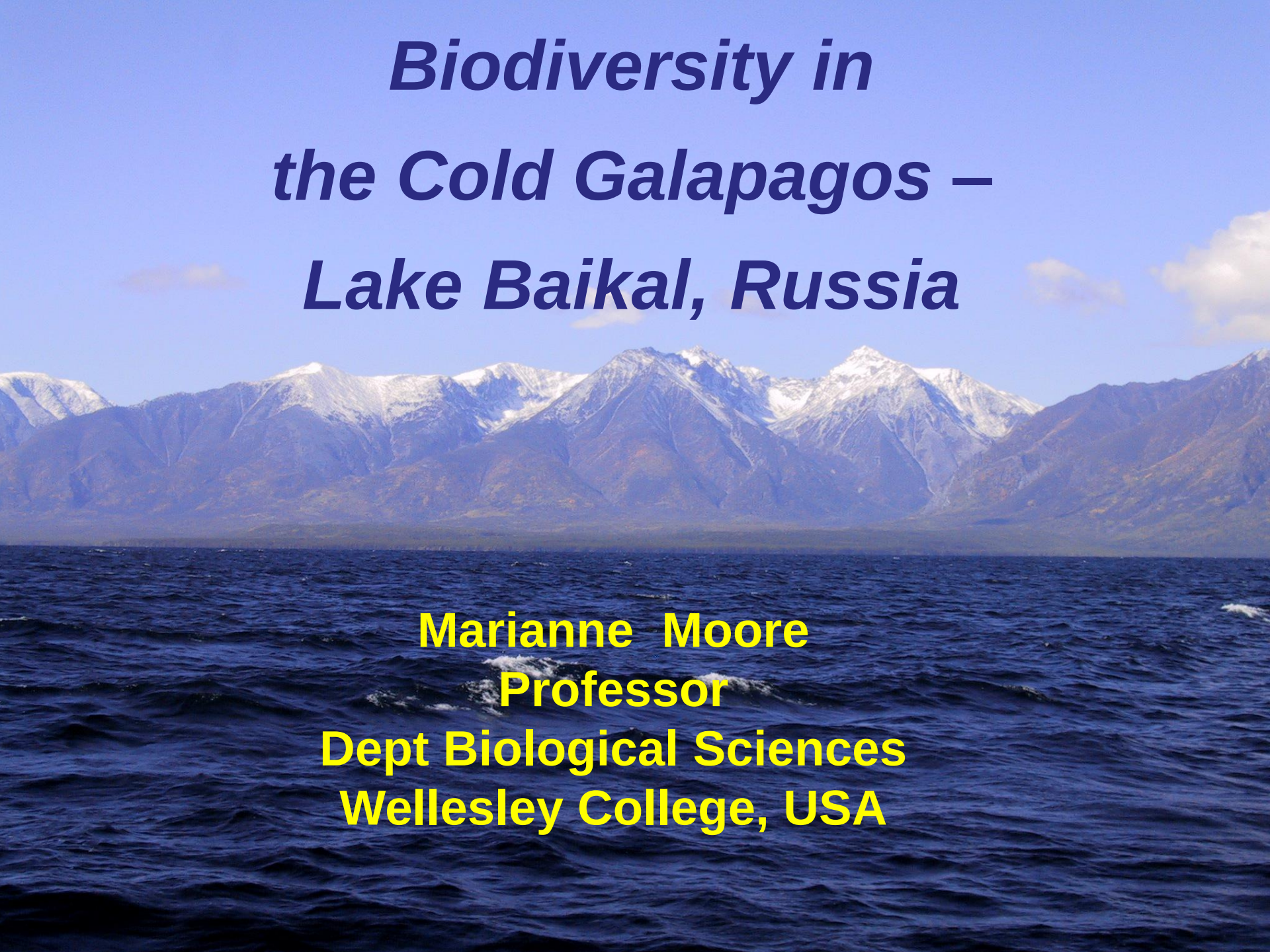

# *Biodiversity in the Cold Galapagos – Lake Baikal, Russia*

**Marianne Moore**
**Professor**
**Dept Biological Sciences**
**Wellesley College, USA**

# Lake Baikal, Siberia

# LAKE BAIKAL

# *LAKE BAIKAL*

- Oldest lake
  (> 25 million yrs old)

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- Deepest lake
  (> 1600 m deep)

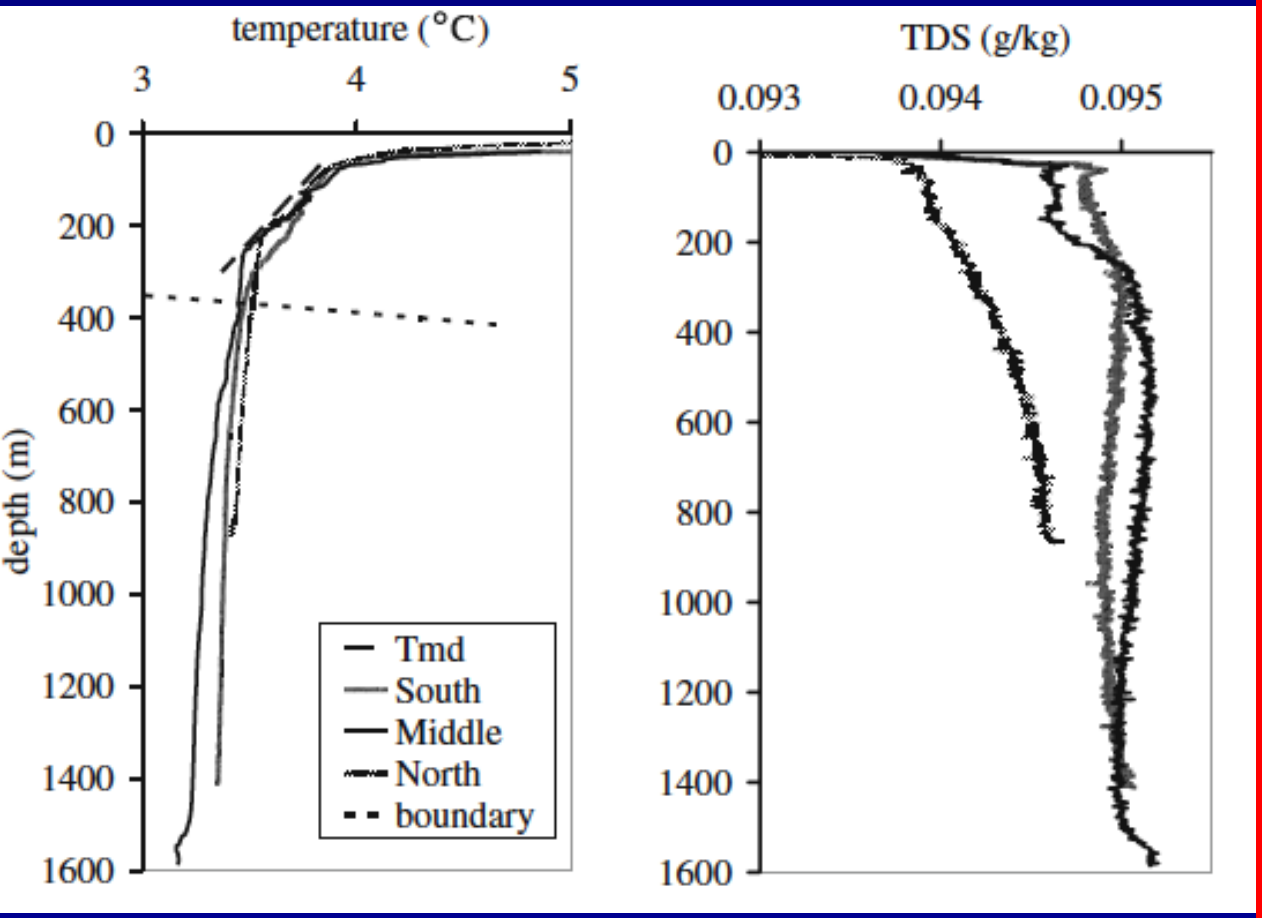
# *LAKE BAIKAL*

- Entire water column is oxygenated

# *LAKE BAIKAL*

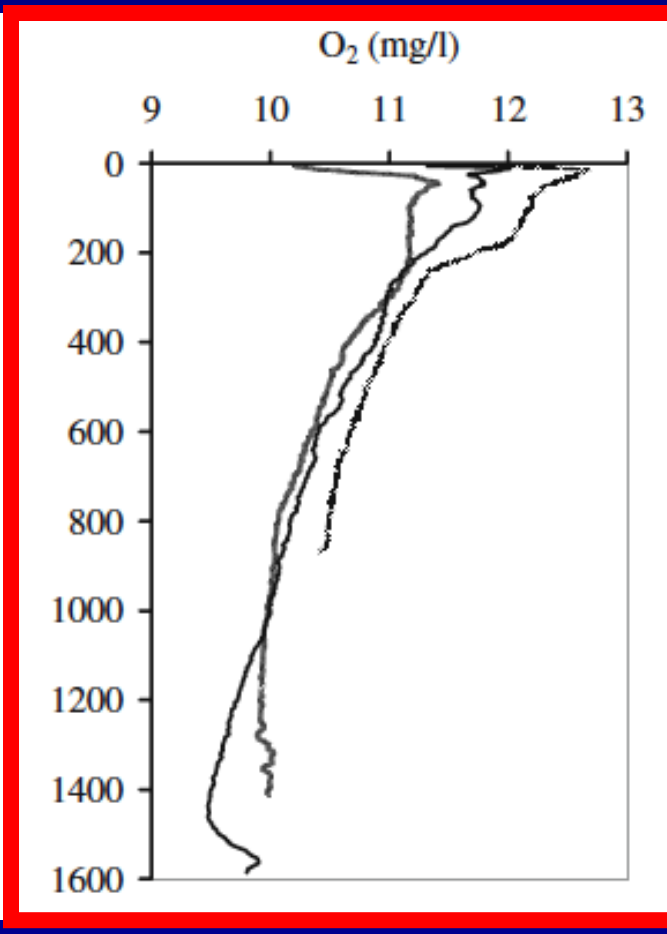
- Entire water column is oxygenated
- Only deep lake (> 800 m) with oxygenated bottom waters

# Oxygen-depth profiles -August, 2006










Granin et al. 2010

# *Only lake with….*


- Hydrothermal vent communities

# *LAKE BAIKAL*

- Major biodiversity hotspot

  > 2500 animal species
  82% endemic

# *LAKE BAIKAL*

- Major biodiversity hotspot
  - > 2500 animal species
  - 82% endemic
- Cold Galapagos

# GAMMARIDS


Baikal gammarids
350 spp.
98% endemic


other
freshwater
gammarids
http://fishingwithjay.wordpress.com/page/2/

# GAMMARIDS

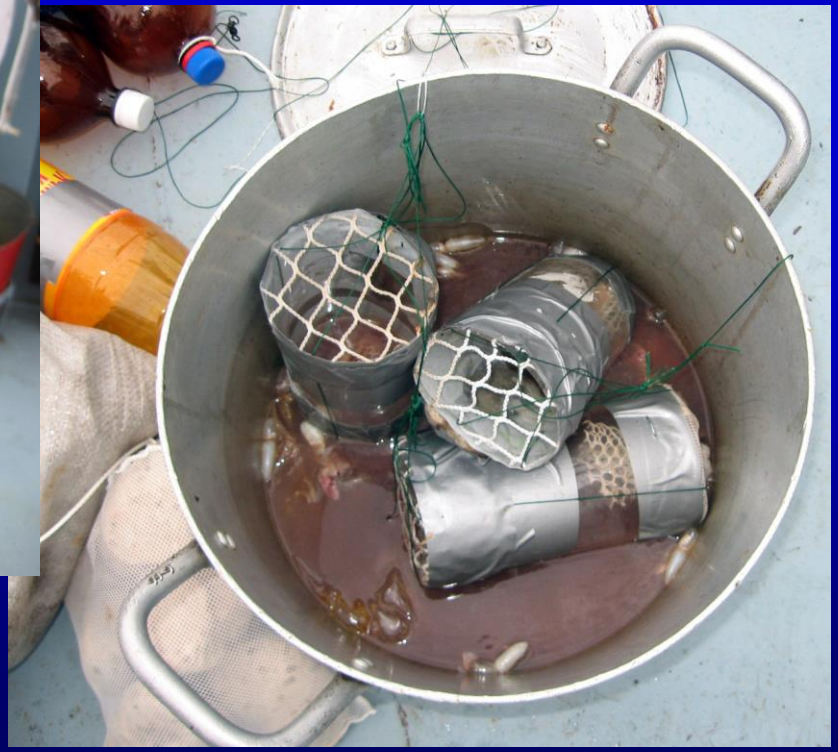


Voracious scavengers in Baikal…

Baited Benthic Traps

Voracious amphipod of Baikal!

Baited Benthic Traps




Omatogammarus albinus
Omatogammarus flavus


PLANARIA
140 spp.
95% endemic

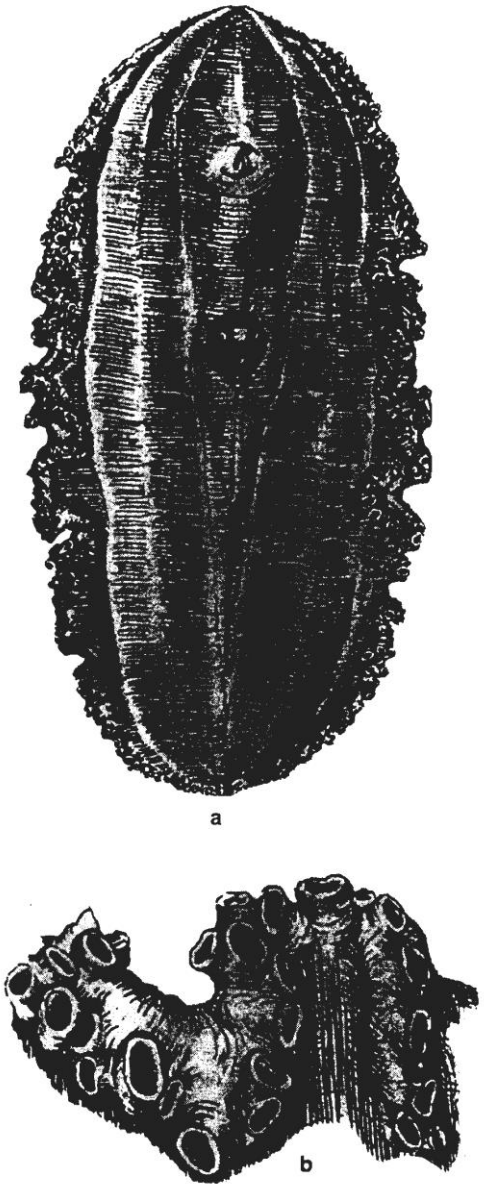



*Fig. 3.12. Baicaloplana valida*, a – fixed specimen from the ventral side, body length when straightened out alive up to 30 cm, width up to 3 cm; b – magnified part of the lateral wall with suckers. After Kozhov, 1947.

# Baikal planaria

*Baicaloplana valida*

Abyssal giant
30 cm

# *Abyssal gigantism*

Tendency for species of deep-dwelling animals to display a larger size than their shallow-water counterparts.

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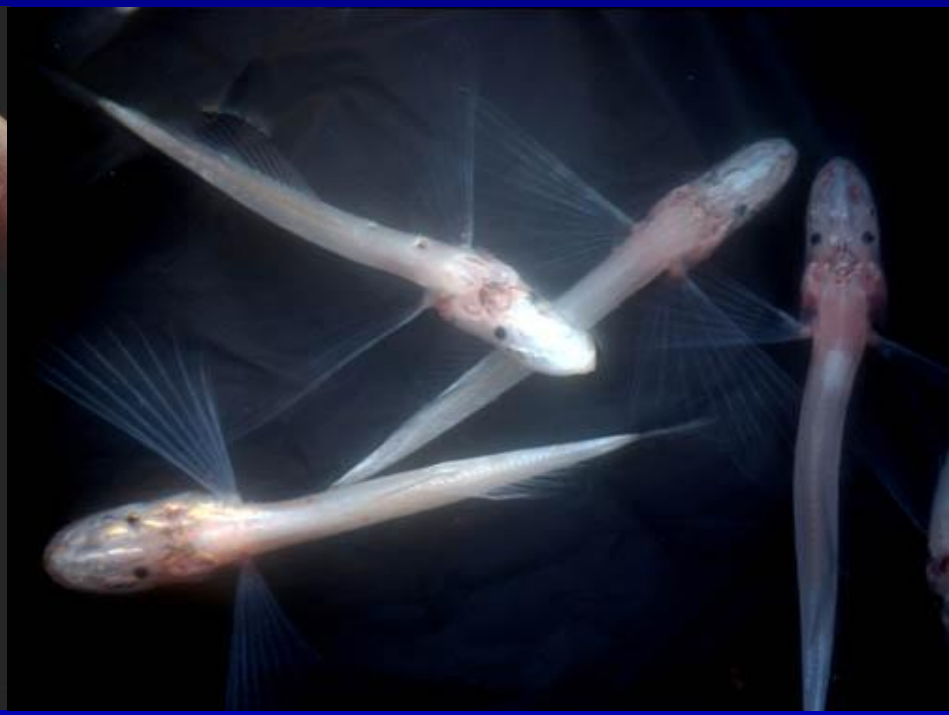
Tendency for species of deep-dwelling animals to display a larger size than their shallow-water counterparts.

- Occurs in deep-sea & L. Baikal


SPONGES
16 spp.
100% endemic


SCULPINS
29 species
27 endemic



# Golomyanka - pelagic abyssal sculpin
(oilfish or candlefish)

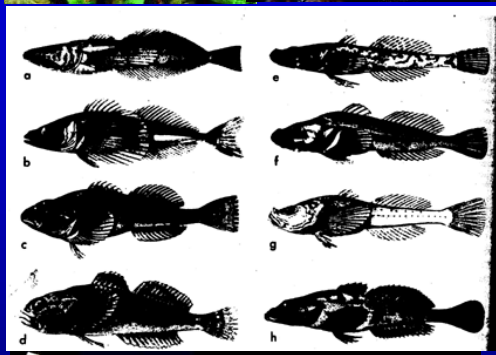
# BAIKAL SEAL

Seal pup

(*Phoca sibirica*)

# *Biodiversity in Lake Baikal*

- Baikal most biodiverse lake in the world:
  - +3500 plant and animal species, > 60% endemic



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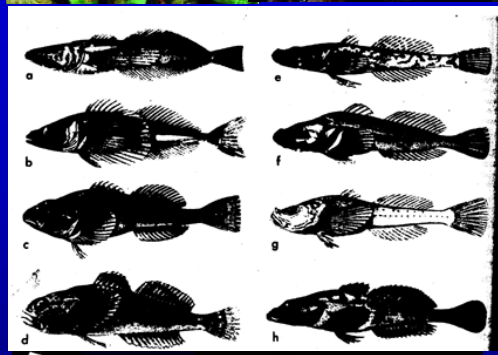

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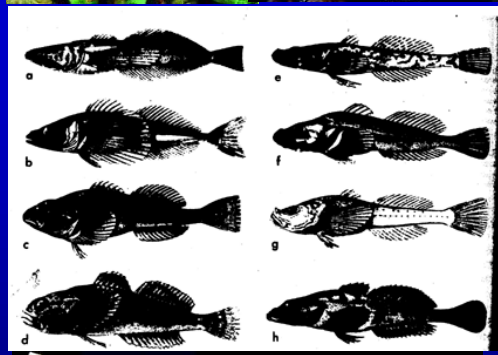
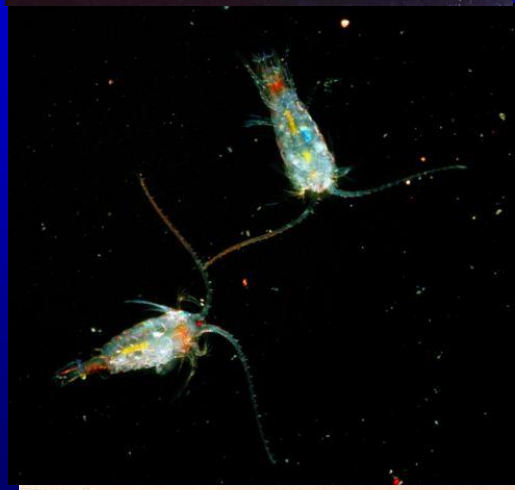
- Gammarids, flatworms, sculpins, and snails esp. diverse
- Paradox: most invert diversity (82%) is contained in nearshore area of the lake (3.4% of lake area)!
- Offshore waters are species poor



# *Offshore biodiversity in Lake Baikal*

- Pelagic food web:
  - a few endemic diatoms
  - one endemic copepod (*Epischura baikalensis*)
  - one pelagic gammarid
  - endemic oilfish and whitefish
  - Baikal seal



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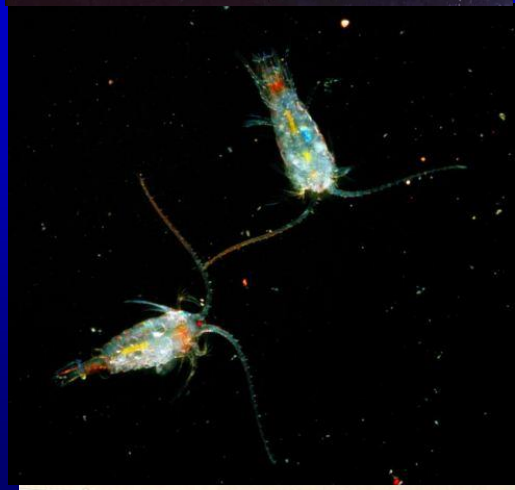
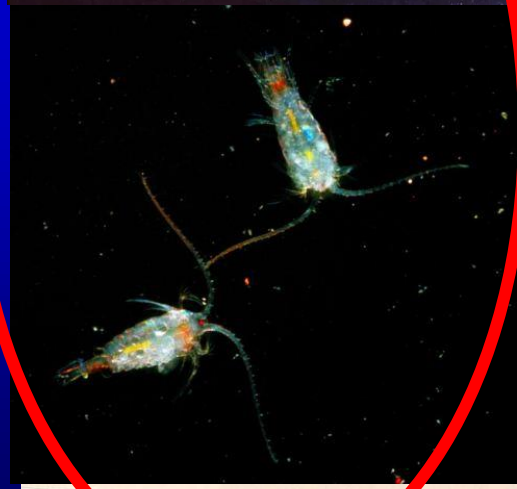
- Pelagic biota: cold loving stenotherms

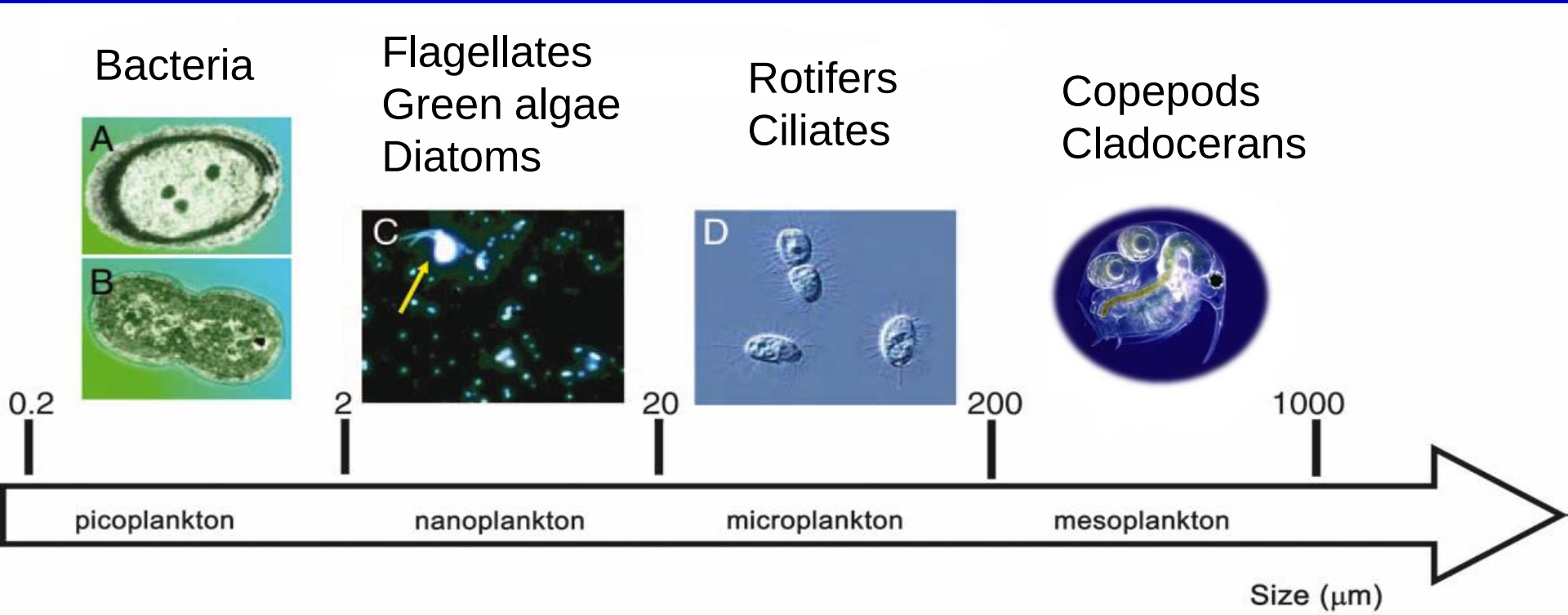


*Russian-US team focusing on Baikal plankton*

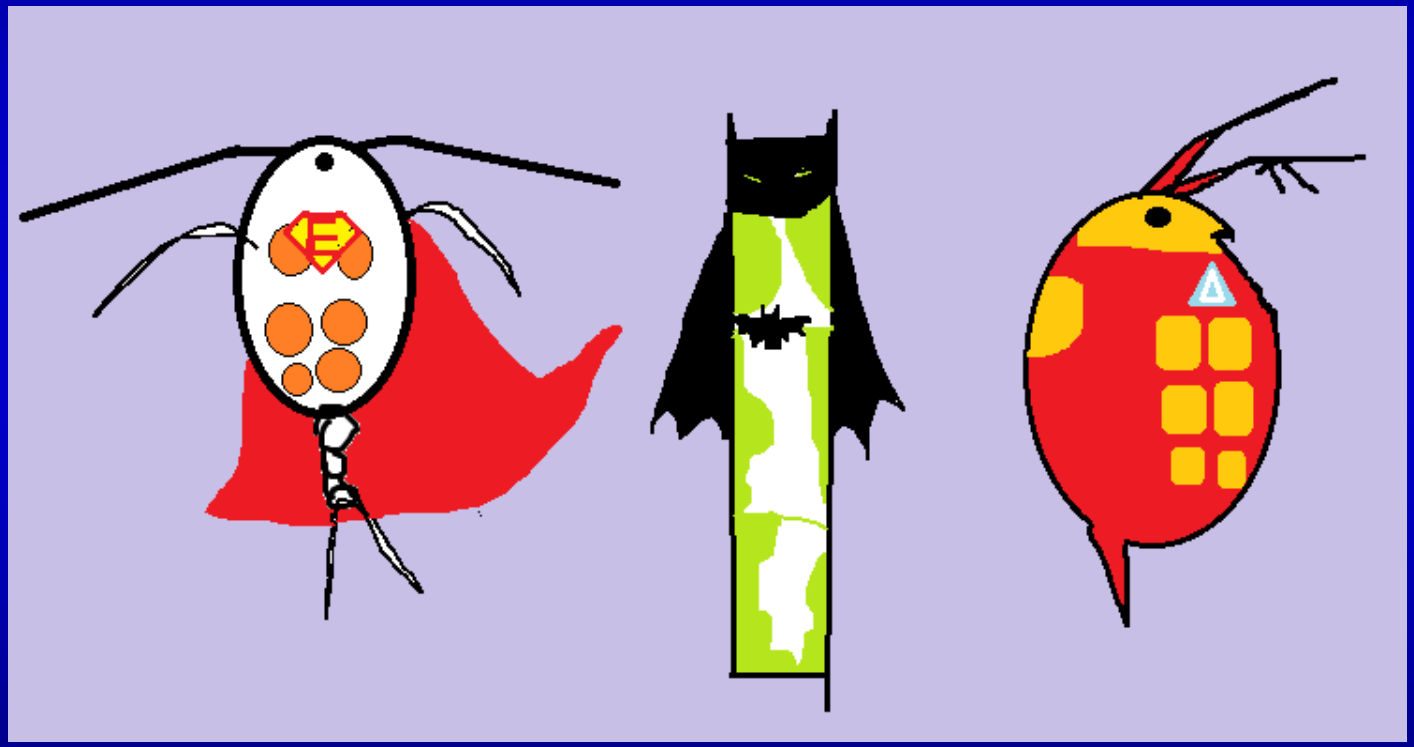


# *Plankton*

- Wet bits in lakes & ocean!
- Small organisms (0.2 µ to > 1000 µ)



# *Plankton are super heroes!*



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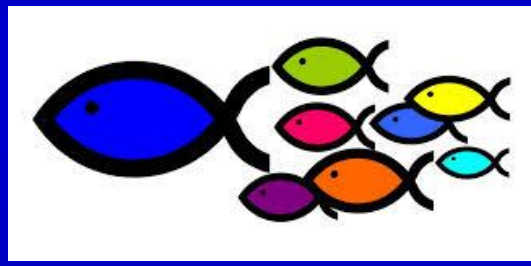

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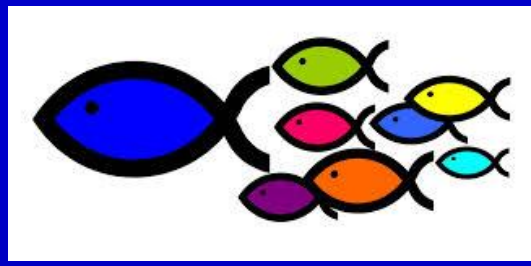
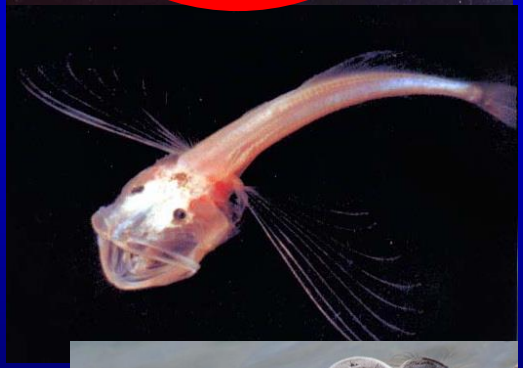


- Provide essential fatty acids for good heart health in humans

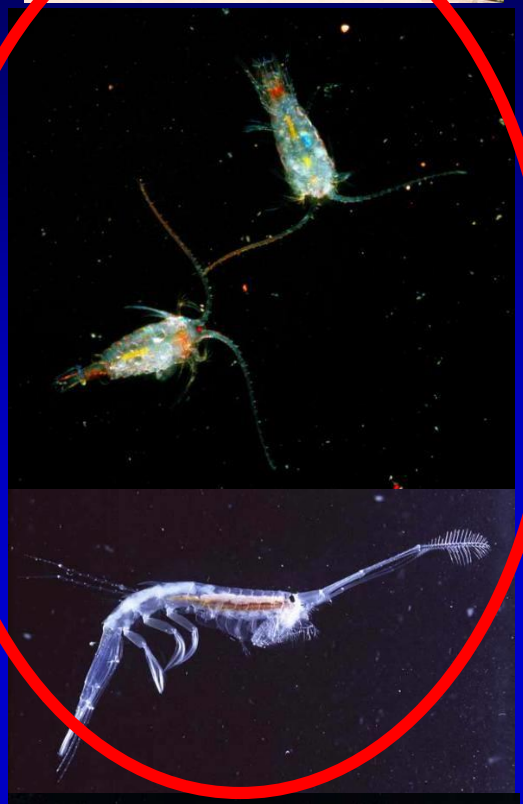
# *Baikal Plankton*

- Phytoplankton & zooplankton



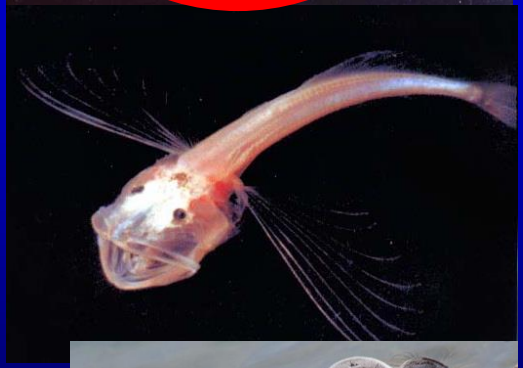
# *Baikal Plankton*

- Phytoplankton & zooplankton
- Endemic (cold-loving species)
- Cosmopolitan (warm-loving species)



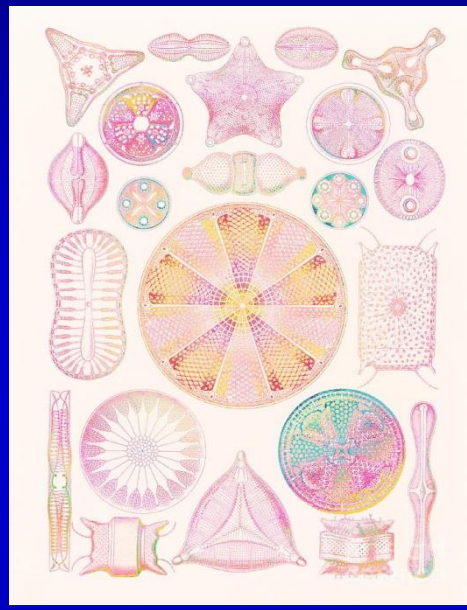
# *Baikal Plankton*

- Phytoplankton & zooplankton
- Endemic (cold-loving species)
- Cosmopolitan (warm-loving species)
- Abundance changing
- Possibly due to climate change



# Biodiversity- what is it?

- Broadly: the variety of life



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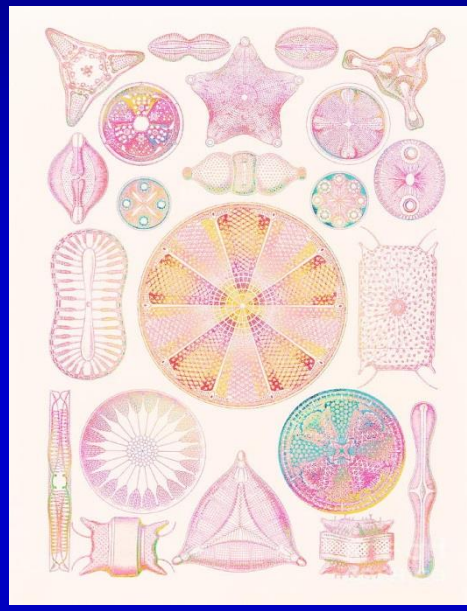

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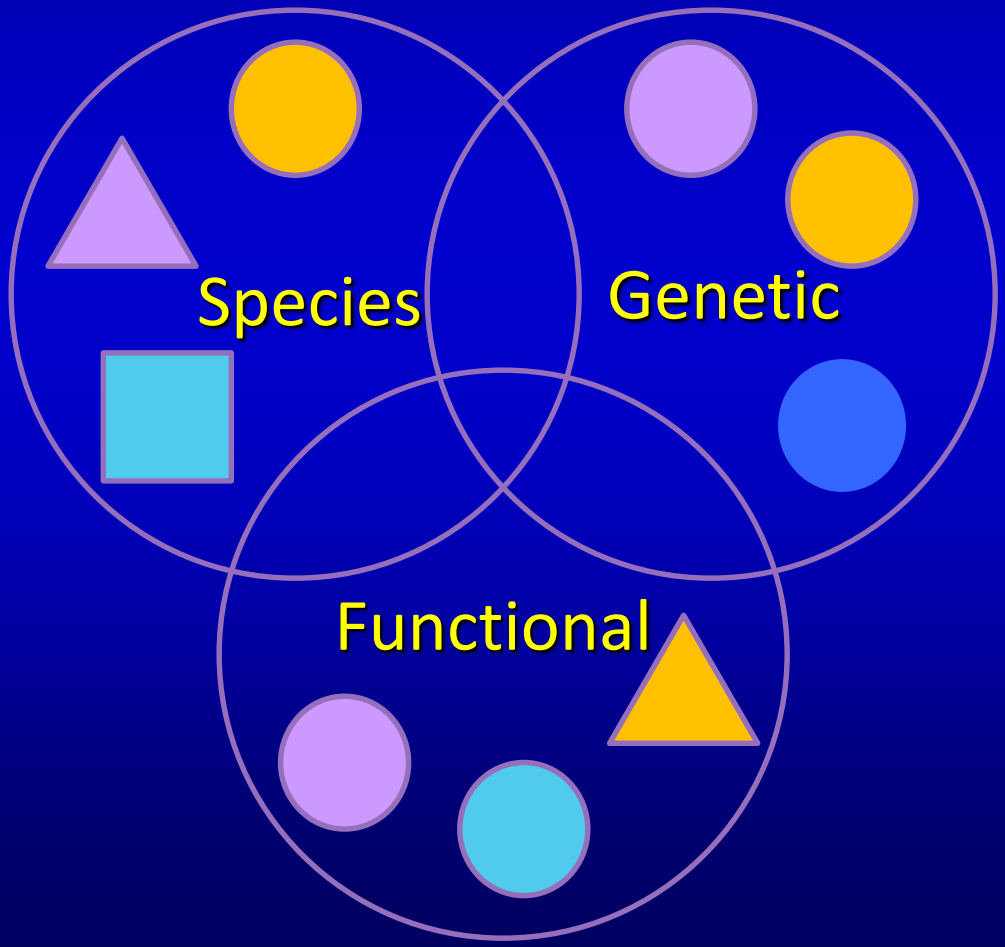
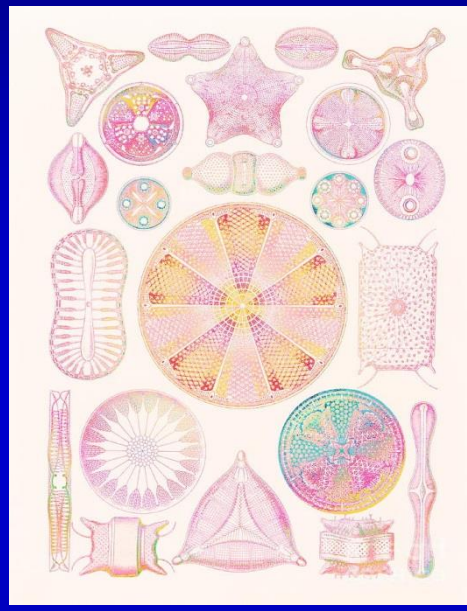
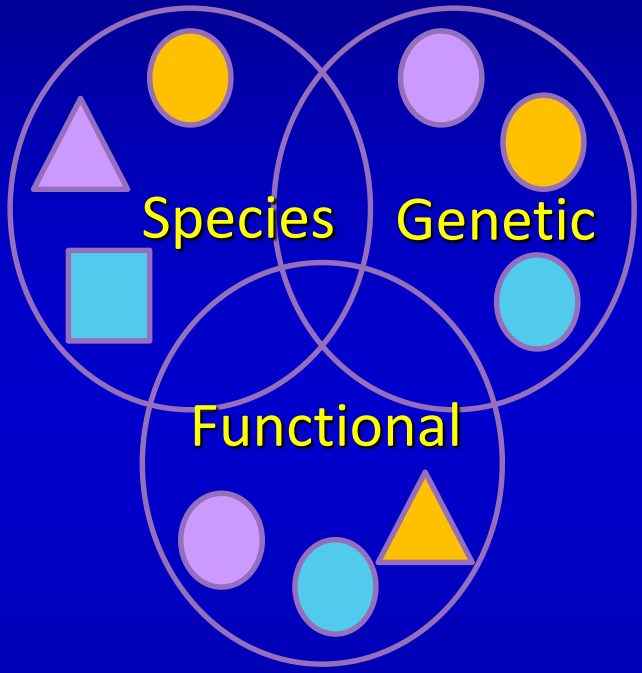


# Biodiversity – what we do not know

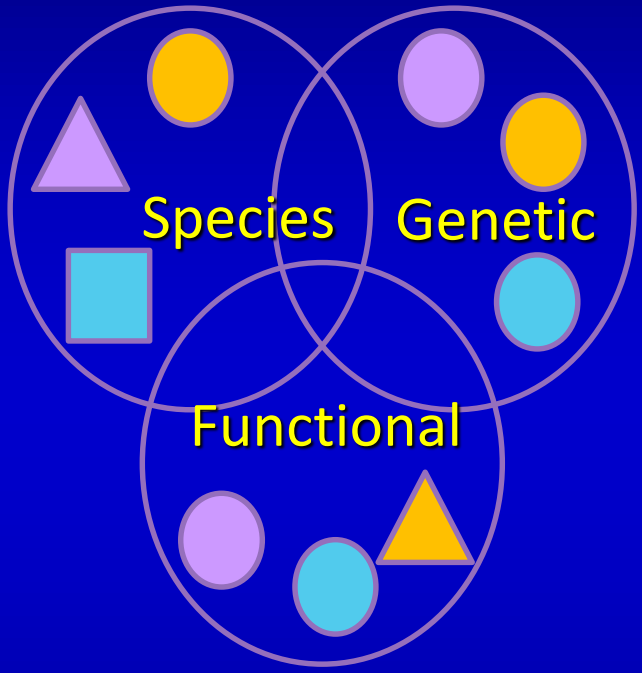
- How are different levels of biodiversity related?



# Biodiversity – what we do not know

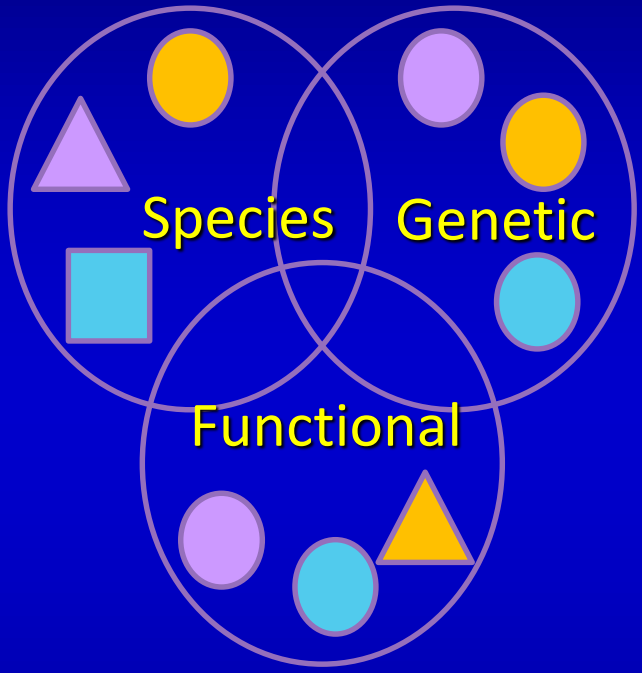
- How are different levels of biodiversity related?

  -- Does high genetic diversity within a species predict high functional diversity



# Biodiversity – what we do not know

- How are different levels of biodiversity related?
  - -- Does high genetic diversity within a species predict high functional diversity
- How might these levels of biodiversity respond differently to climate change?



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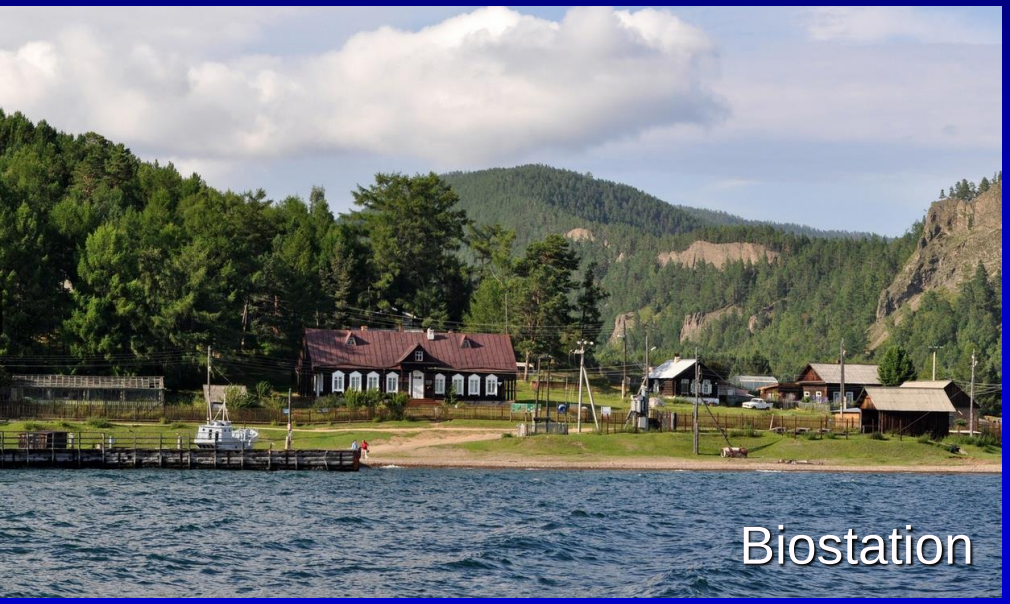
2. FUNCTIONAL DIVERSITY – Characterizing functional traits (growth rates, grazing rates) for different species and strains

3. MODEL -- how different levels of diversity will interact with climate change to shape future pelagic community of the lake

# *Our Biodiversity Team*

- Six universities
- Twenty scientists
- Molecular biologists, ecologists, mathematical modelers


# *Where we live and work at Baikal…*



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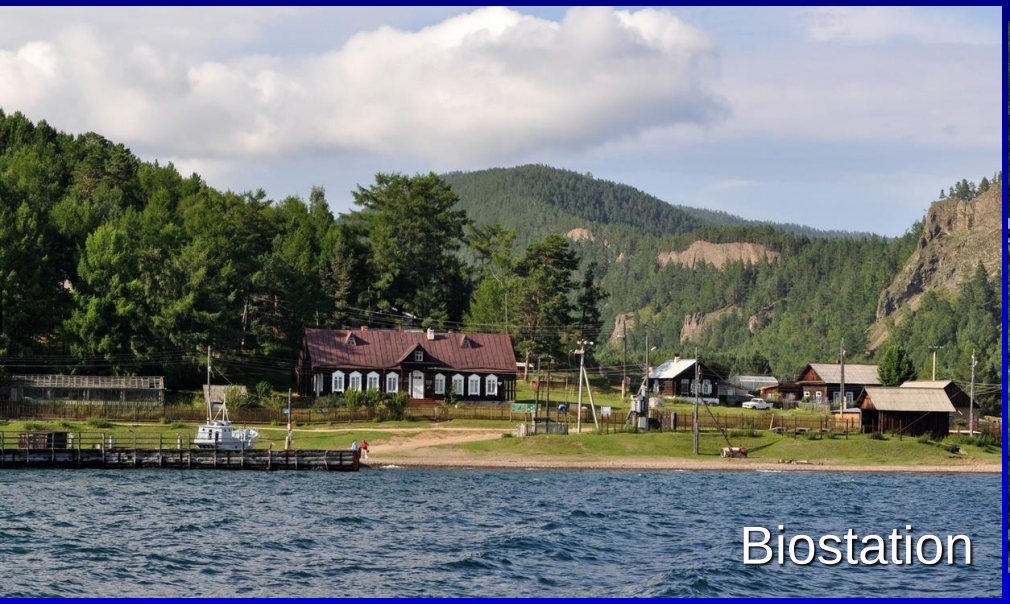
Biostation


Lab


Lab

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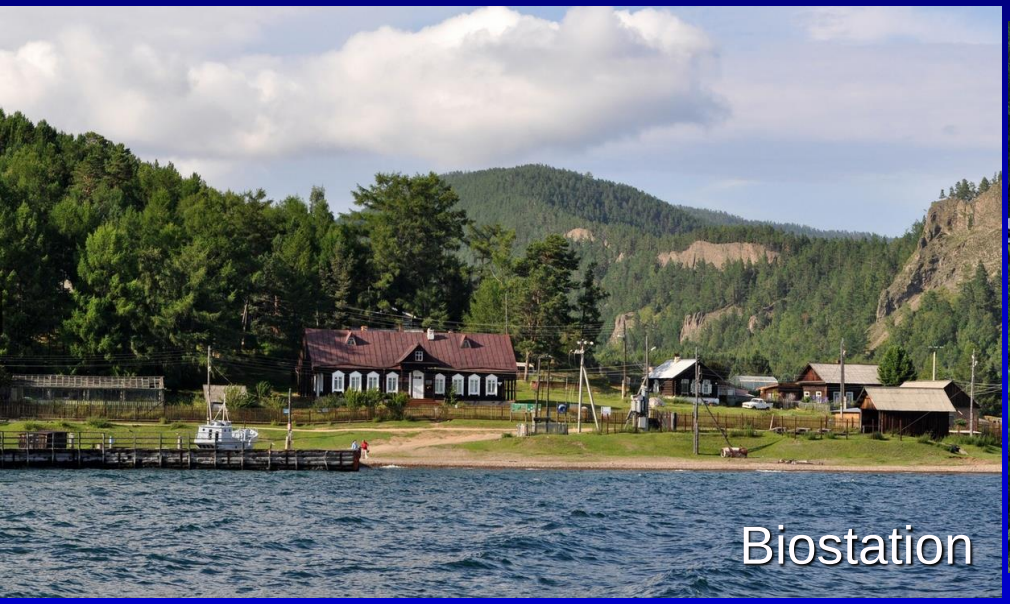





*Our research is motivated by previous findings of Russian scientists and students*

Dr. Mikhail Shimaraev

Dr. Olga Kozhova

Lyudmilla Ryapenko & Sergei Veschev

Dr. Lyubov Izmest'eva

# *Climate change at Lake Baikal*

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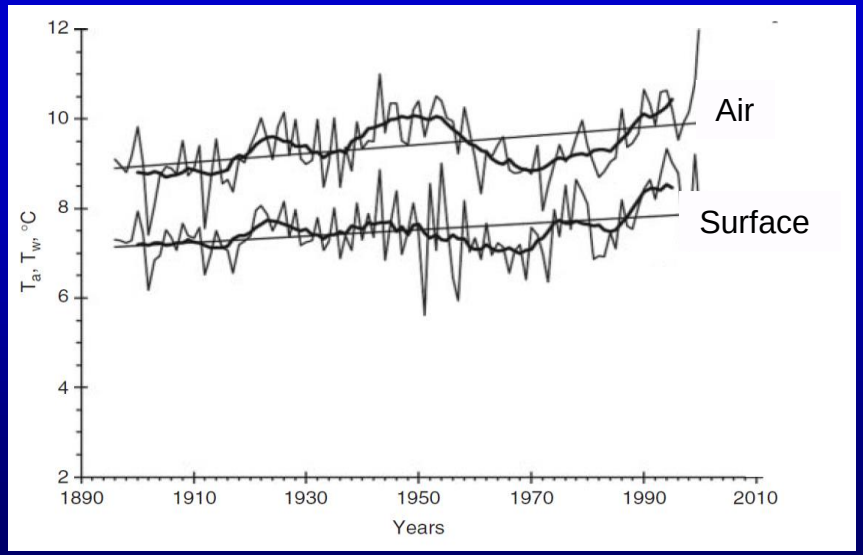
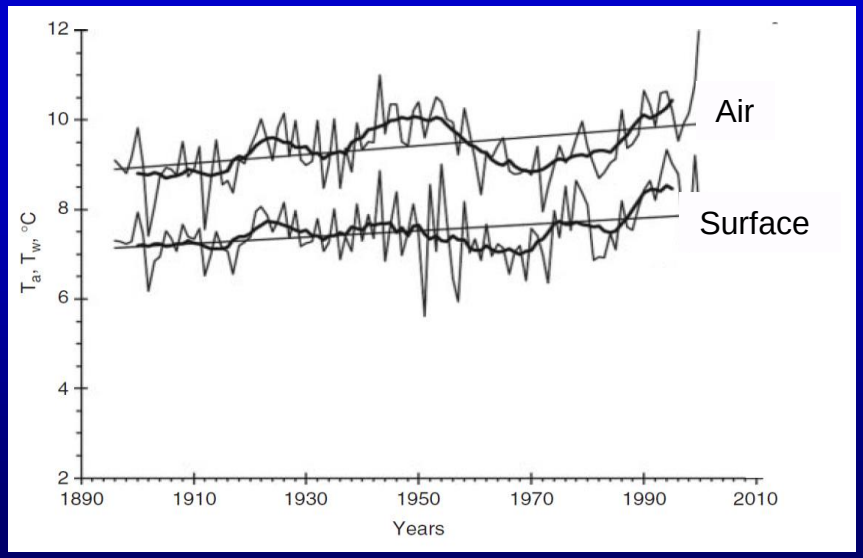
- Air temperatures increased at twice the global average over last 100+ years
- Summer surface temperatures increased 2.5 ° C since 1948

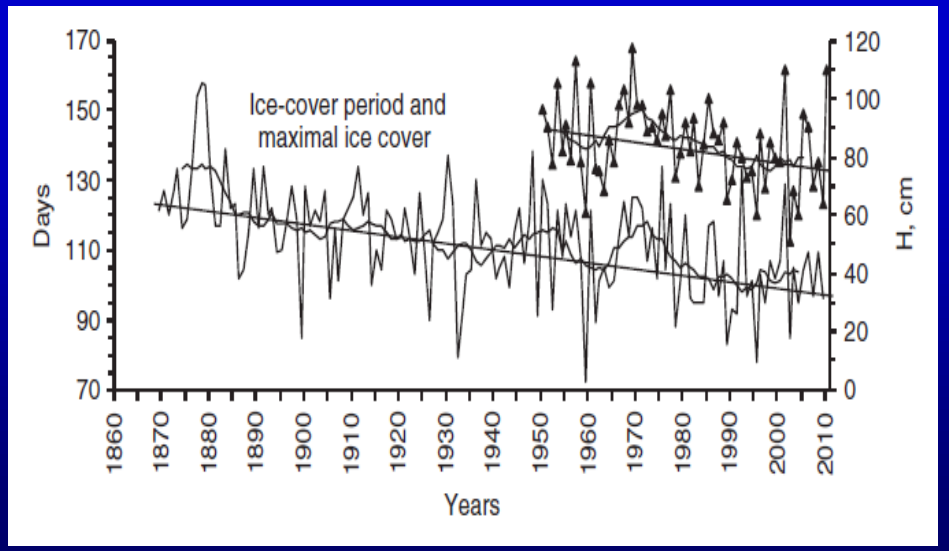



Shimaraev and Domysheva 2013

# *Climate change at Lake Baikal*

- Air temperatures increased at twice the global average over last 100+ years
- Summer surface temperatures increased 2.5 ° C since 1948
- Ice cover duration & ice thickness decreased

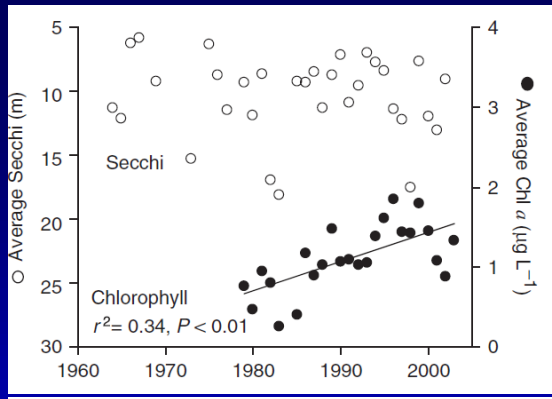


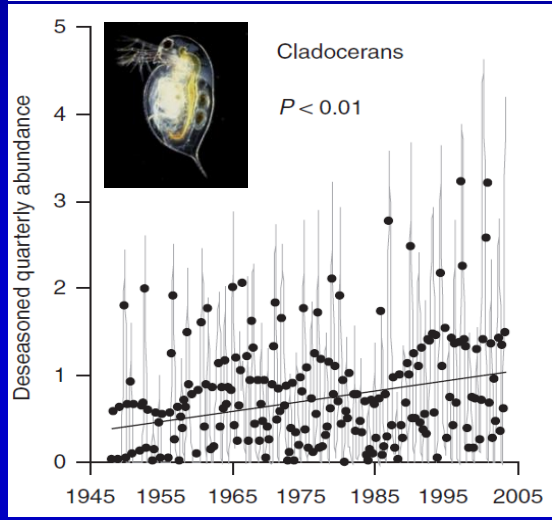



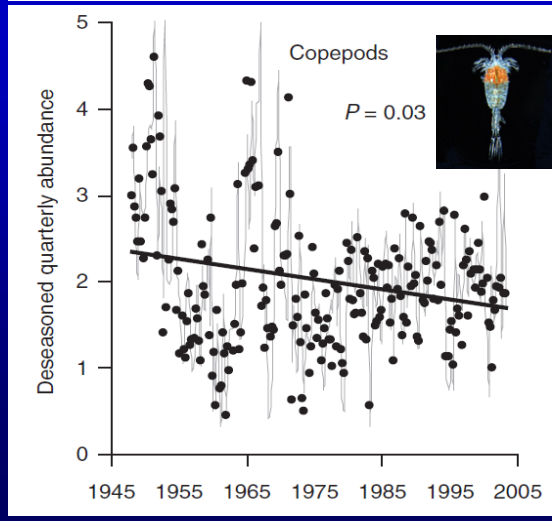

Shimaraev and Domysheva 2013

# *Biological changes in Lake Baikal*

- Increased concentration of chlorophyll (phytoplankton)




Hampton et al. 2008

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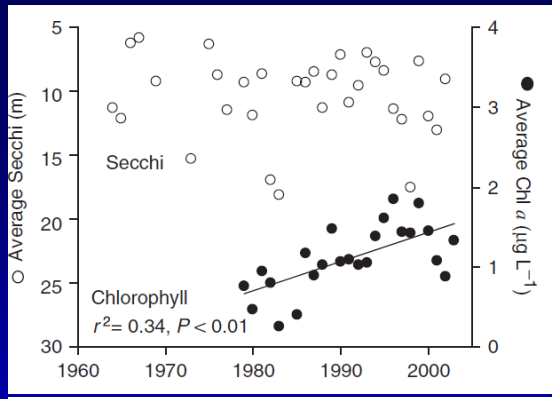
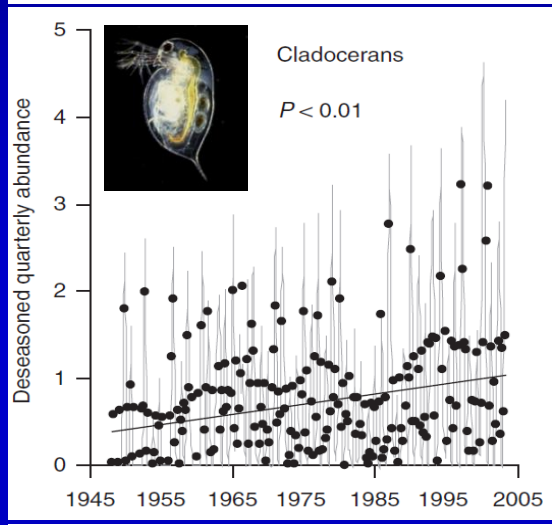
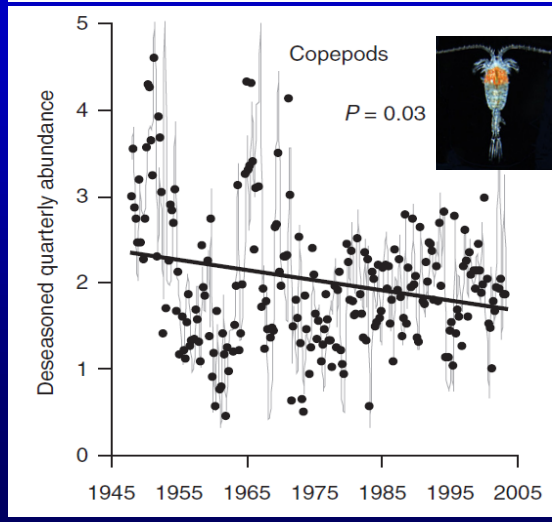


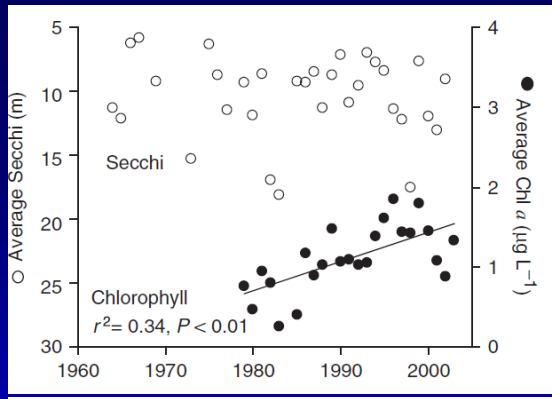



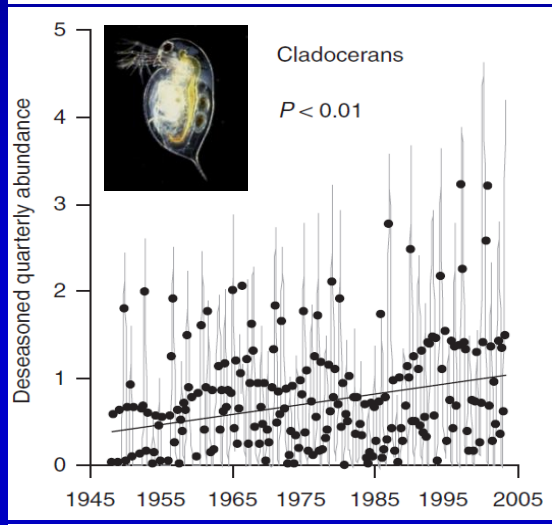

Hampton et al. 2008

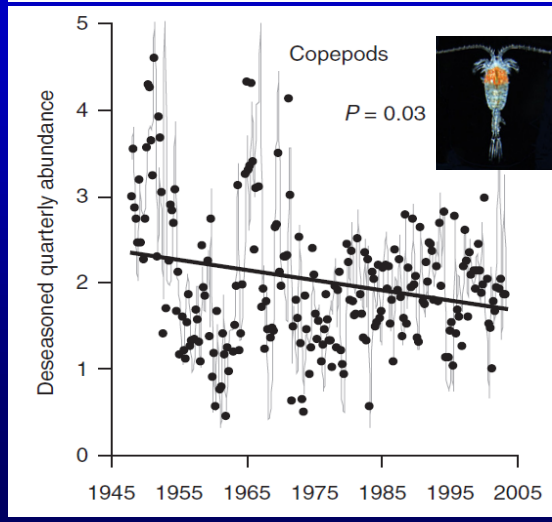
# *Biological changes in Lake Baikal*

- Increased concentration of chlorophyll (phytoplankton)
- Increased abundance of cosmopolitan zooplankton (e.g., cladocerans)
- Decreased abundance of endemic copepod (*Epischura baikalensis*)

Hampton et al. 2008



Mikhail Kozhov

Olga Kozhova
(daughter)

Liubov’ Izmestyeva
(granddaughter)

Mikhail Kozhov

Liubov’ Izmestyeva
(granddaughter)

Olga Kozhova
(daughter)

Biological Station, Irkutsk State University

# *ACKNOWLEDGMENTS*


- Liubov Izmest'eva
- Zhenya Silow
- Kirill Shchapov
- Lena & Sasha Pislegin
- Field station staff
- Crew of *Kozhov* cutter
- Denis A-Gribanov
- Rita Tsitsenko
- Nadia Shakhtanova
- Ted Ozersky
- Katie Wright
- Teo Nakov
- Elena Litchman
- Lev Yampolsky
- Stephanie Hampton
- Steve Katz
- Ed Theriot
- Derek Gray
- Kara Woo
- Carolin Ferwerda
- Genia Nizkorodov


Photo by
Kara Woo

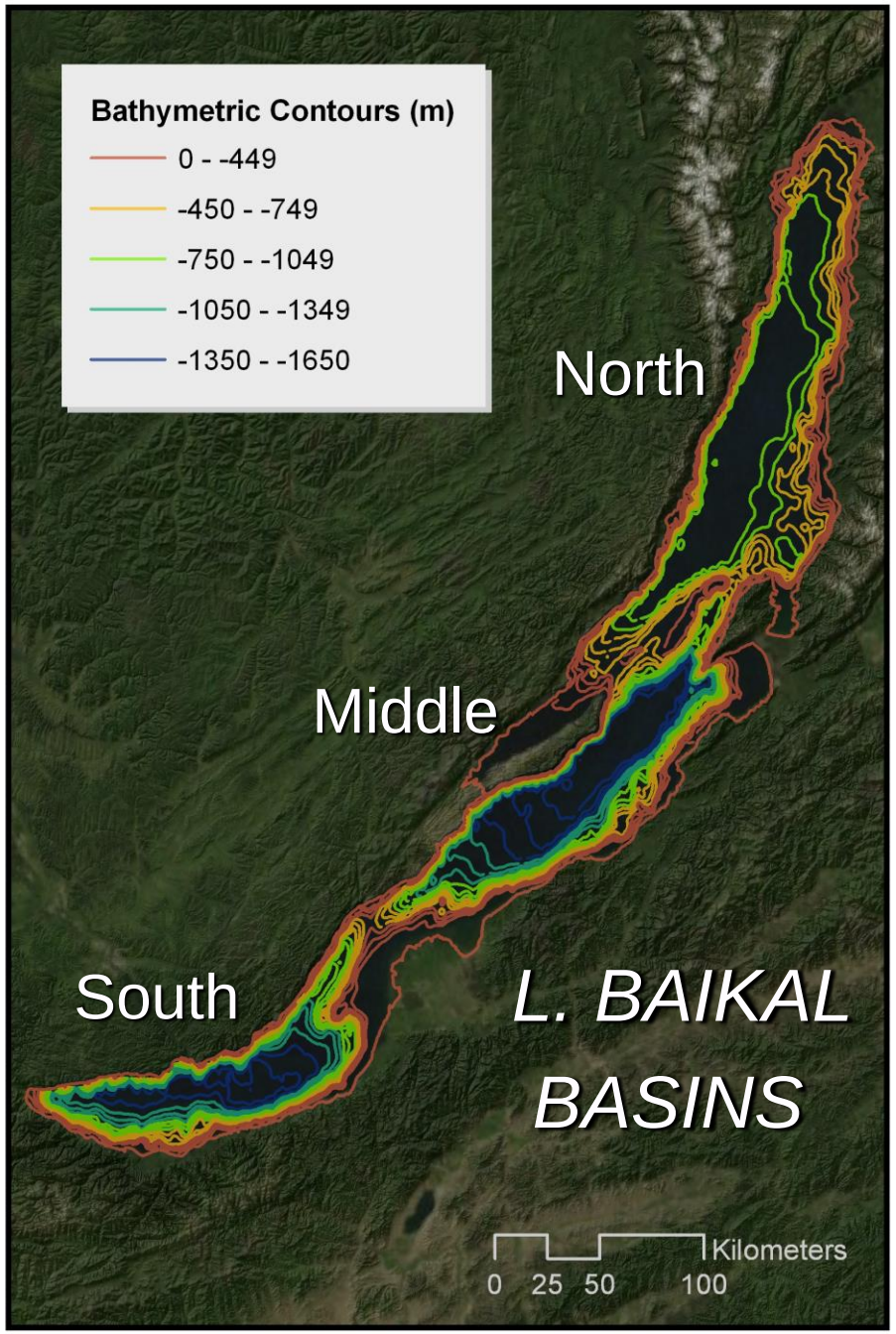
# *Industrial Corridor*


- Empirical work & modeling

Mamontov et al. 2000

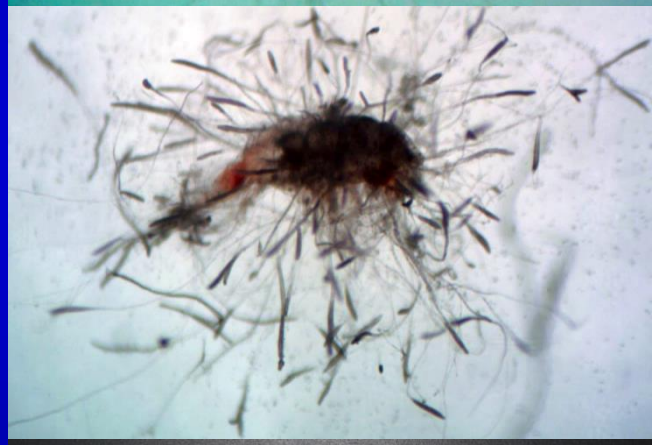
McLachlan et al. 2005

# *Basins of Baikal*



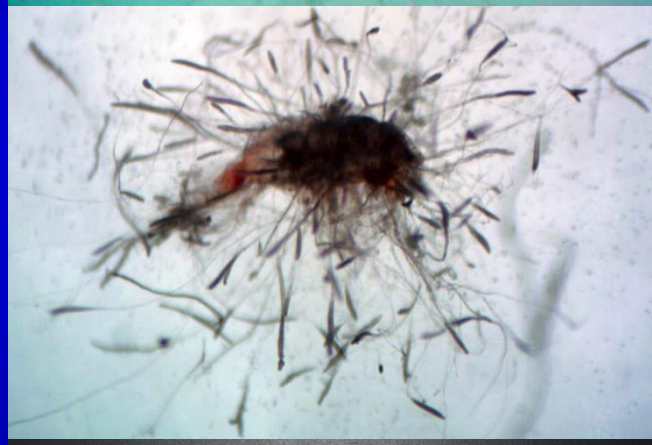

Bathymetry from International Continental Scientific Drilling Program

# Parasite infects *Epischura*



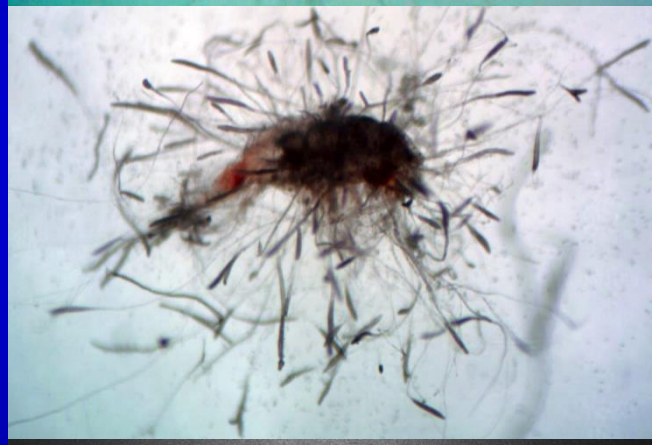
# Parasite infects *Epischura*

- Infects *Epischura* during warm years (Yasnitsky 1930)
- Identified morphologically as *Saprolegnia*



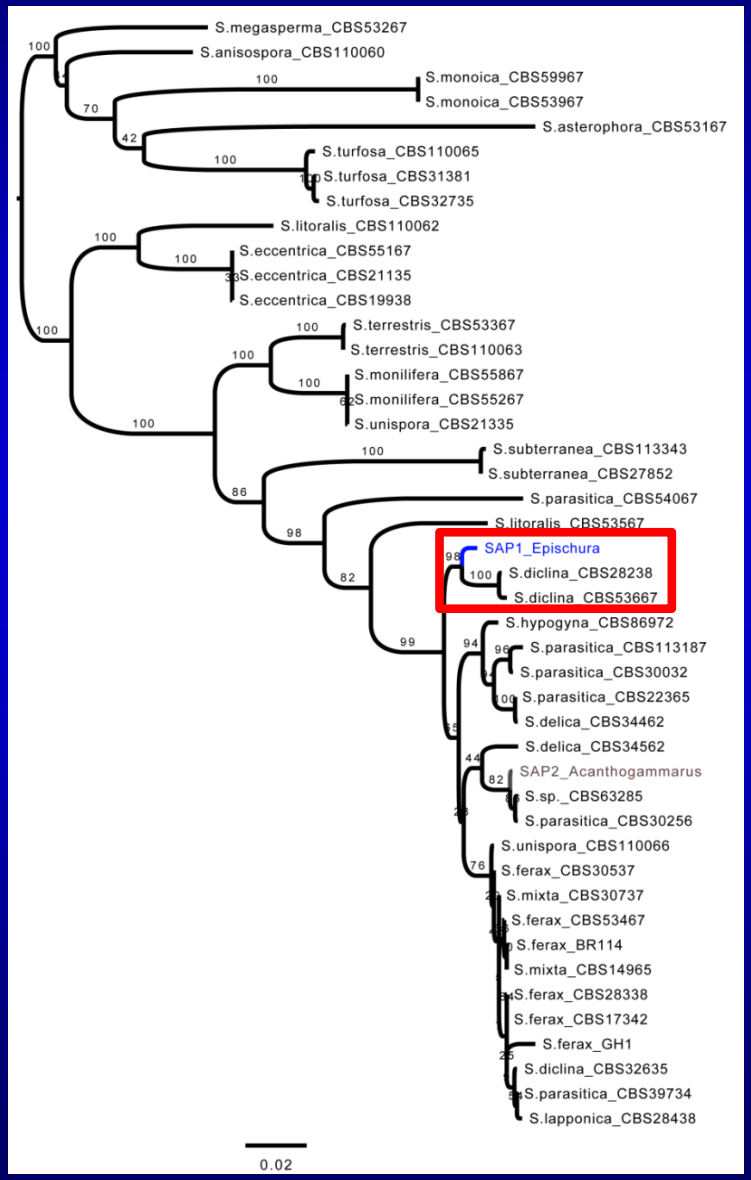
# Parasite infects *Epischura*

- Infects *Epischura* during warm years (Yasnitsky 1930)
- Identified morphologically as *Saprolegnia*
- Grows on agar allowing growth rate measurements
- Identify through gene sequencing



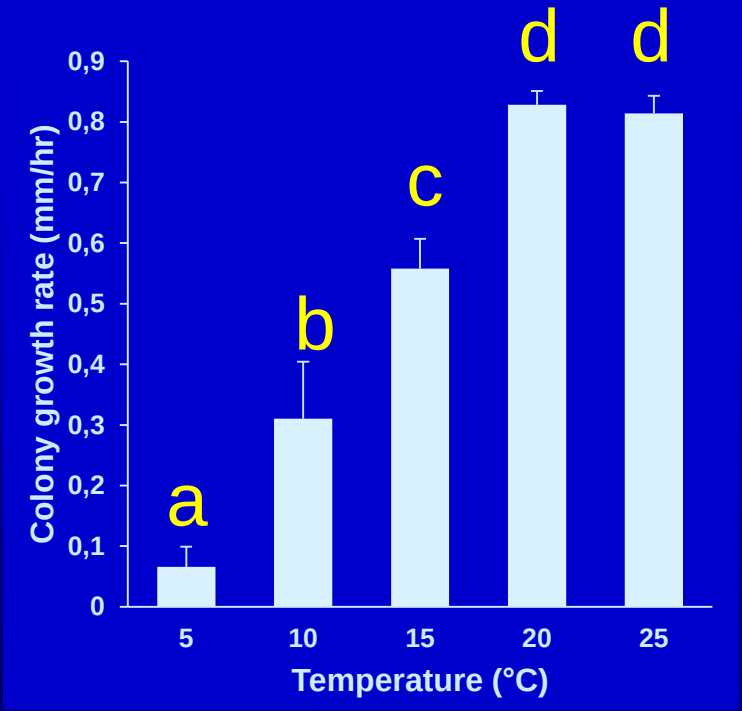
# Oomycete parasite

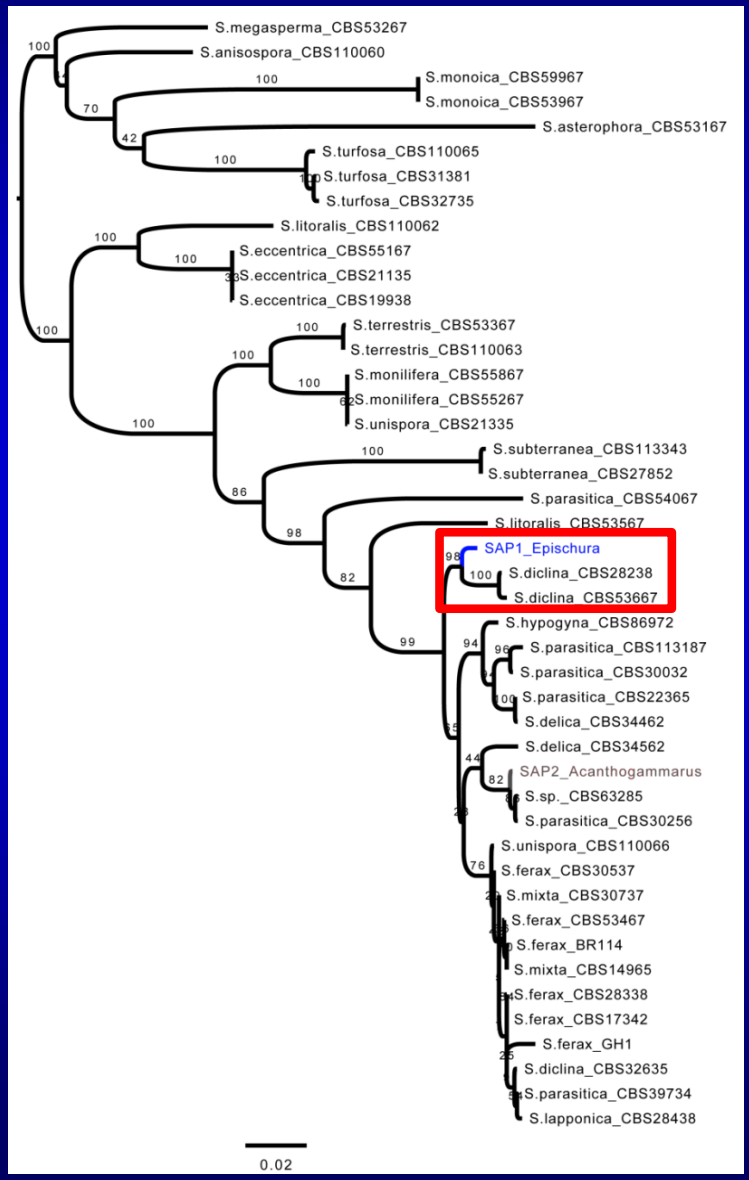
- COI and ITS genes identify parasite as a sister strain to *Saprolegnia diclina*



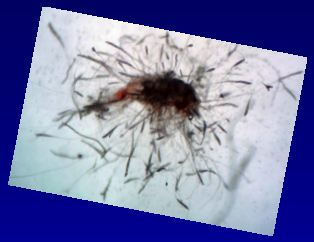
# Oomycete parasite

- COI and ITS genes identify parasite as a sister strain to *Saprolegnia diclina*
- Lab experiments show peak growth of parasite at 20˚ C



*Is the effect of this parasite more severe at high temperatures?*



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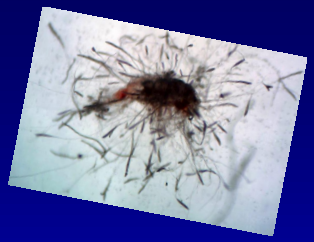
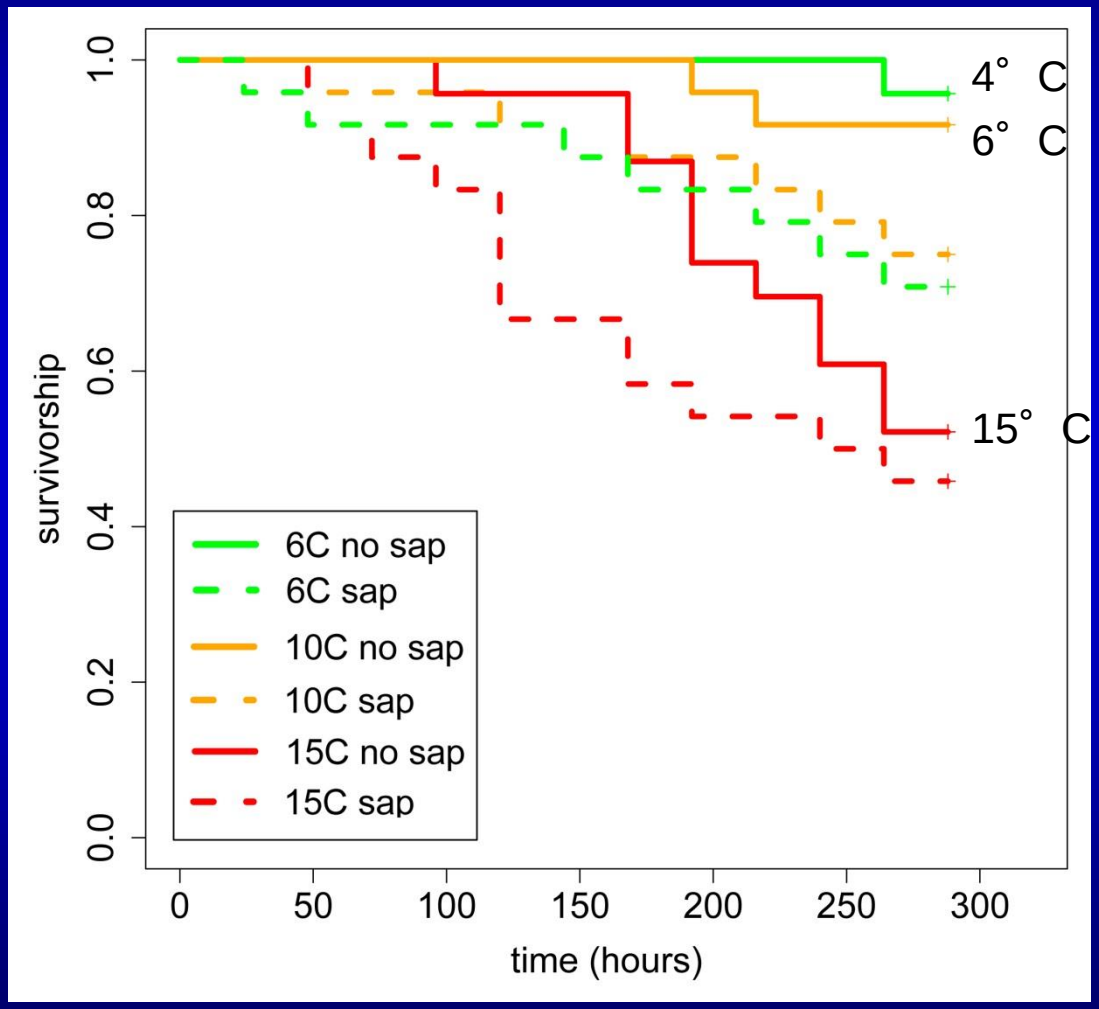
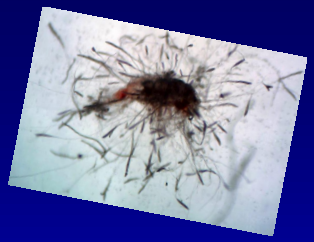


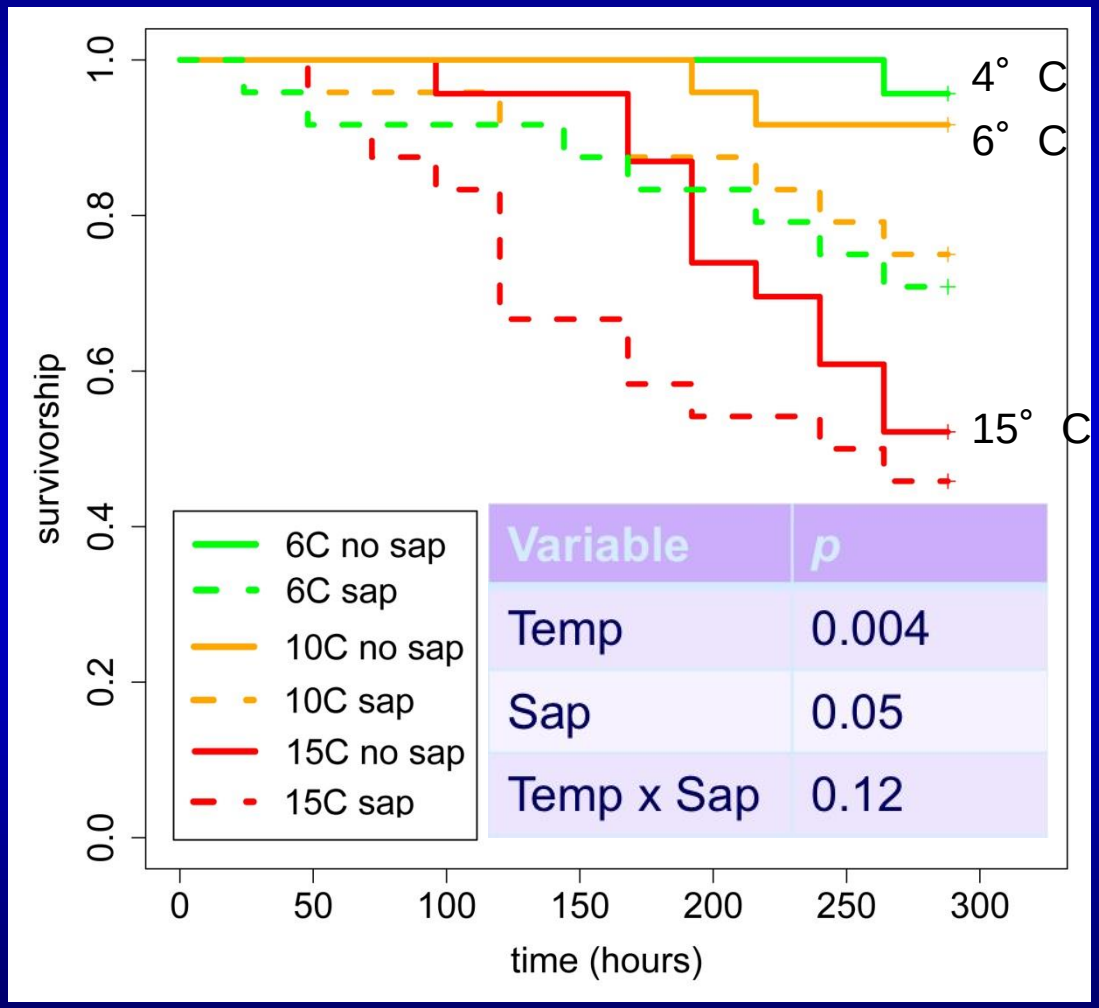



Solid line – no parasite

Dashed line – parasite present

# *Is the effect of this parasite more severe at high temperatures?*






| Variable | *p* |
|---|---|
| Temp | 0.004 |
| Sap | 0.05 |
| Temp x Sap | 0.12 |

Solid line – no parasite

Dashed line – parasite present

# Future work

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- Other species: *Cyclops kolensis*, *Daphnia galeata*

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- Other functional traits: growth rates, feeding rates

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- Other species: *Cyclops kolensis*, *Daphnia galeata*
- Other functional traits: growth rates, feeding rates
- Integration of data with mathematical model of ecosystem