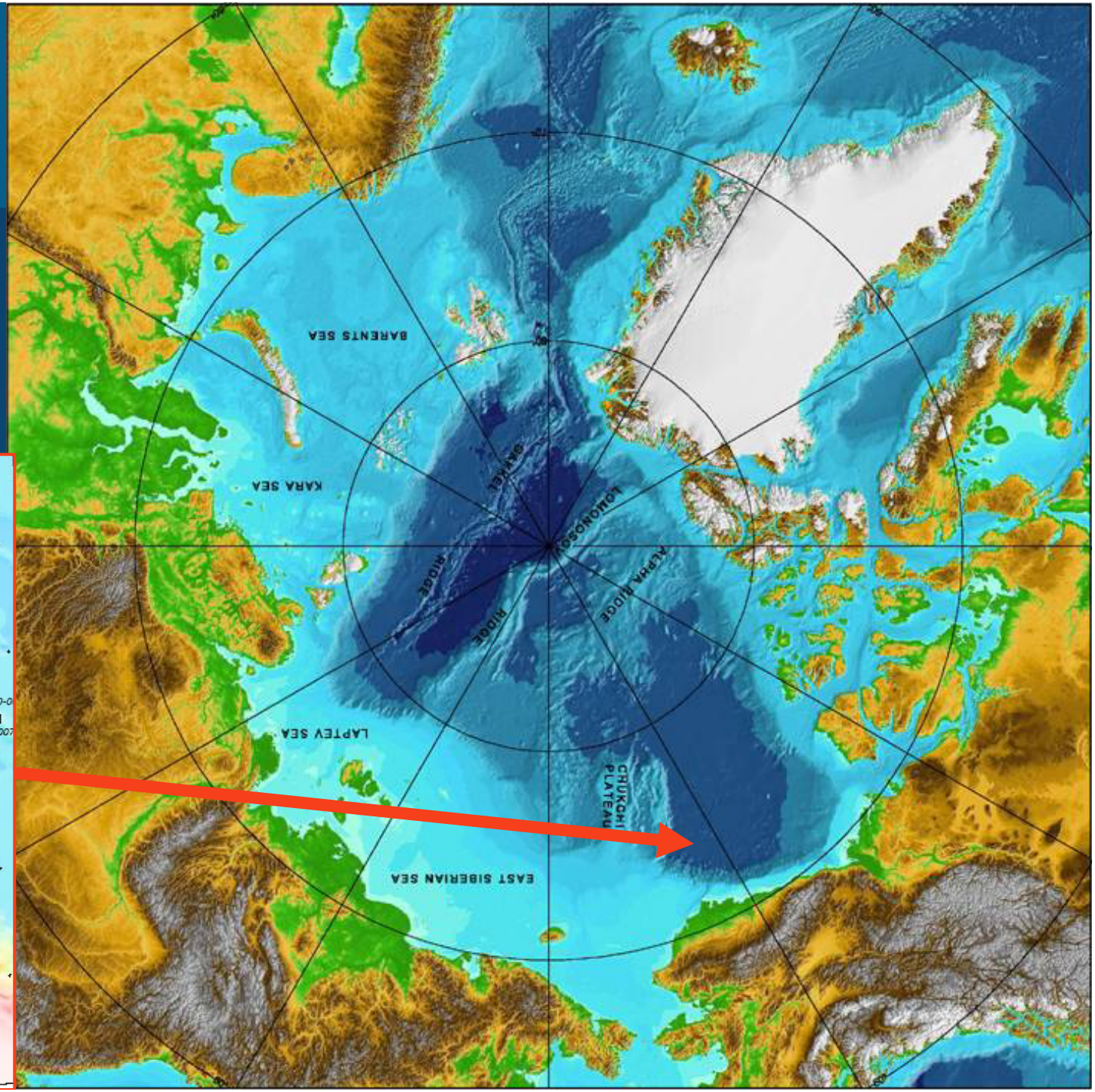
some smaller scale projects (public outreach, sample analysis)

NOAA ARO Contribution:

Rusalca expeditions (current and future)

Ocean Exploration 2005

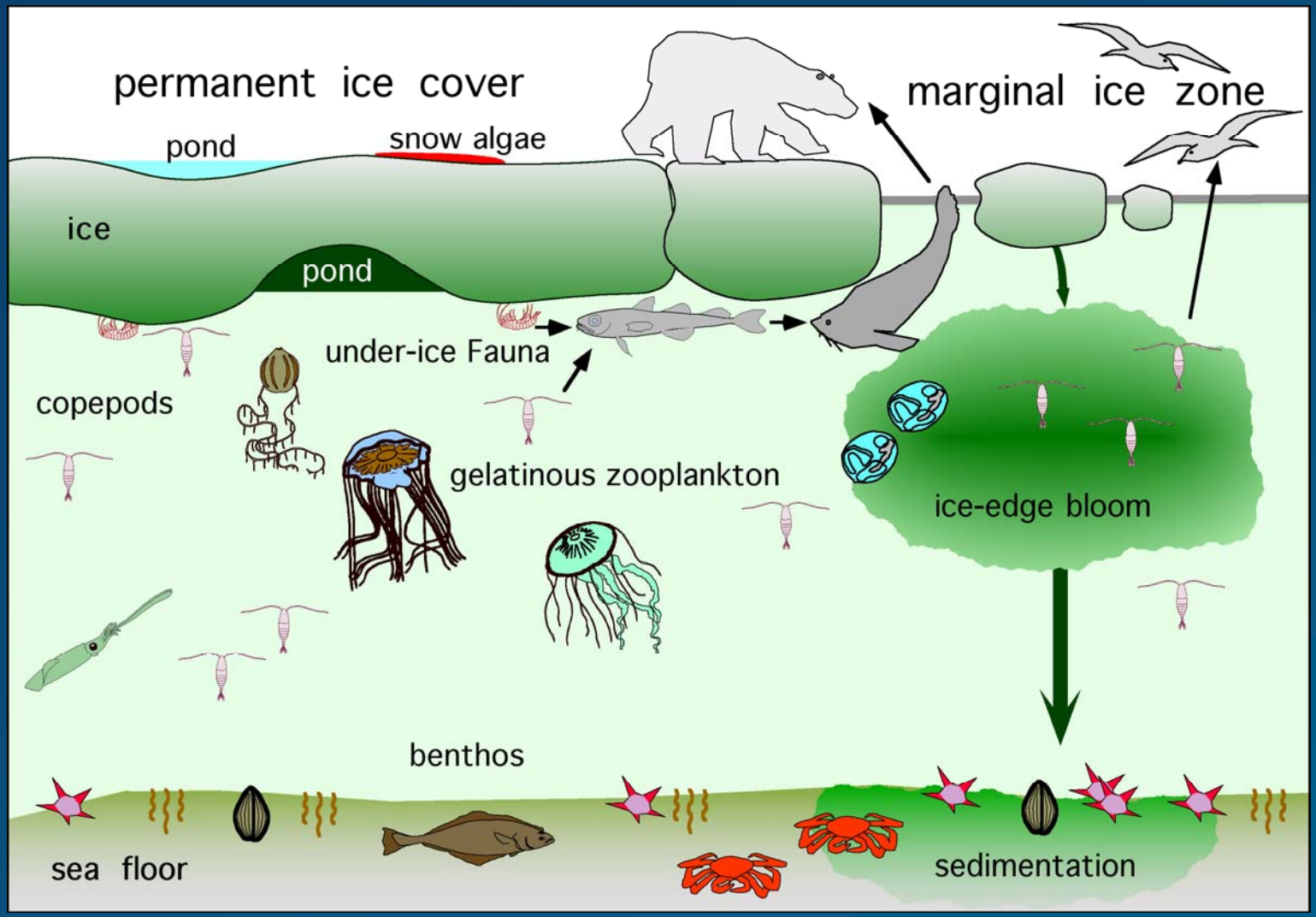




Healy expedition 05

35 scientists, Several universities, USA, Russia, China
Funded: NOAA Ocean exploration
Coordination at UAF
1 month at sea
2 months preparation, 25 months sample and data analysis

Modules



MM/Birds

Sea ice

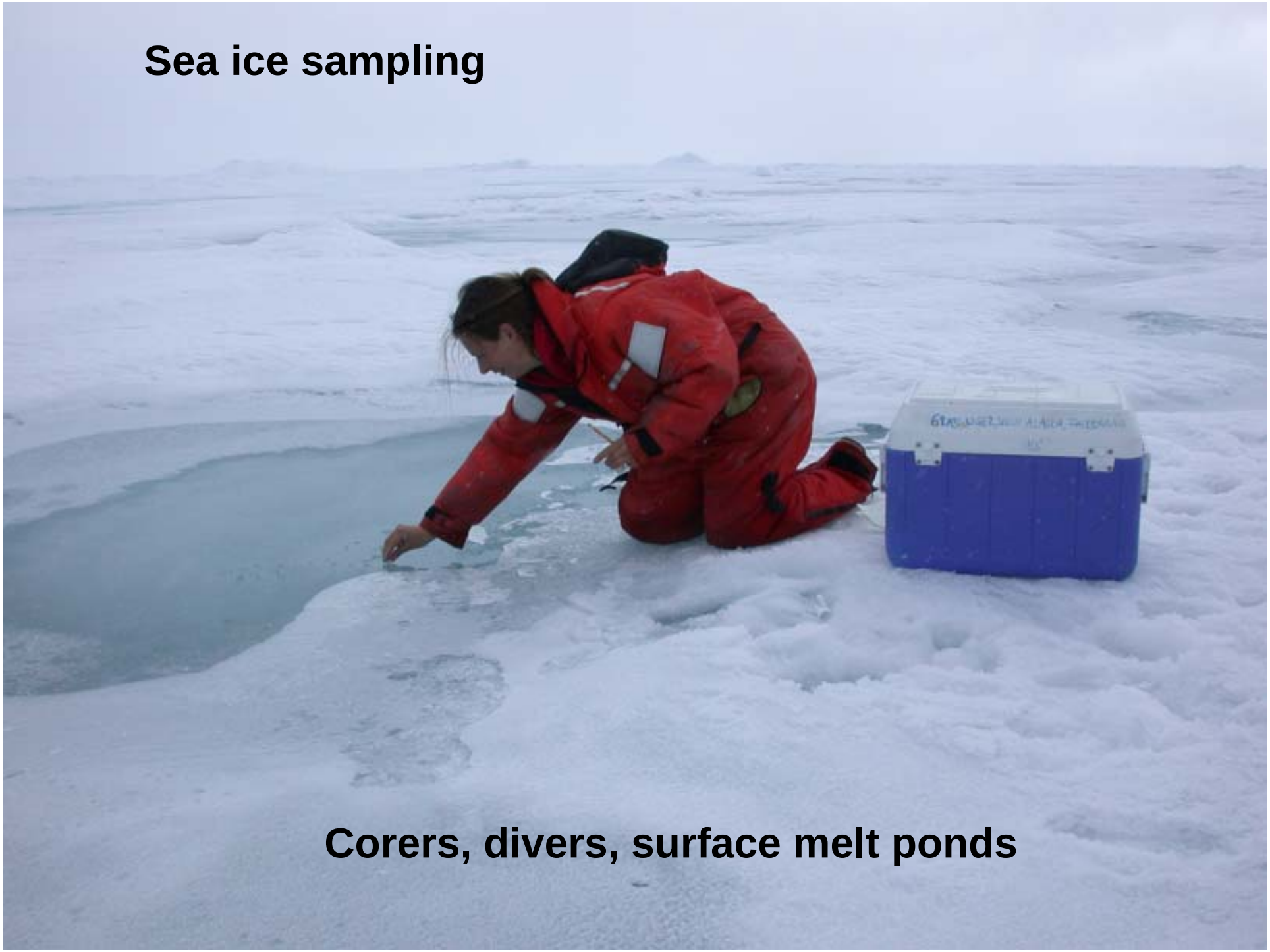
Pelagic

Benthic

Fish

(mapping)

(physics)


Sea ice sampling
Corers, divers, surface melt ponds

The microscopic life inside the ice

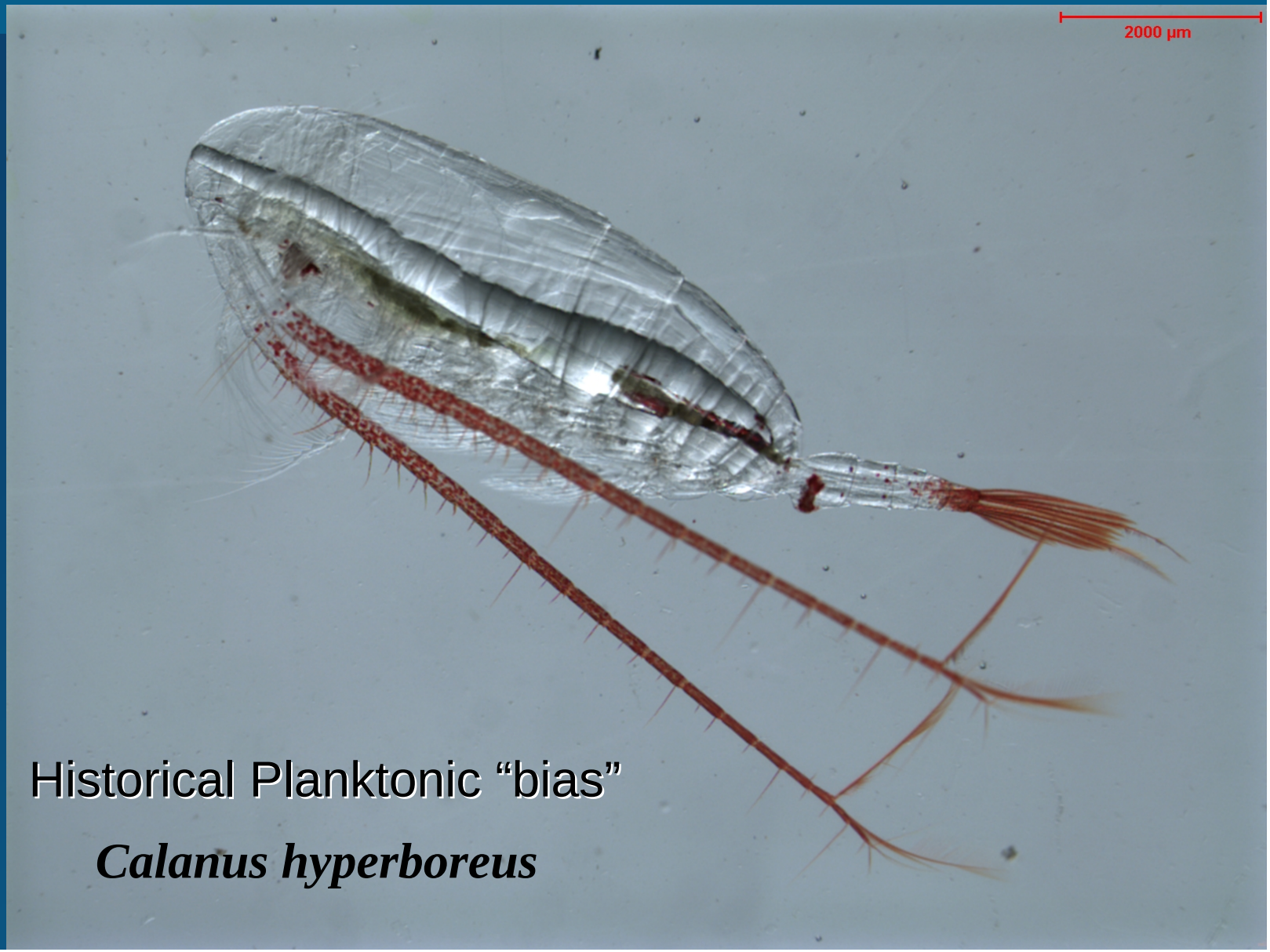
- **For the Arctic:**
- **bacteria (Archaea, Proteobacteria etc. ?? species)**
- **› 200 diatoms**
- **› 200 flagellates**
- **› 30 metazoans**
- **allochthonous fauna**

Sympagohydra tuuli

Under-ice fauna

Arctic cod (*Boreogadus saida*): link to seals and birds

The Pelagic fauna

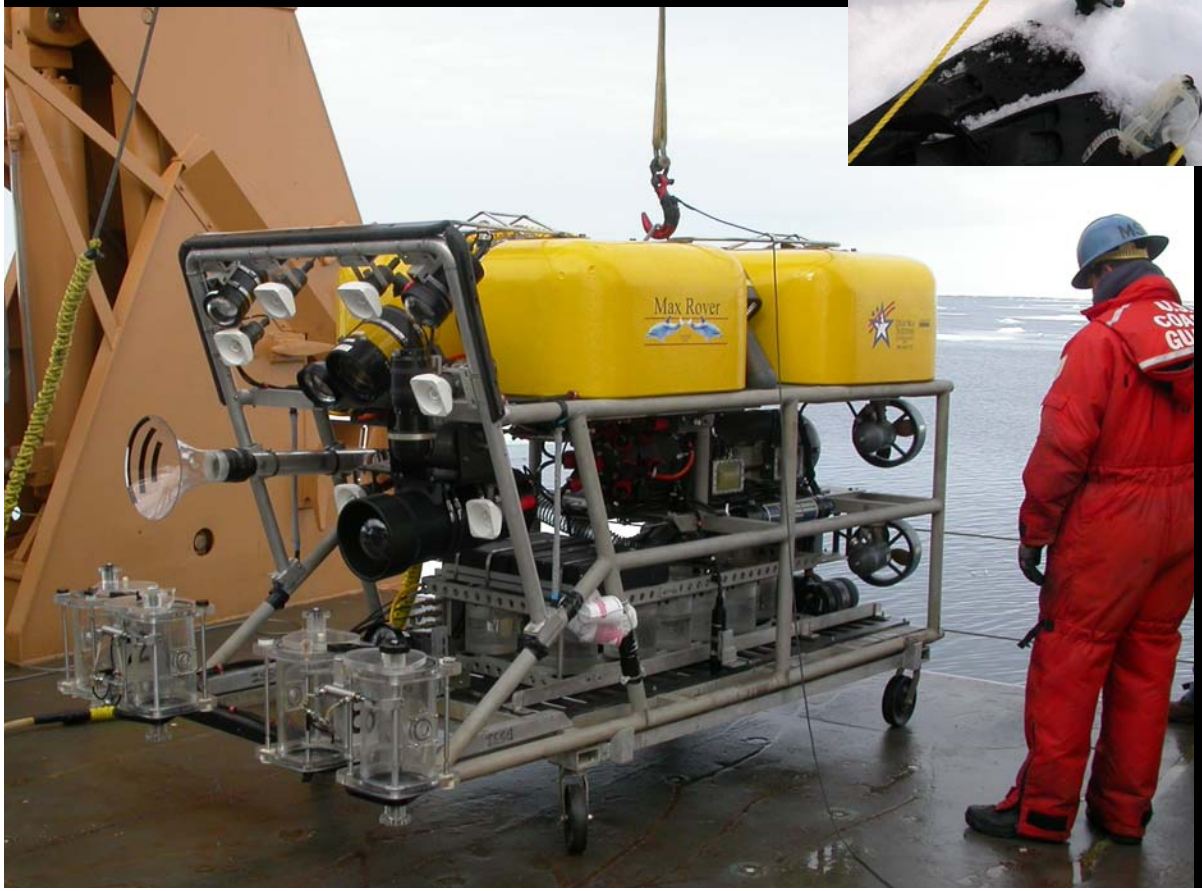


Historical Planktonic “bias”

Calanus hyperboreus

- Standard collection methods
- Major processes
- Biases
- Cryptic (and boring) to the public

Exploration & *Science*



- Visual
- Engages public interest

New Species of Jellyfish (Narcomedusae)

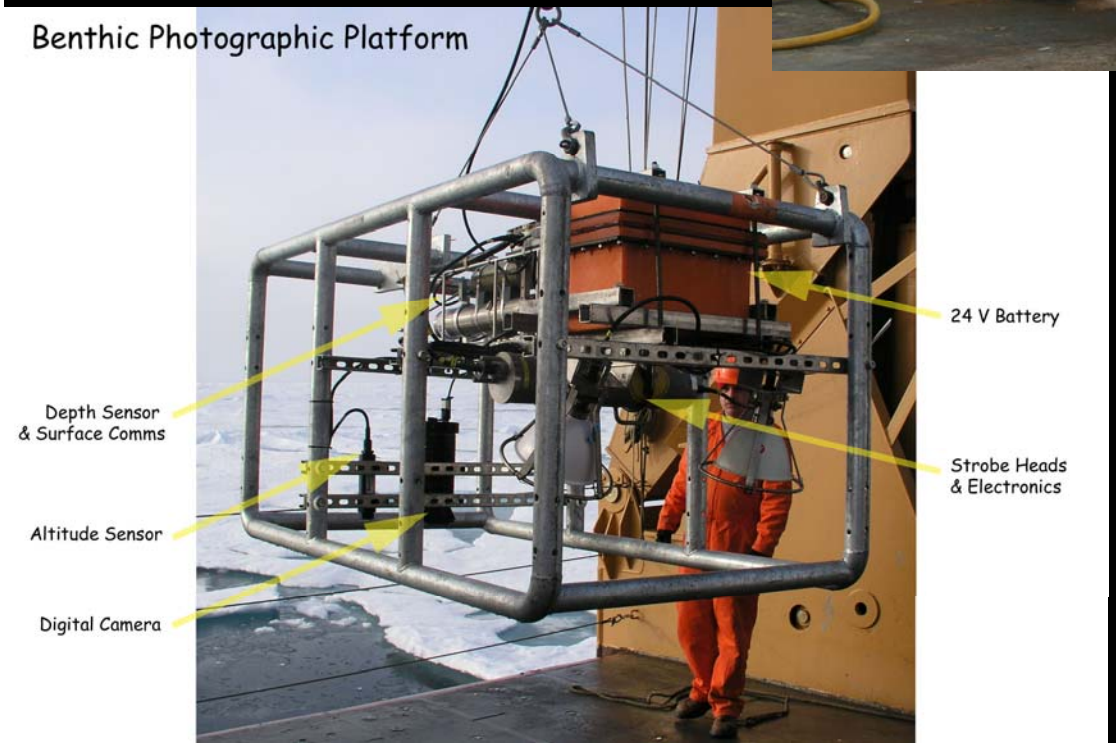
Common at ~1000 m - 100's observed in 2005

Dozens collected

Doubled the number of known comb-jellys

Records for squid and octopus

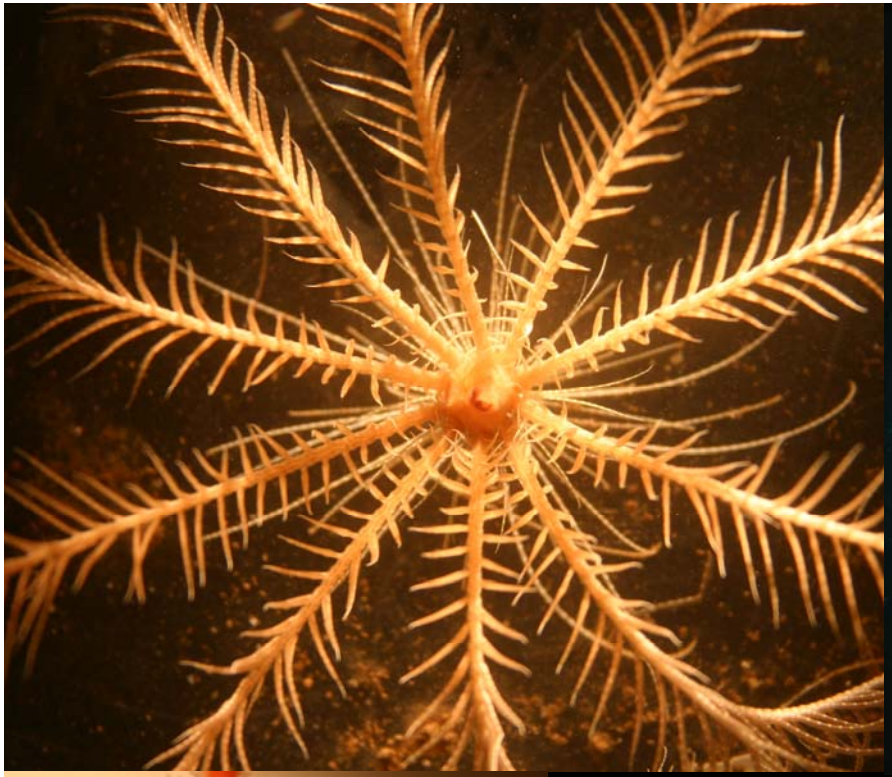
Imaging Tools



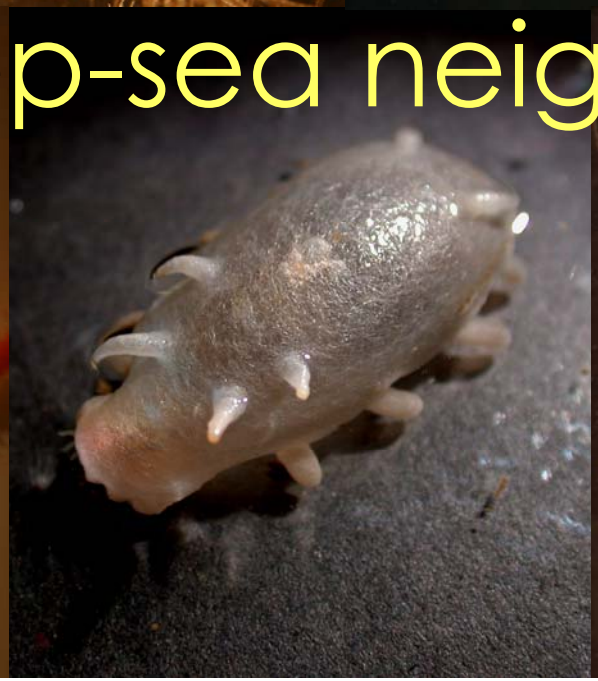
- Benthic photo platform (to 6000m)
- ROV (to 2800m)

Collection Tools

- Box core (small animals)
- ROV and trawl (large animals)
- Healy water intake



The deep-sea neighborhood

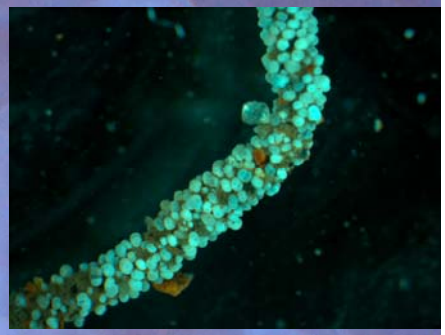


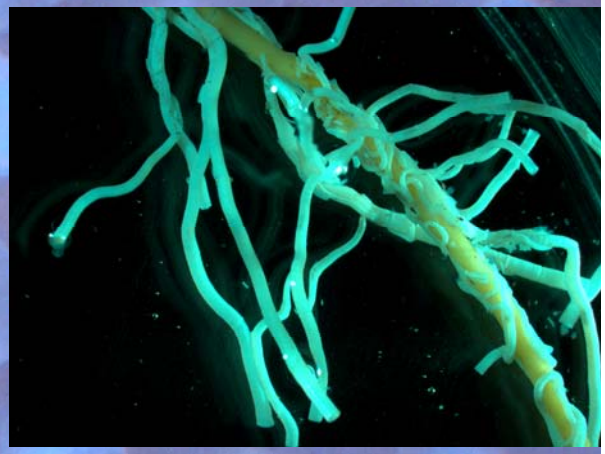
Creepy crawlers

- Diverse infauna
- Abundant epifauna

New species, new records

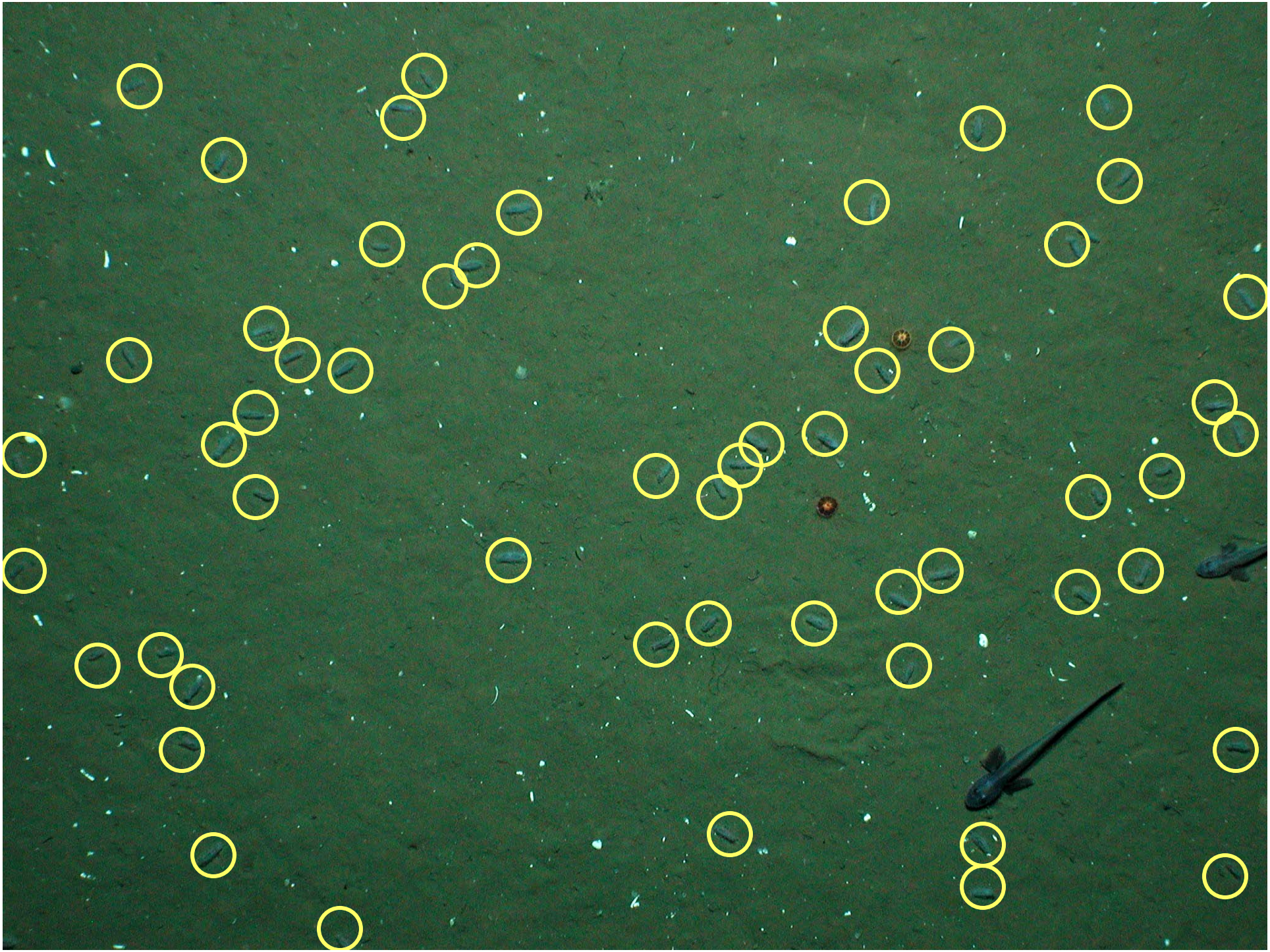
- New species of bristle worms
- 5 new records for area



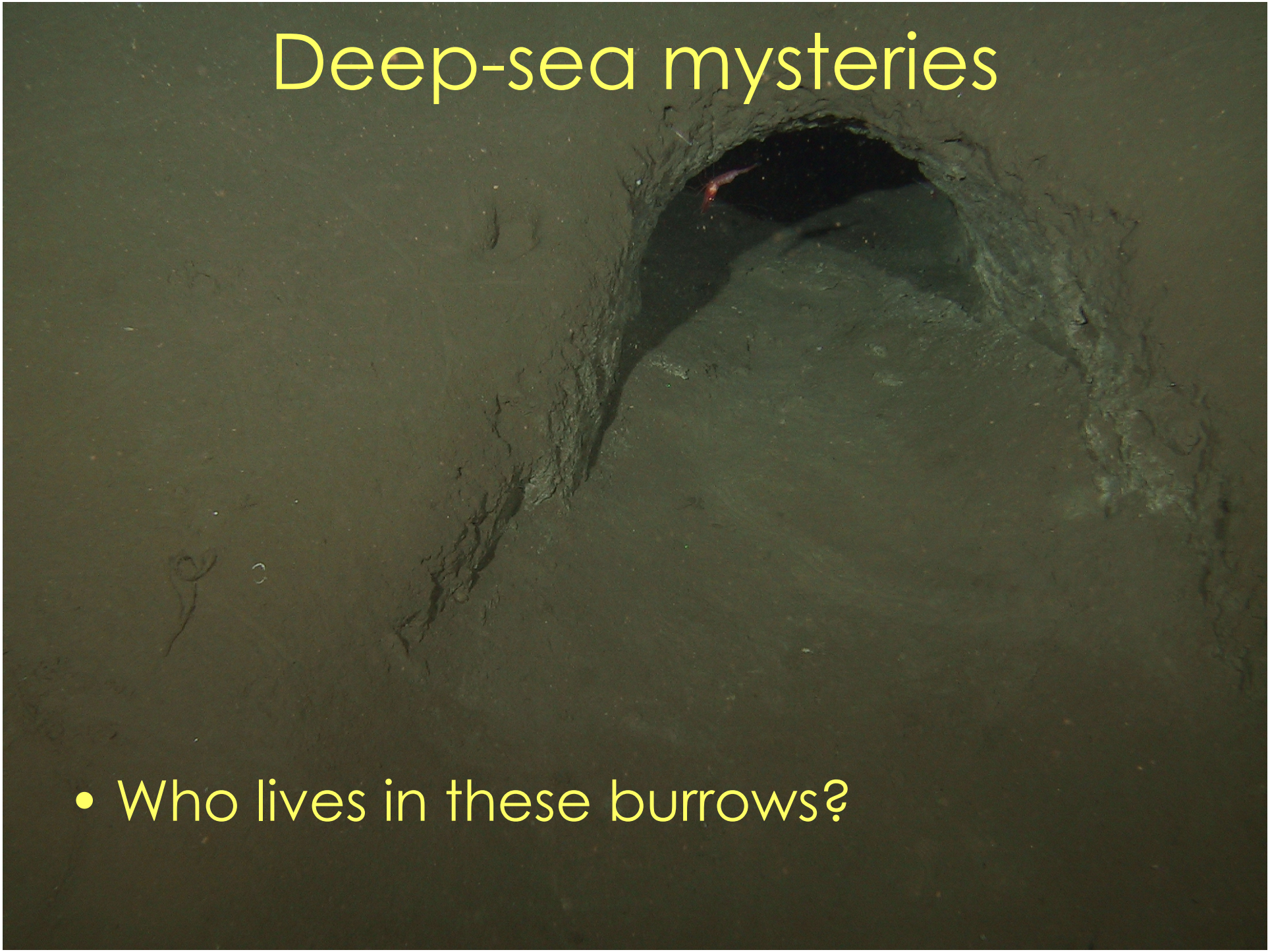


Unexpected finds

- High epifauna densities (St. 12 – sea cucumbers)
- Gooseneck (stalked) barnacles
- Stalked crinoids (sea lilies) – dominant in Paleozoic
- Curiosities (worm, bungy ‘coral’)



Deep-sea mysteries



- Who lives in these burrows?

- Science:
  - Greater biodiversity (and biomass) in deep-Arctic basins than currently appreciated in all three major realms
  - Special Issue in Deep-Sea Research (2007/2008)
- Infrastructure:
  - Business office at UAF (salary, overhead)
  - NOAA Research support:
    - OE: summer 2005 expedition, several smaller projects
    - RUSALCA: Russian US Census of the Arctic: 2008 and 2012 (?)
      - Only ice free water
- Education & Outreach:
  - Student participation at UAF
  - School presentation (Lathrop, Little Diomede, Barrow)
  - Press releases:
    - NPR, Newsminer, Toronto Star, ABCnews, National Geographic
      - International media releases from Pakistan to Japan (Fred Gorell)

Lesson plan developments with NOAA OE

Additional Service activities by ArcOD:

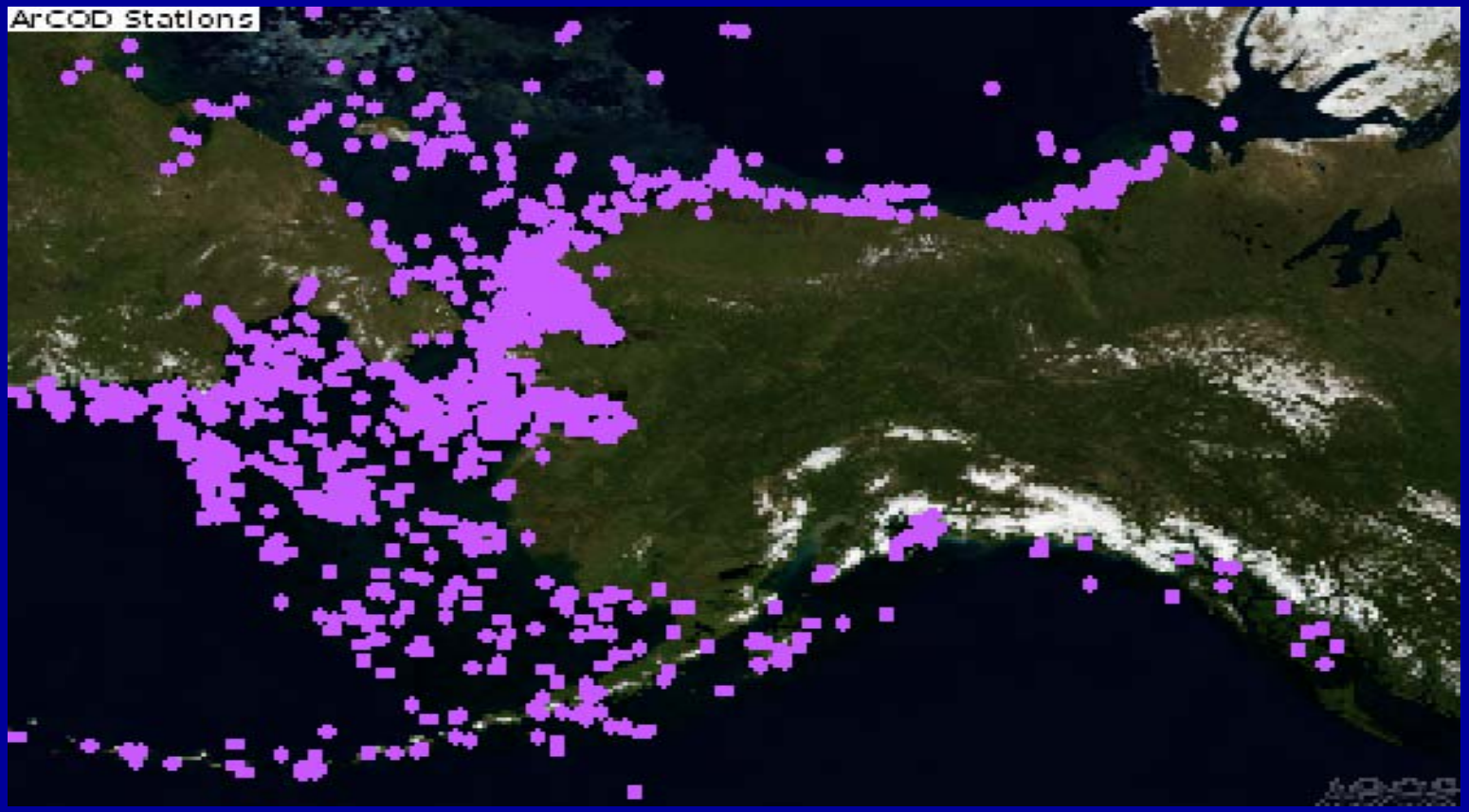
Invertebrate identification keys Zoological Institute RAS (Sirenko)

- 9 Volumes planned
- Volume II, part I:
  - Currently translated into English (K. Coyle) at ArcOD cost
  - Alaska Sea Grant as Publisher?
  - Print first, then electronic version

Invertebrate identification keys example: part of Euphausiids

- Ключи для определения Euphausiacea северных морей России.
- Отряд Euphausiacea.
- Семейство Euphausiidae.
- Ключ для определения родов и видов семейства Euphausiidae.
- 1(4). Глаза более или менее округлые, без перетяжки (Табл. 1, рис. 2). Ни одна пара торакоподов не удлинена и не превращена в хватательные конечности (Табл. 1, рис. 1).
- 2(3). Седьмая пара торакоподов с хорошо развитым сегментированным эндоподитом (Табл. 1, рис. 3). (Базальный членик антеннулы с перепончатой листовидной лопастью, направленной вверх и назад (Табл. 1, рис. 4). Экзоподит шестых и седьмых торакоподов у обоих полов развит, а восьмой пары рудиментарный)……..
- ……Род *Meganyctiphanes*, *M. norvegica* (M.Sars,1857). (Табл. 1, рис. 1-4).
- L - до 44 мм. Атл.суб. б-а. Баренцево море, Арктический бассейн и прилежащие районы Карского моря и моря Лаптевых. 0 - 500 м .
- 3(2). Эндоподит седьмой пары торакоподов рудиментарный, несегментированный или состоит из двух коротких члеников (Табл. 1, рис. 5)……..
- ……Род *Thysanoessa* (часть). (стр.)
- 4(1). Глаза с поперечной перетяжкой (Табл. 1, рис. 6). Вторые (Табл. 1, рис. 7) или третьи (Табл. 1, рис. 8) торакоподы удлинены и превращены в хватательные конечности.
- 5(8). Только вторая пара торакоподов удлинена и превращена в хватательные конечности (Табл. 1, рис. 7).
- 6(7). Два последних членика хватательных ног несут мощные щетинки на конце и на латеральных краях (Табл. 2, рис. 1)……..
- ……Род *Thysanoessa* (часть). (стр.)
- 7(6). Щетинки на последнем членике хватательных ног образуют концевой пучок в виде мощных апикальных иголочек, латеральные края двух последних члеников без щетинок (Табл. 2, рис. 2)……
- …….Род *Nematoscelis*, *N. megalops* G.O.Sars, 1883 (Табл. 1, рис. 7; Табл. 2, рис. 2)
- L - до 26 мм. Бип. Юго-западная часть Баренцева моря. 0 - 600 м .
- 8(5). Только 3 пара торакоподов превращена в хватательные конечности (Табл. 1, рис. 8). (Они с расширенными проподусами, несущими игловидные шипы (Табл. 1, рис. 3). Эндоподит 7 торакоподов рудиментарный, состоит из 2 члеников. Верхняя и нижняя части глаз почти одинаковой ширины (Табл. 2, рис. 4))……
- …….Род *Stylocheiron*, *S. maximum* Hansen, 1908 (Табл. 1, рис. 8; Табл. 2, рис. 3-4).
- L - до 33 мм. Панок.Бат. Юго-западная часть Баренцева моря (Мотовский залив). 200 - 400 м .

AOOS /OBIS/ ArcOD Database – long term record of Arctic diversity



http://ak.aoos.org/op/data.php?region=AK&name=obis

Currently >22000 records; 40000 records by 2009, >100000 by 2020

NOAA and ArcOD

- - very positive history
- - linkages in missions
  - Short term: ArcOD hopes to win NOAA as sponsor for one major IPY related expedition – NOAA OE - ArcOD legacy
- - long term view:
  - NOAA: monitor the state of the oceans

    Arctic Ocean Time Series: AOS (similar to BATS or HOTS)
  - Census of the marine environment
    - Which of the two thousand species to monitor?
    - Decision based on solid science – as outcome of IPY on international scale

NOAA and ArcOD

ArcOD/NOAA co-operation

- Repeat and extent exploration and monitoring in the Arctic every 5 years with international team of experts
  - Train the **workforce** needed for future challenges
  - Connect to well trained science teams (**highest scientific standard**) – peer reviewed publications
  - Ensure public **outreach**
  - Ideal combination between NOAA and CoML – although sometimes competition, in the end to **mutual benefit** of all parties involved.
  - New **challenges** with exploration of the Arctic
    - Technology to assess diversity (from DNA to imagery)

Arctic Ocean Change