Curso Intensivo Intersemestral

(Paleo)Bio Inidcadores Neotropicales

Introduction to Cladocera (wáter fleas): Biology and Ecology

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POSGRADO EN CIENCIAS DEL MAR Y LIMNOLOGÍA

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Cladocera

(water fleas, los cladóceros)
since Jurassic 145 million years ago

Daphnia

and it seems that
Cladocera are much
more older
Since **Ordovician**

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Cladocera is monophyletic group with four suborders and 11 families:

1. **Daphniidae**
2. **Moinidae**
3. **Bosminidae**
4. **Macrothricidae**
5. **Chydoridea**
6. **Sididae**
7. **Holopeidae**
8. **Polyphemidae**
9. **Cercopagidae**
10. **Podonidae**
11. **Leptodoridae**

Around 400 species……

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- The modern Cladocera developed in the Jurassic period (208 mil. y. ago) during the period of supercontinent Pangea
- Evolutionary history of branchiopods began from Cambrian sea
- Today only few Cladocera species are found in marine environmental

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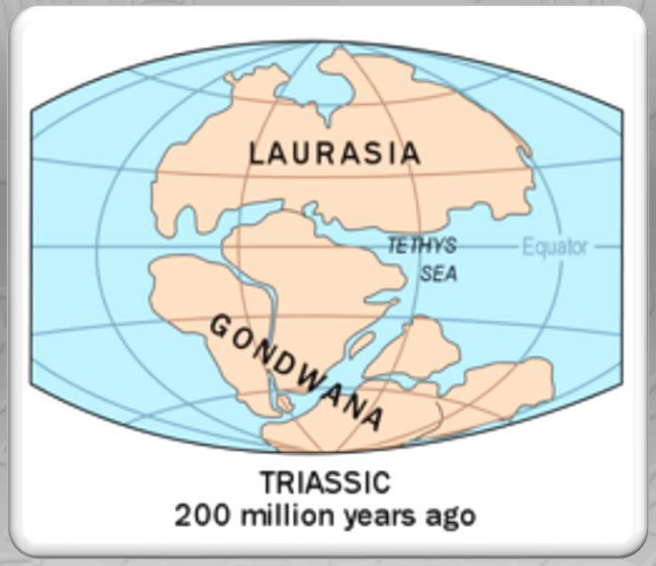
The split of Pangea (into Laurasia and Gondwana 180 million years ago) defined first geographical dispersal of the order.

It seems that some species are conected with the previous Laurasia or Gondwana



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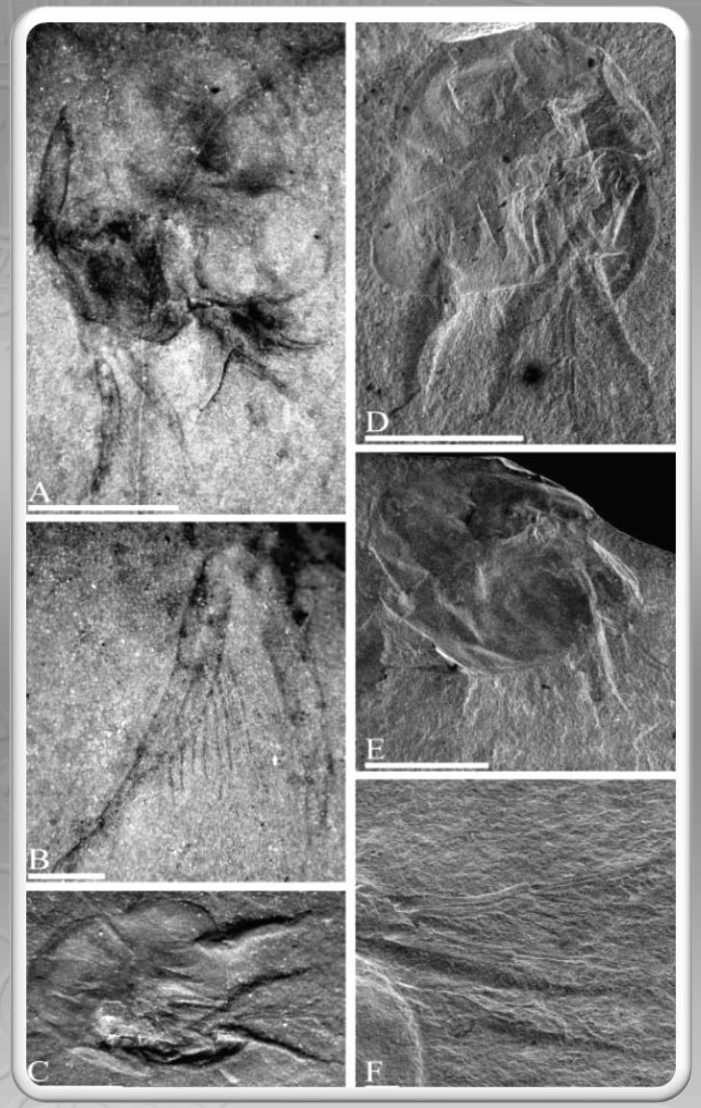
Extinct species
From Jurassic
period, from
Chalunikha,
Russia



Leposida ponomarenkoi

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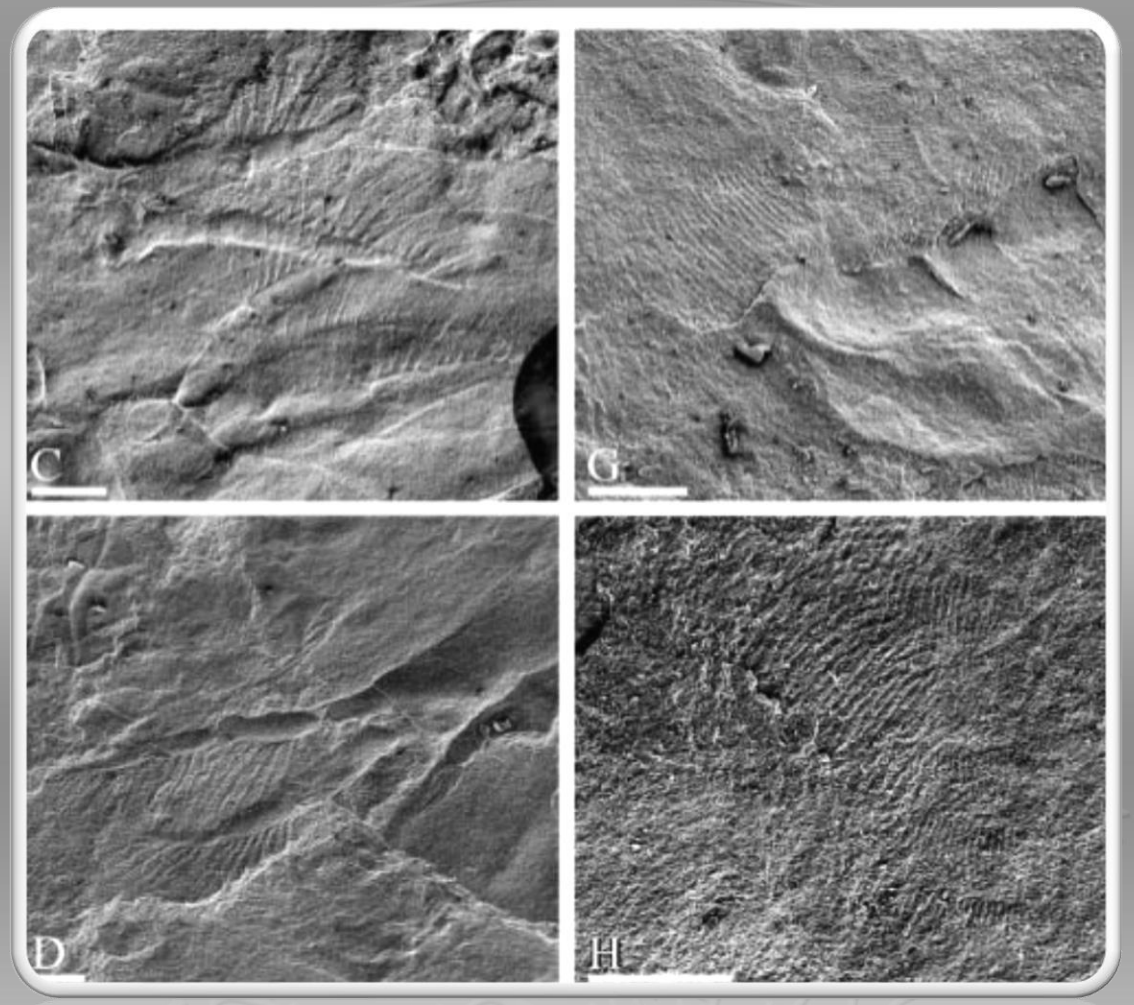

Leptodorosida zherikhini

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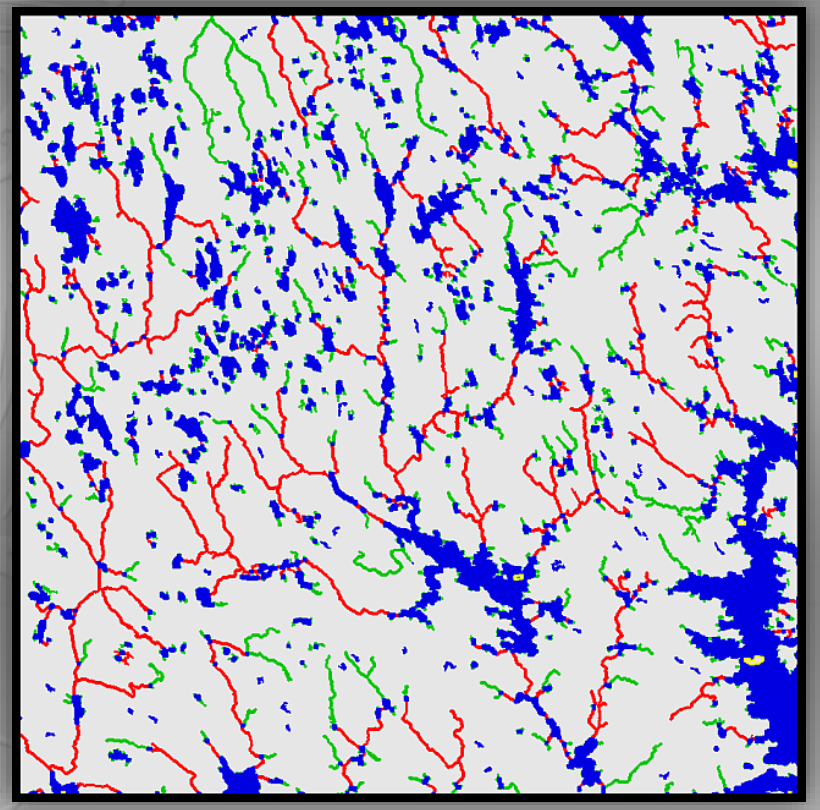
The geographical distribution of cladocera is a function of geological history of area :

- River networks,
- lake system,
- and other barriers



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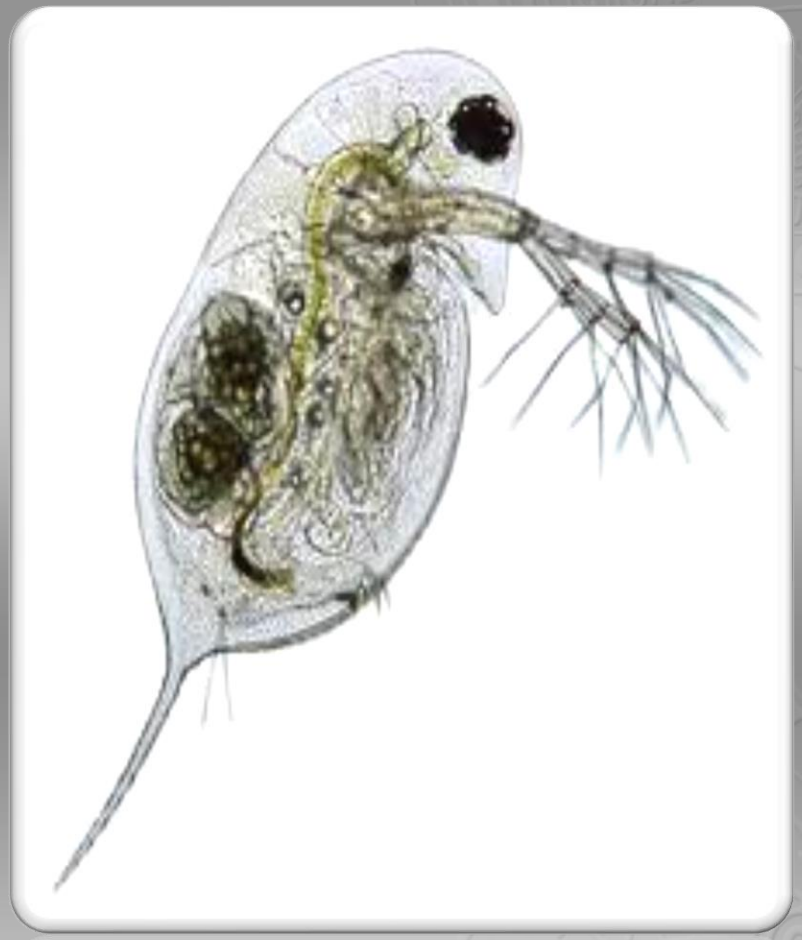

Nowadeys Cladocera species richness is higher in mid-northern latitudes, decreasese towards tropics and pools

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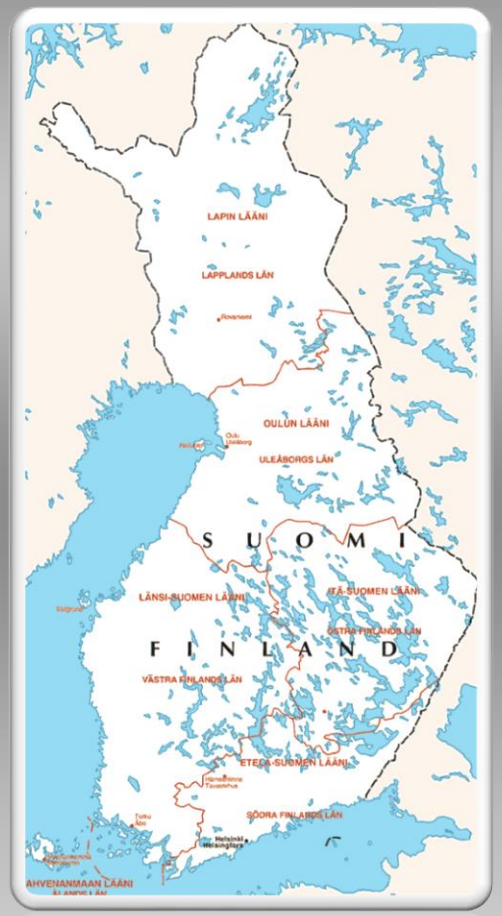
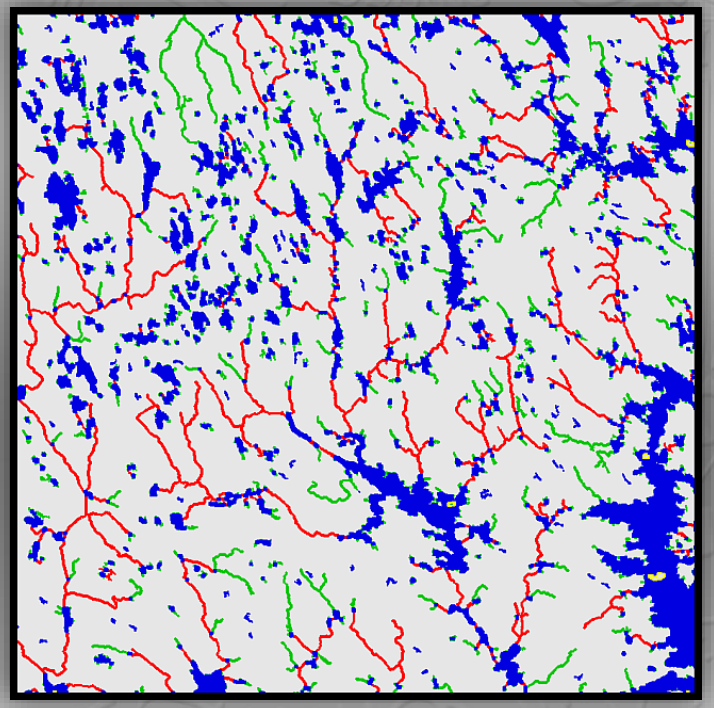
Today vast number of north lakes is exceptional and this is an effect of Pleistocene glaciations





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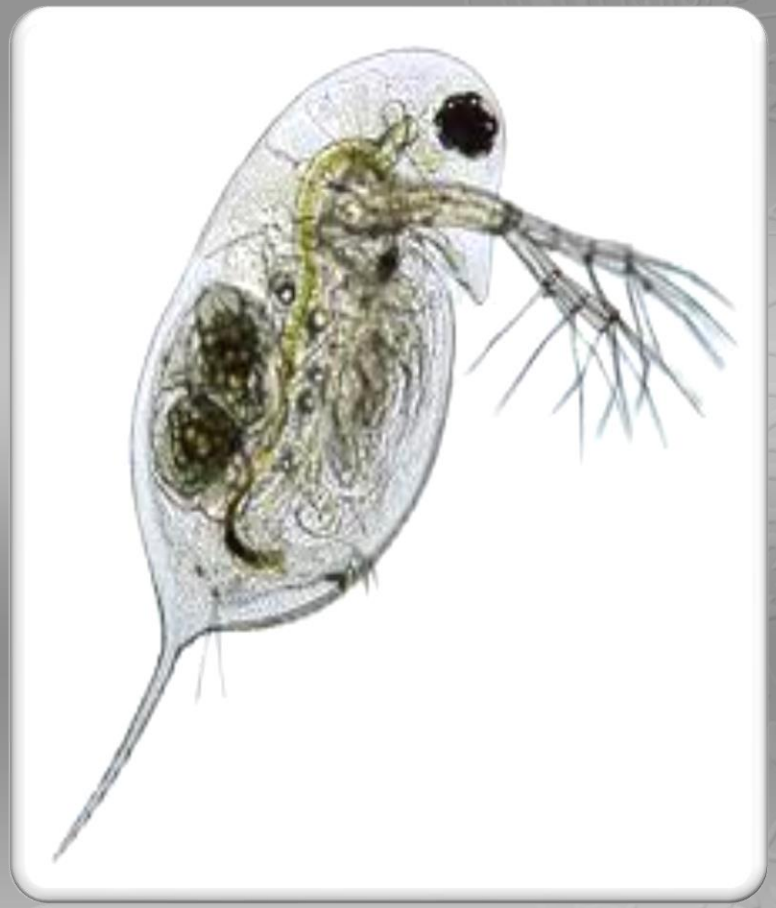

Nowadays freshwater aquatic ecosystem in the tropics are river-dominated systems, with oxbow lakes and temporary pools.

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Apart of geography and geology the presence
and absence of Cladocera in different regions of the World is controlled by biotic factors:

1. Competition and predation
2. Preliminary production
3. Nutrient regeneration
4. Oxygen availability

Recent study indicates that temperature is a factor controlling Cladocera population and it is the most important across latitudes

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Distribution of Cladocera is controlled mainly by two factors:

1. Capacity of dispersal

✓Reproduction parthenogeneticlly

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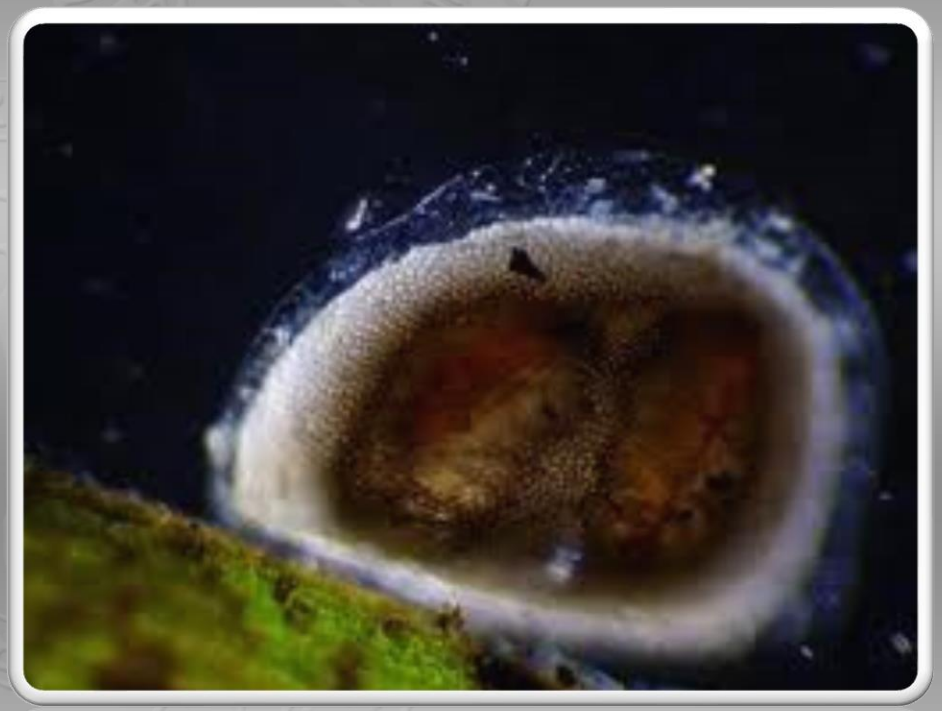
Trasportable resting eggs (ephippia)



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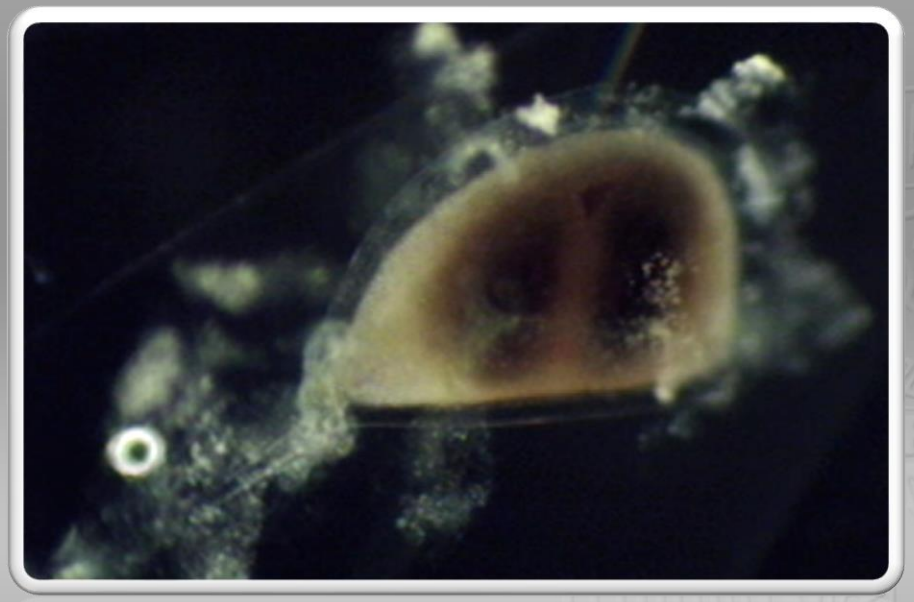
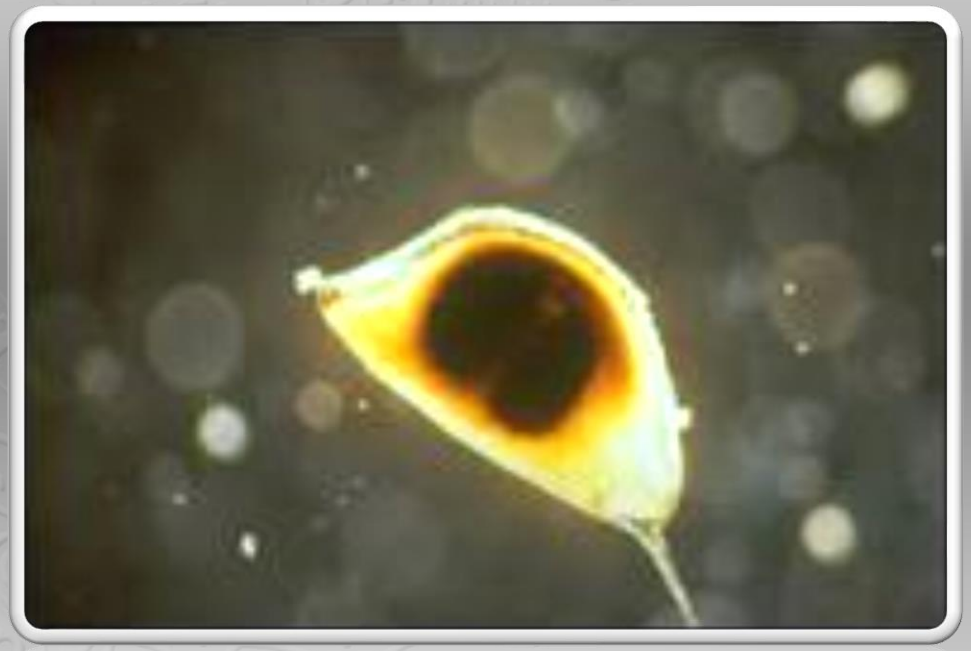


Diapausing eggs are covered by several protective membranes



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Distribution of Cladocera is controlled mainly by two factors:

2. Tolerance to various environmental condition

Organism ability to survive:

- physical
- chemical
- and biological pressures

Despite of very good ability for dispersal very few species of Cladocera are cosmopolitan with the worldwide distribution !!!

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Cladocera Biology

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Left: bacteria, salmon-pink colour
Right: green algae, transparent with the gut green or yellow

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Newborn Daphnia looks more or less like adult,

except that the brood chamber is not yet development

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First eggs are deposit in the brood Chamber c.a. 5-10 days in 20 C

Adults may produce parthenogenetic offspring every 3-4 days

Daphnia in the laboratory may live 2-3 months, in the lake . . . . .?

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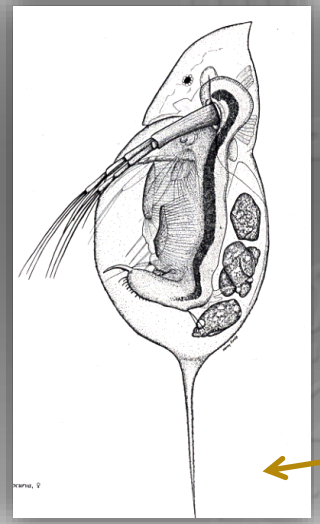
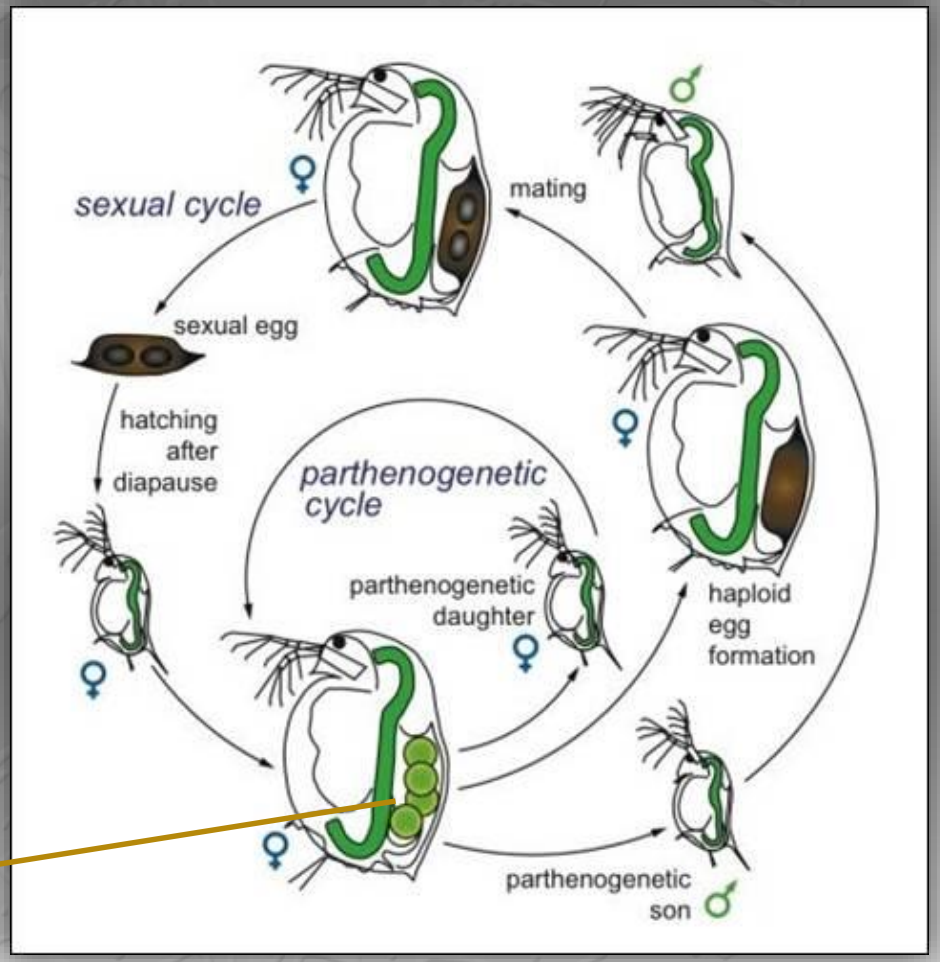
Reproduction of Cladocera





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When do males appear?

- Reduced food availability
- Hight density of specimens
- Decresing day lenght
- Lower temperature
- Dryness
- Strong predation
- Toxicity

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When do males appear?

- Males are smaller by size
- Have larger antennules
- Postabdomen is modified by having hook used for fertilization

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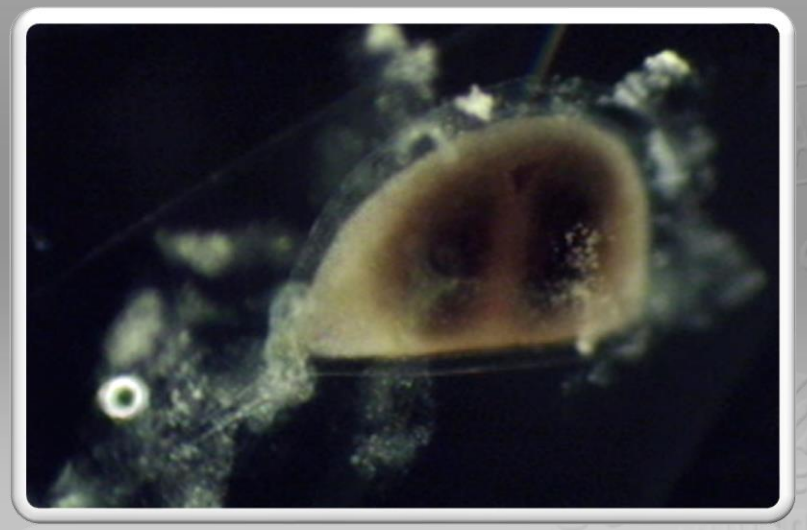
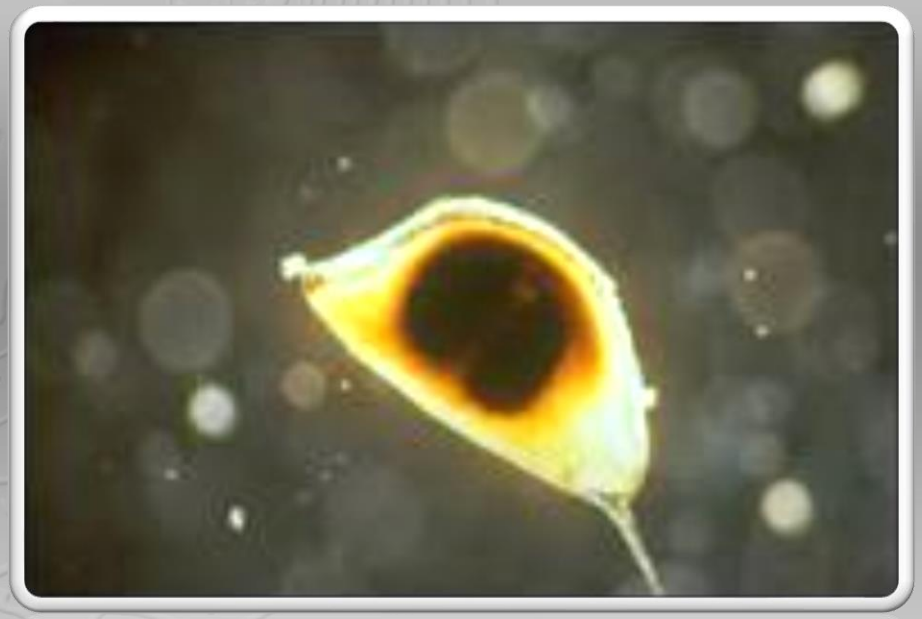


Ephippia can sink to the bottom or drift in the water, may disperse by the wind and animales.

May preserve unfavorible condition even a lot of sesons.
Hatching is inducted by:
-appropriate photoperiod
-temperature
-availability of water or food



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From resting eggs hatch only females which usually produce parthenogenetic eggs themselves

BUT . . . . .

When environmental condition is bad, females may start immediately sexual reproduction

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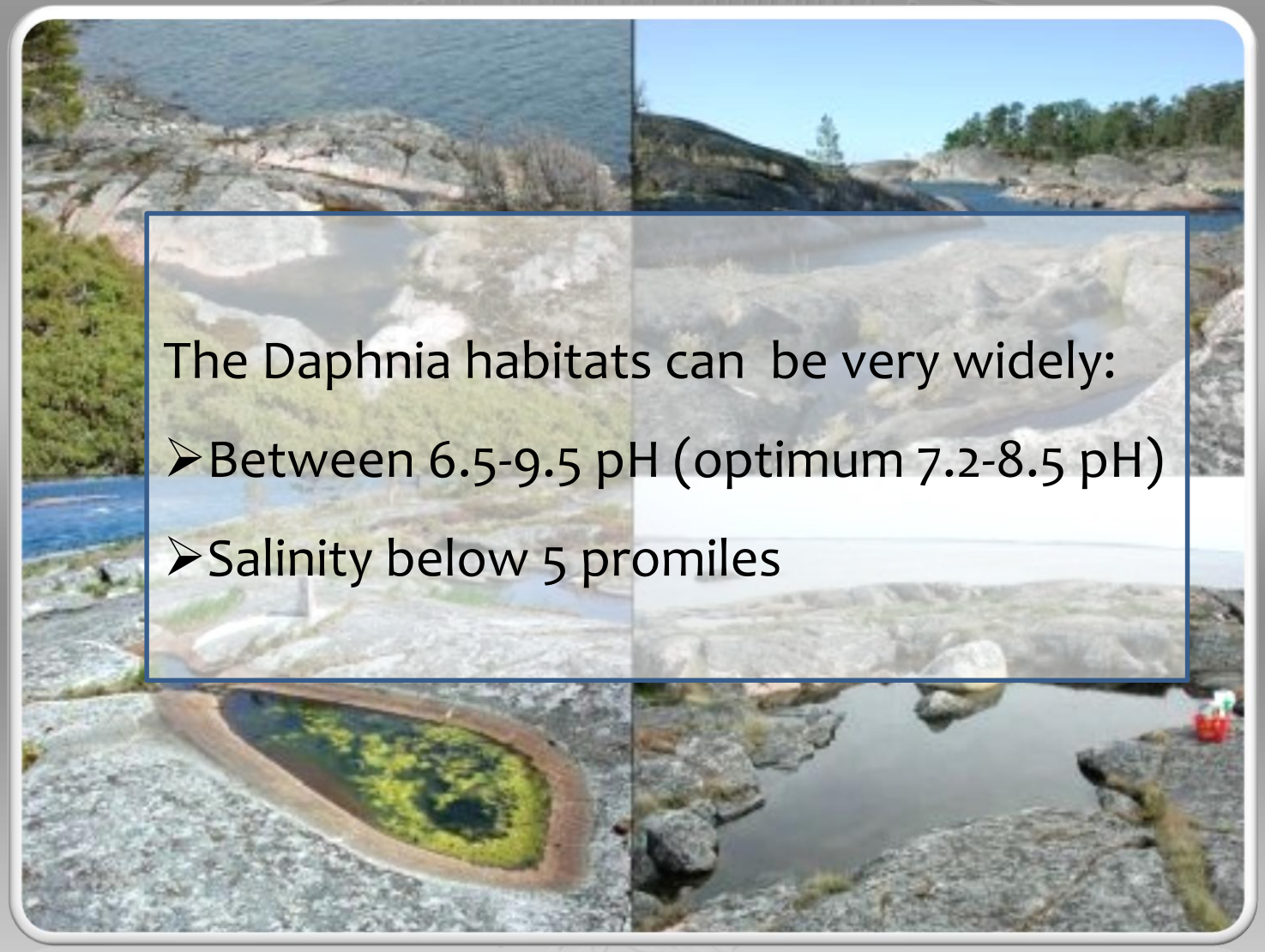

The Daphnia habitats can be very widely:

- Between 6.5-9.5 pH (optimum 7.2-8.5 pH)
- Salinity below 5 promiles

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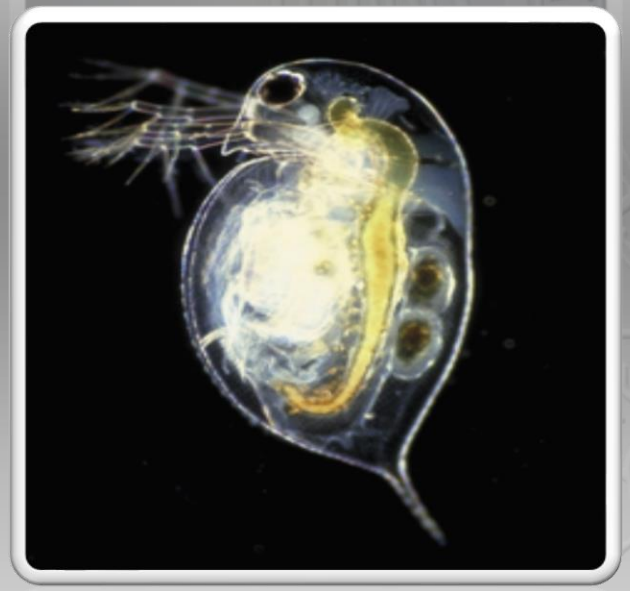
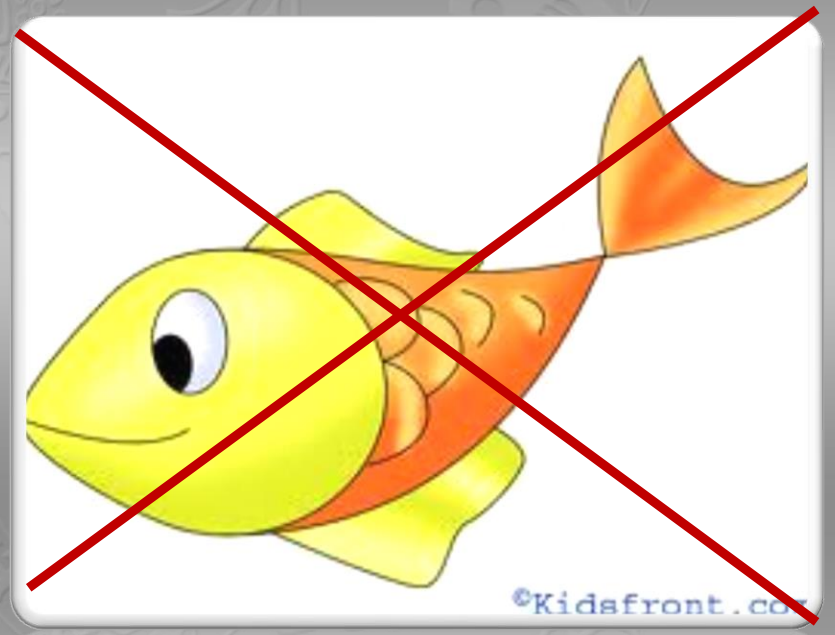
D. manga

D. pulex





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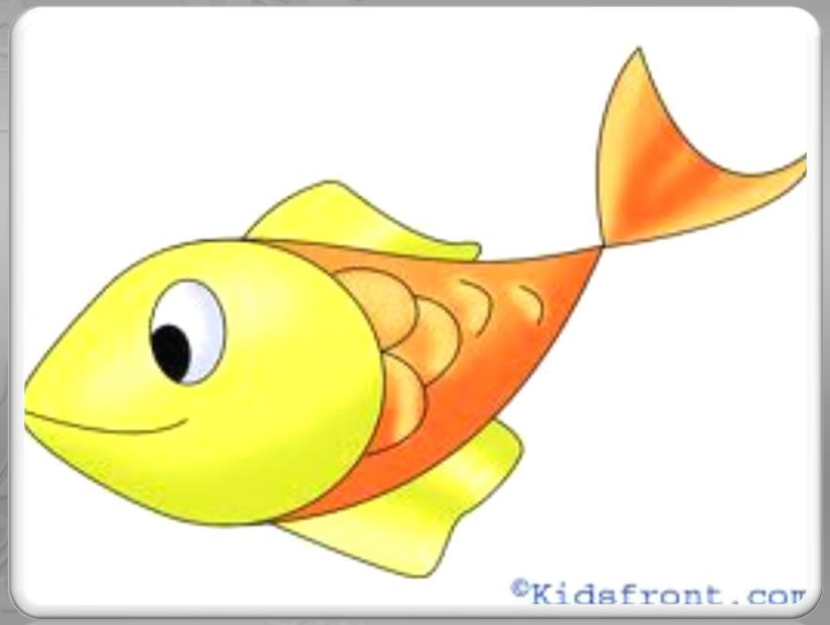
D. galeata



D. hyalina

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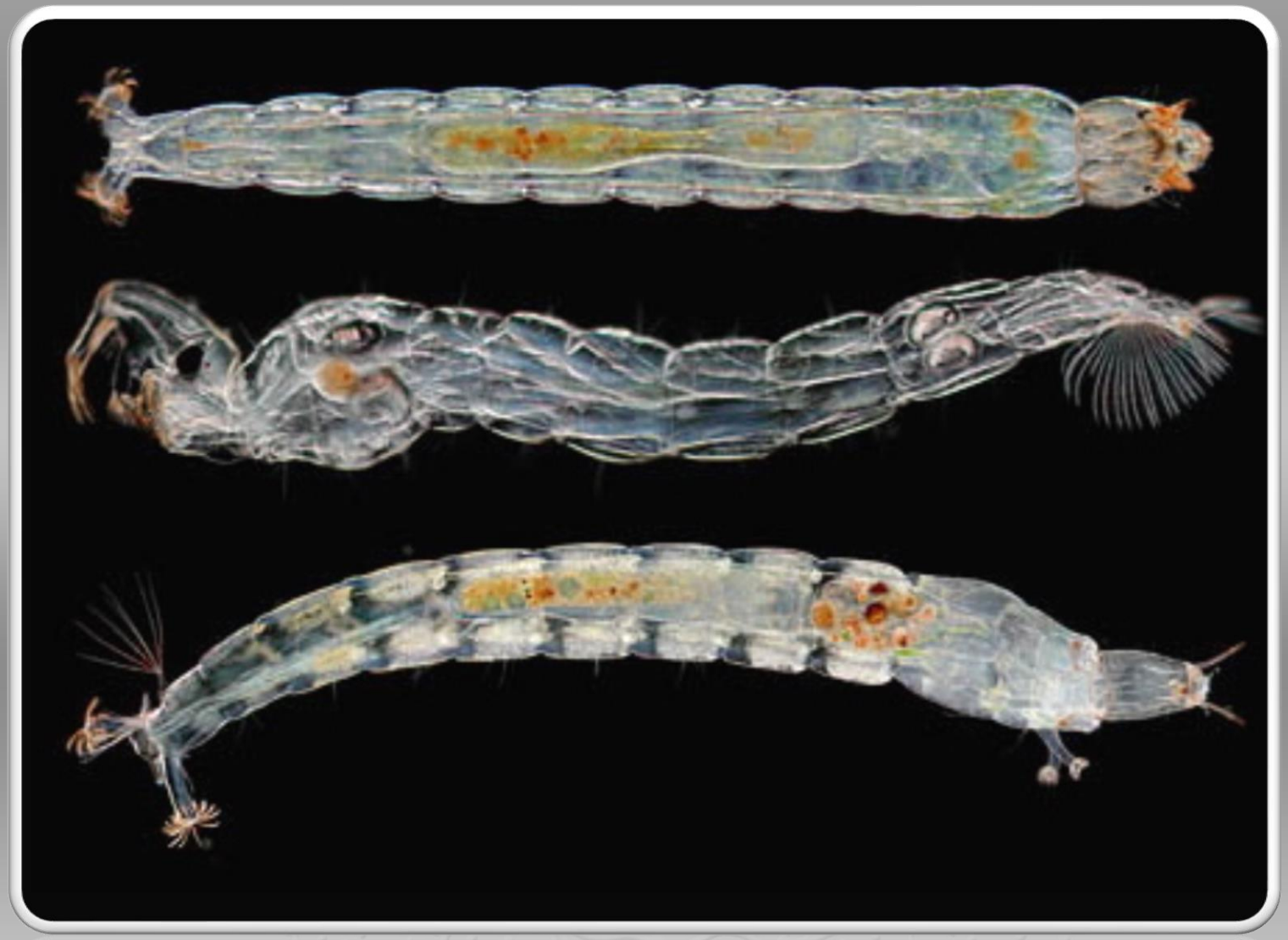

Larvae of the Chaoborus (Phantom midge)

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Daphnia behavior ☺

http://www.youtube.com/watch?v=RCbwaWxb-54&feature=related

Daily vertical migration

Horizontal migration

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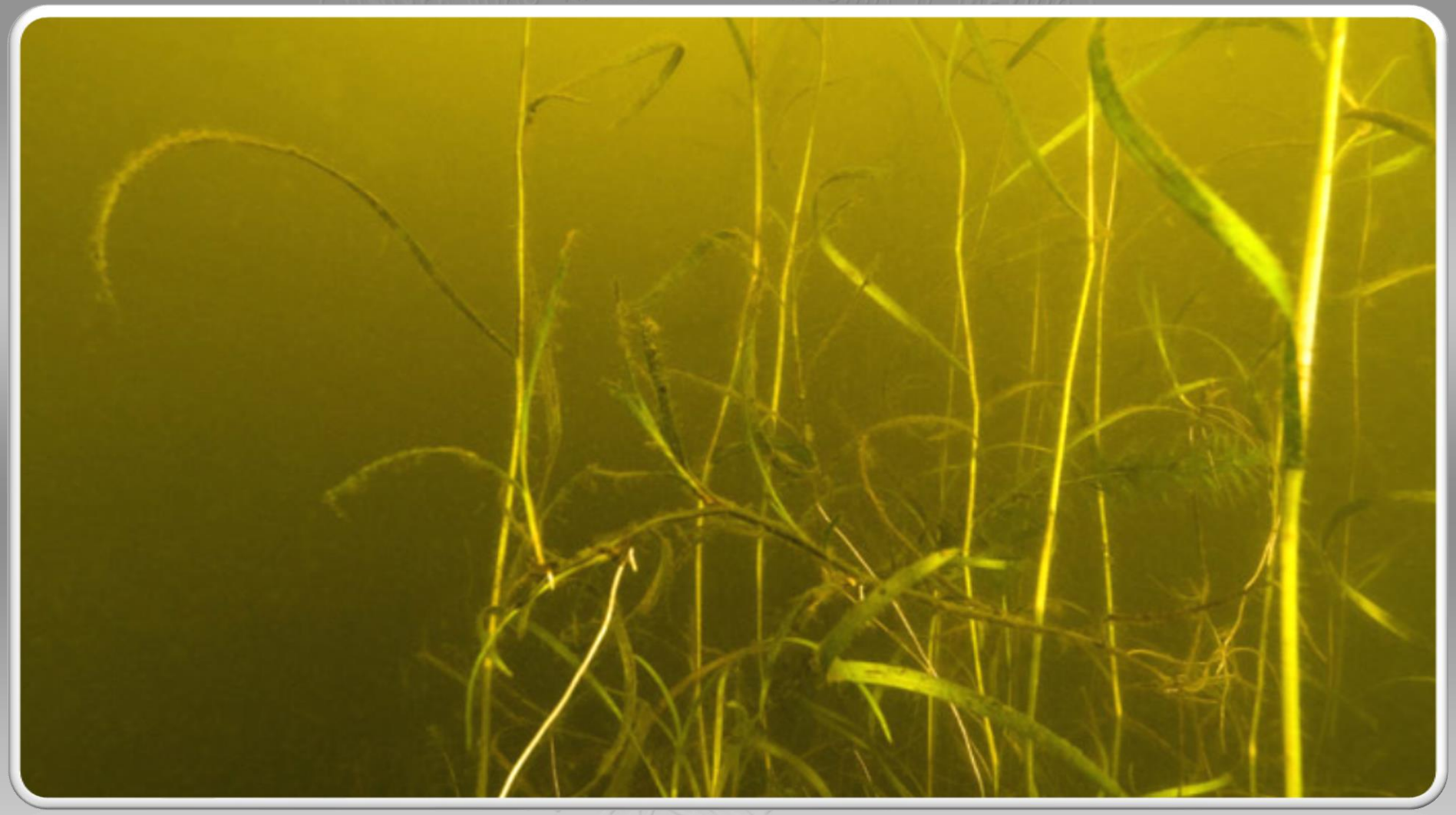
Habitat ecology of Cladocera



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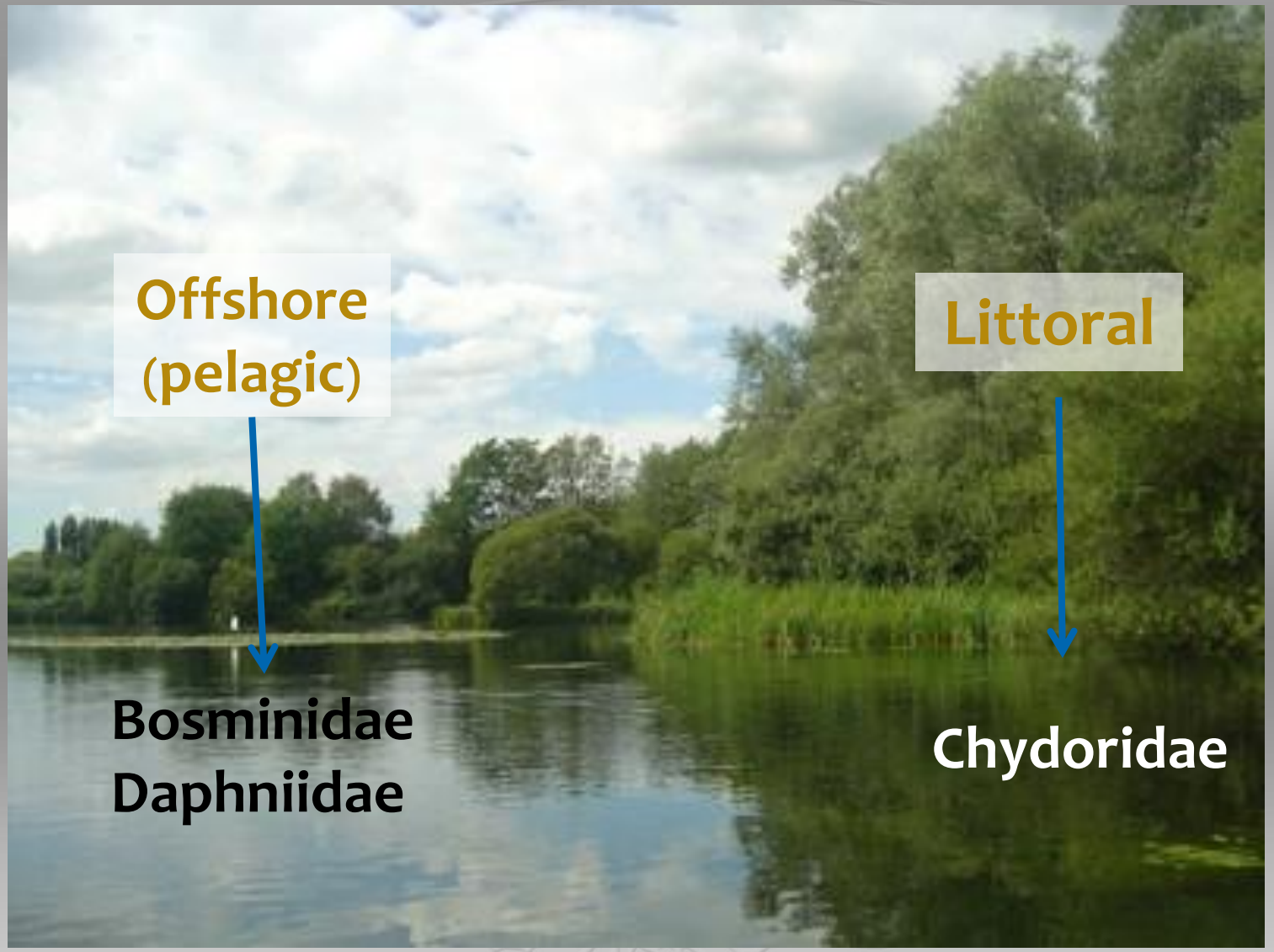

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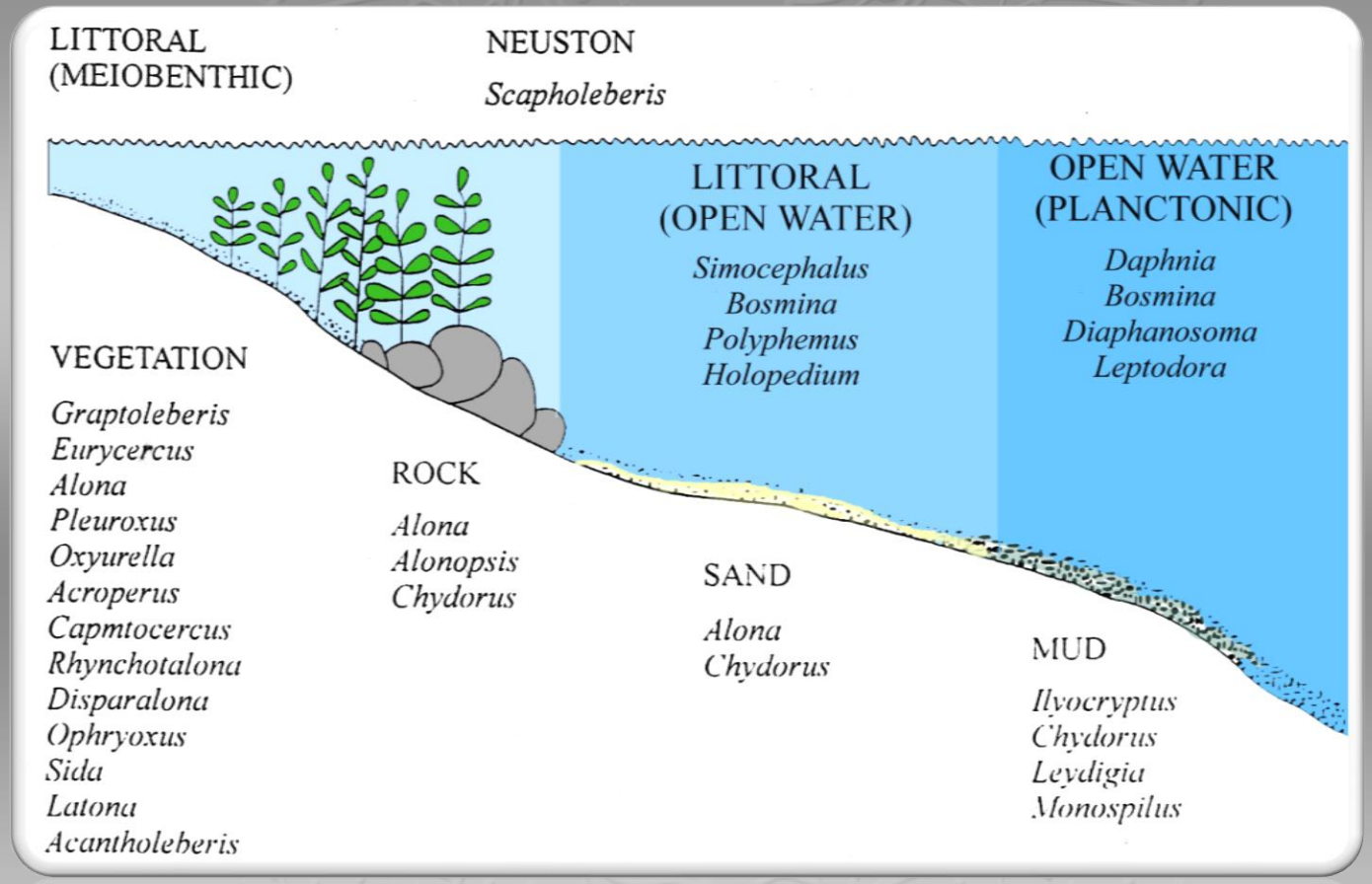
The major ecological niches of Cladocera



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❖ Many Cladocera are adopted to a wide range temperature changes (seasonally) but their growing and reproduction is slower in the cold water

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Altitude by direct way (dispersal and colonization abilities) **and by indirect way** (by temperature and vegetation) **is the main factor controlling Cladocera species composition.**

However

There are only few true cold stenothermal species

Eurycercus glacialis

Ophryoxus gracillis

Chydorus piger

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- ✓ **Temperature 15-20 C – maximizes parthenogentic reproduction**
- ✓ **Population can be multiply many times in just few days under favorable temperature.**
- ✓ **Only produce one generation per season under marginal temperature or not reproduce at all if temperature is to low**

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Ceriodaphnia quadrangularis

needs temperature

over 8 C to reproduce

in boreal region

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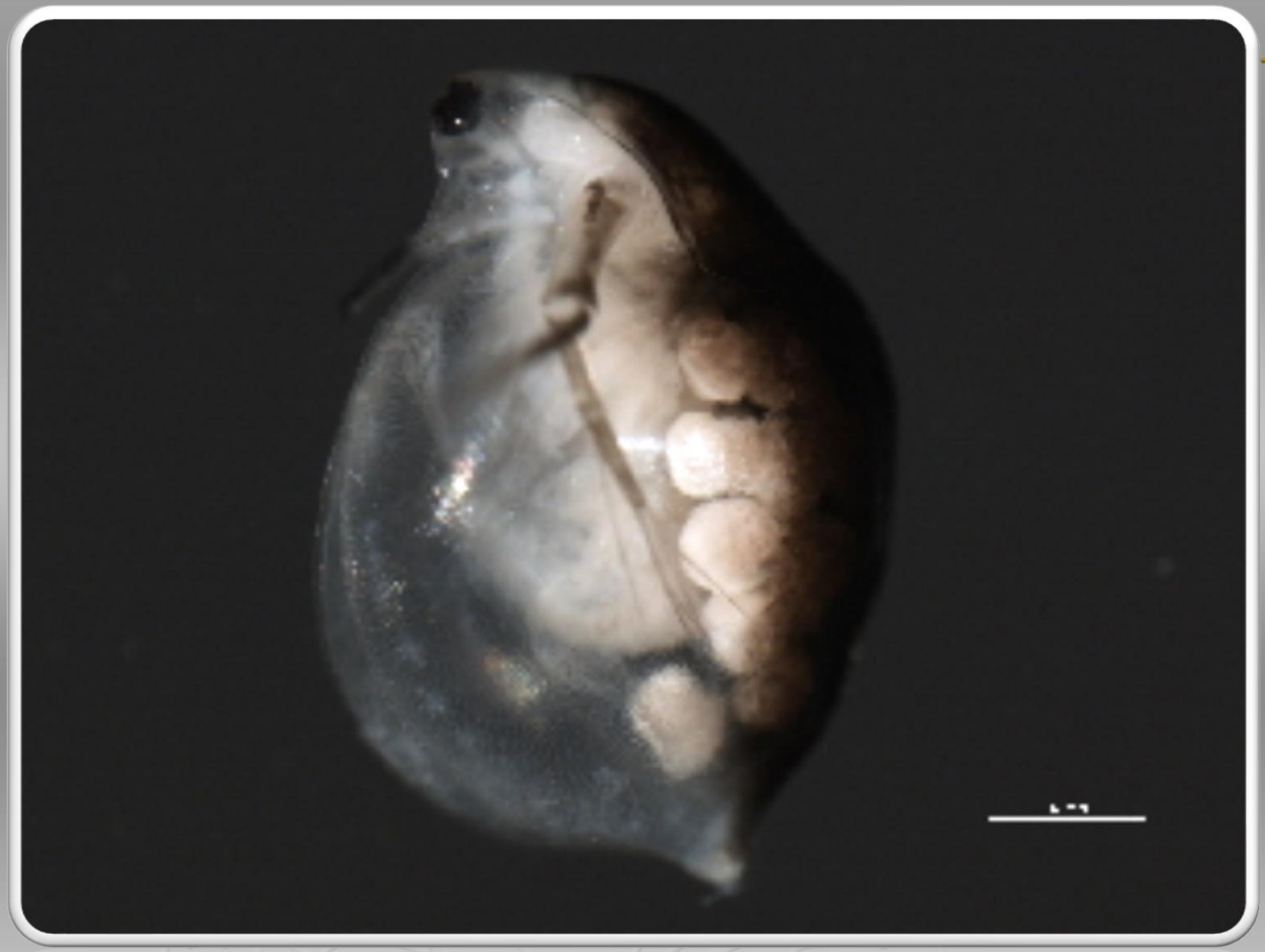
Daphnia middendorffiana



Max. temperature is 15 C

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Daphnia umbra

cold mountain and

tundra lakes

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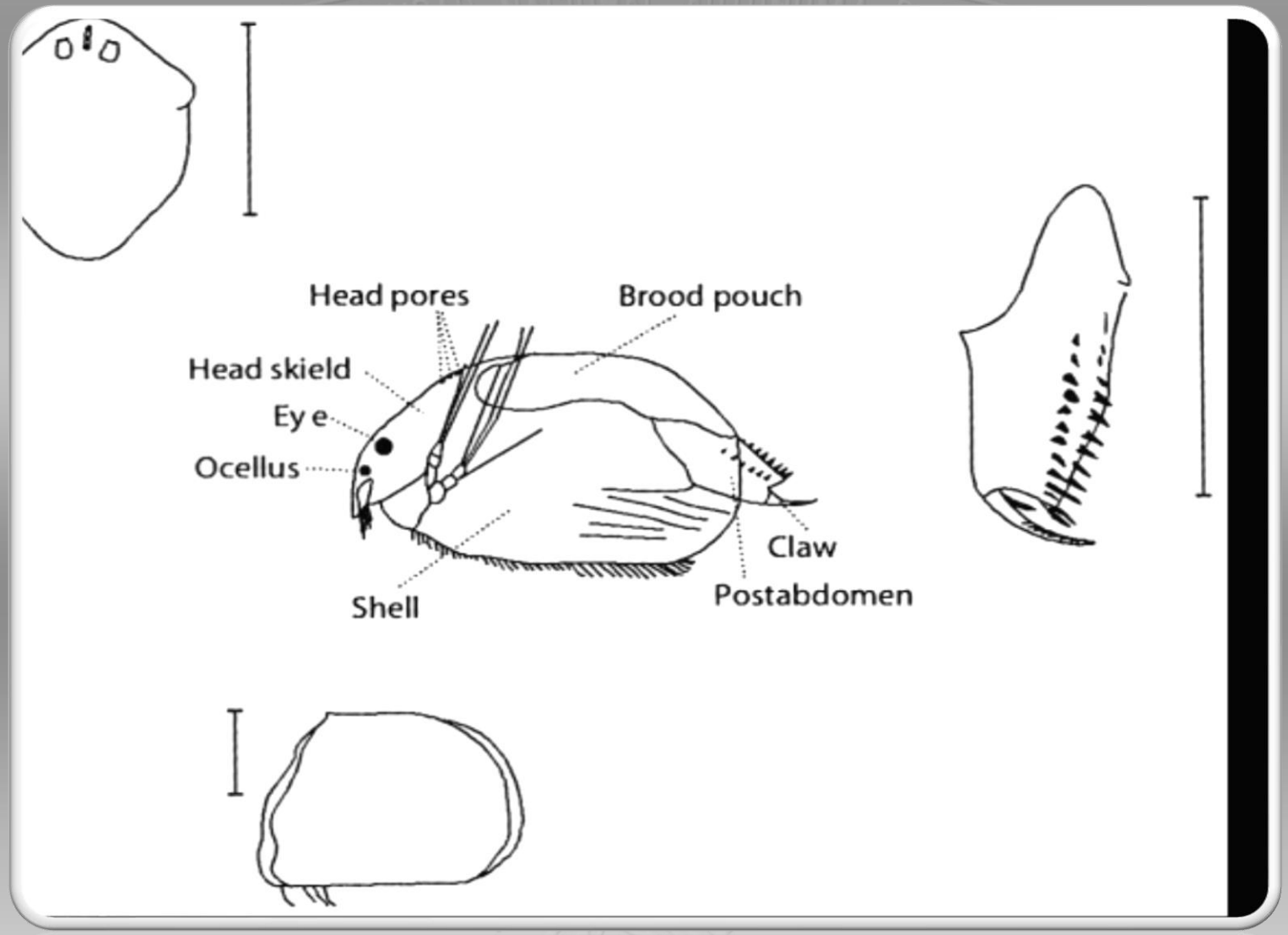

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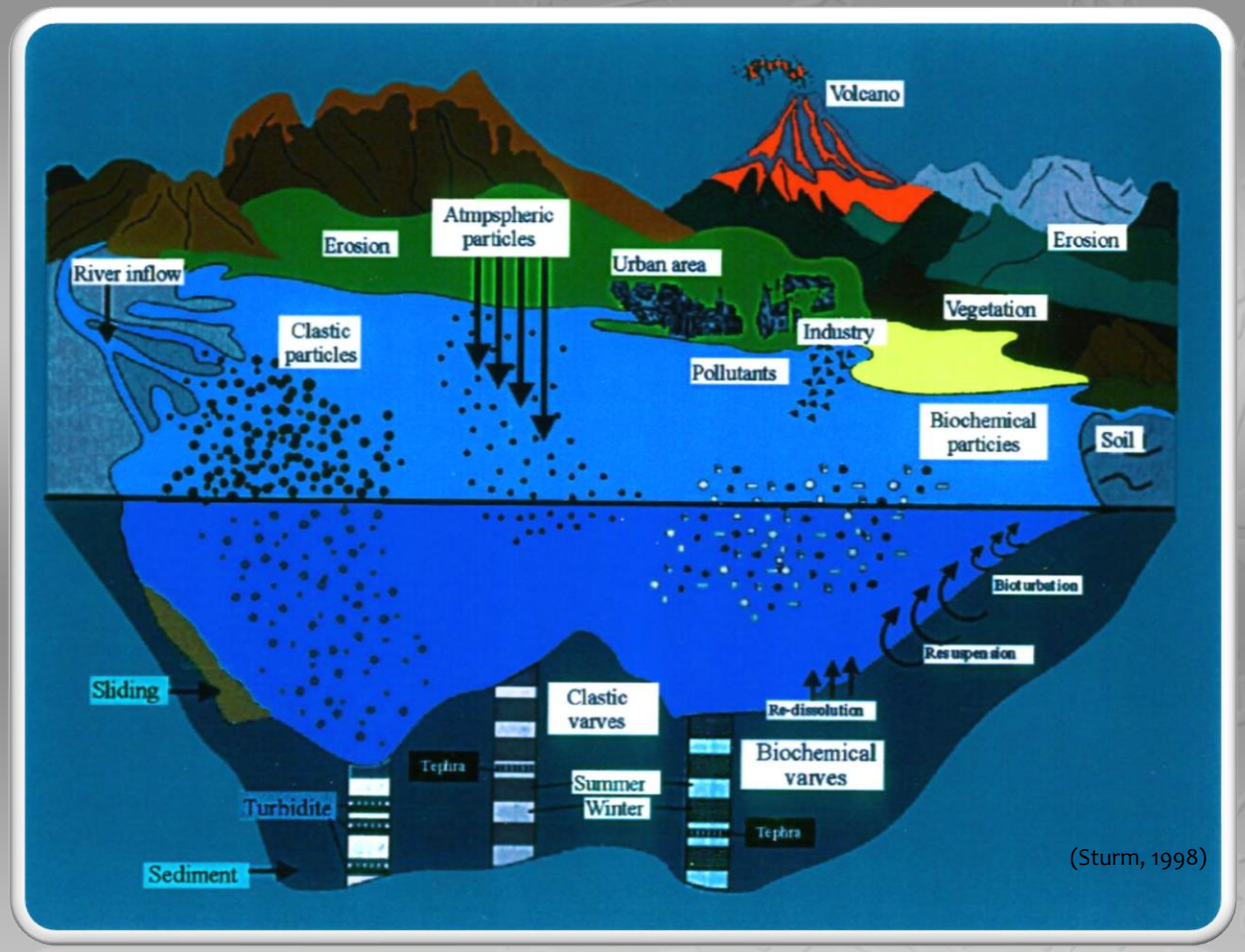
Lake is natural archive of the past



(Sturm, 1998)

Past environmental changes are recorded in the deposits of lakes and ponds

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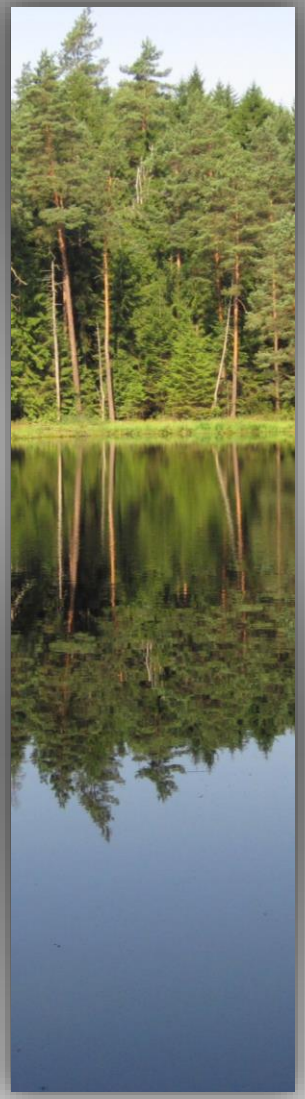

LAKE SEDIMENTS REPRESENT NATURAL ENVIRONMENTAL ARCHIVE

Information about past environmental condition is provided by:

- lithology
- chemical composition
- plants fragments
- animals remains

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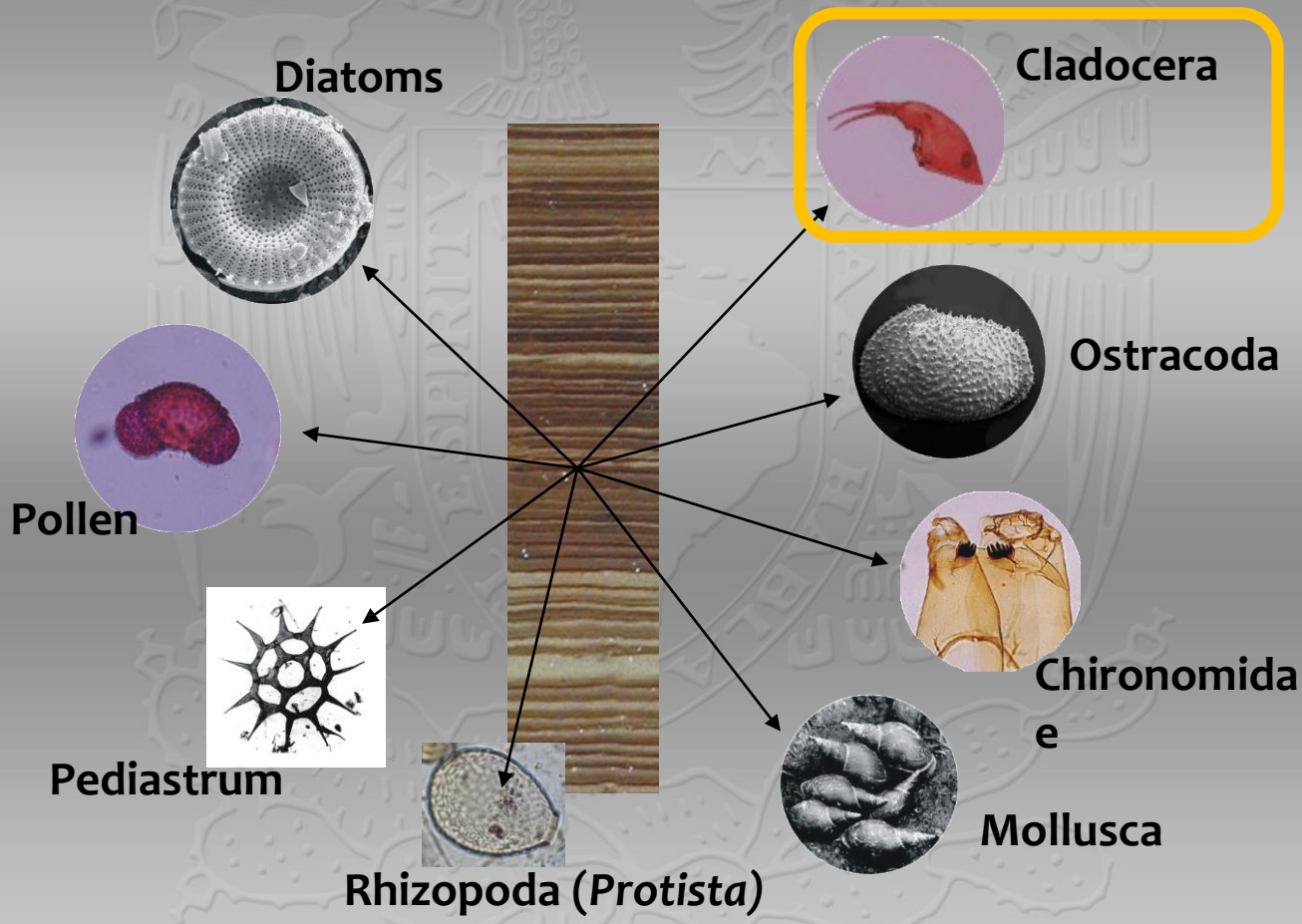
Paleolimnology, analysis of remains deposited in freshwater sediments



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CLADOCERA – water fleas

- Subphylum CRUSTACEA, order CLADOCERA
- Body size 0.3 to 18 mm
- Cladocera mostly freshwater zooplankton
- Generally around world there are 450 species
- In Europe live c.a. 100 species
- In the lake Cladocera lives both in littoral and open wate zones
- Filter feeders
- Breeding: parthenogenesis and sexual reproduction

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WHY CLADOCERA?

- Cladocera remains are common in lacustrine sediments
- It is possible to identify remains to species or even subspecies level
- Requirements of Cladocera to the environment have not changed during the several thousands year
- Among Cladocera there are bioindicatior species
- They are sensitive to environmental changes

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We can use subfossil Cladocera analysis to reconstruct:

- Trophy status
- Changes of water level
- climatostratygraphy
- pH
- Salinity
- Climate changes
- Human impact

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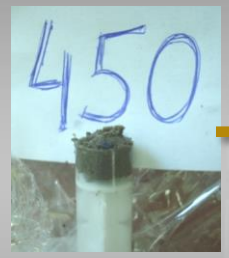
Materials and Methods



Sieve
40 µm

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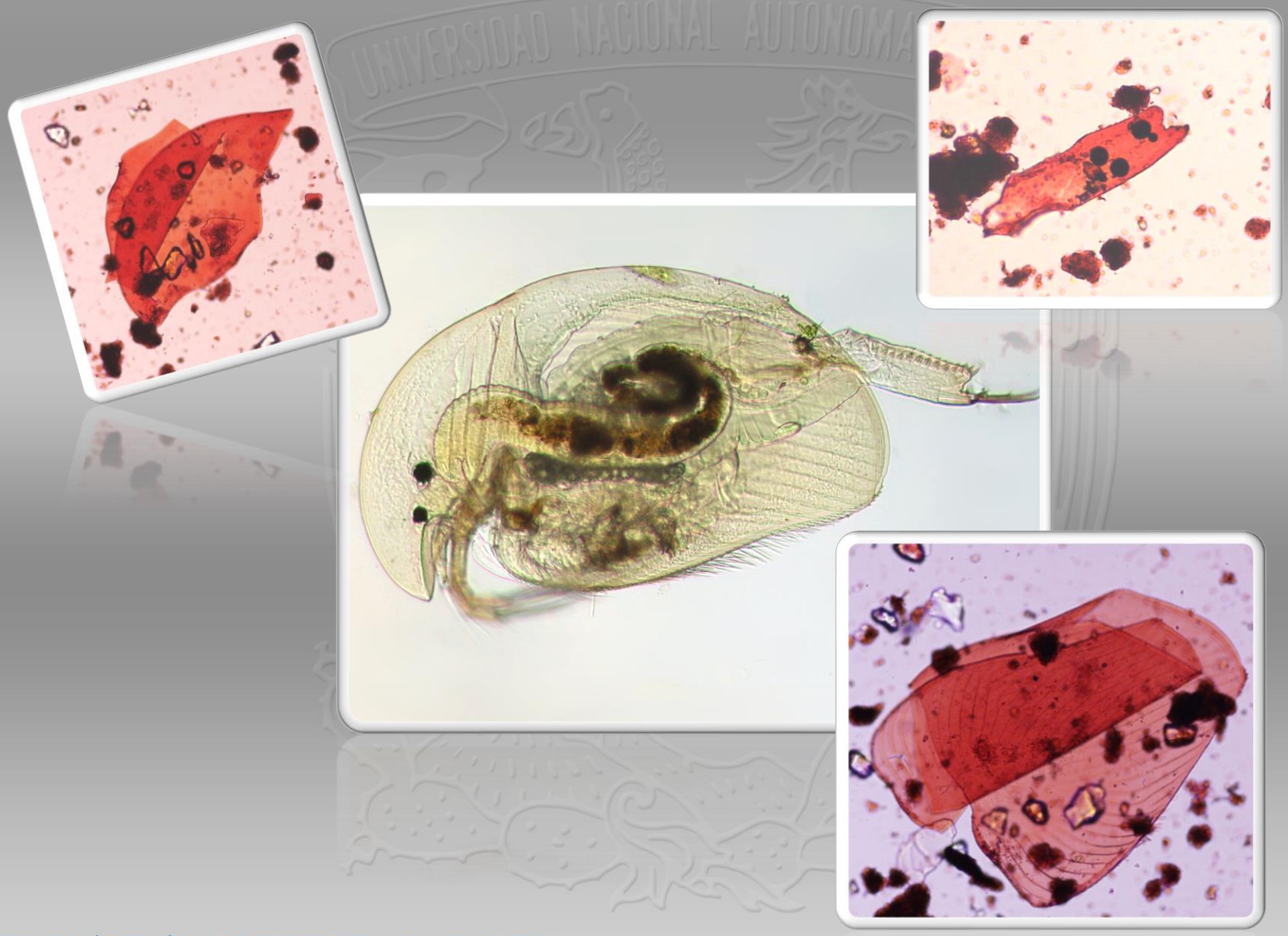

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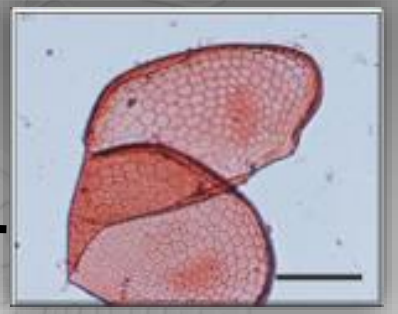
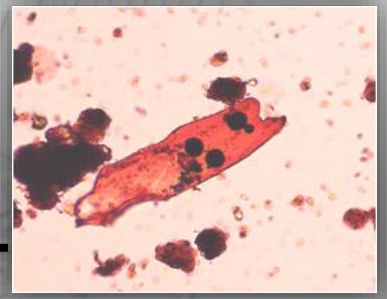
Cladocera remains in lake sediments

headshield



shell

postabdominal claws



postabdomen

ephippium

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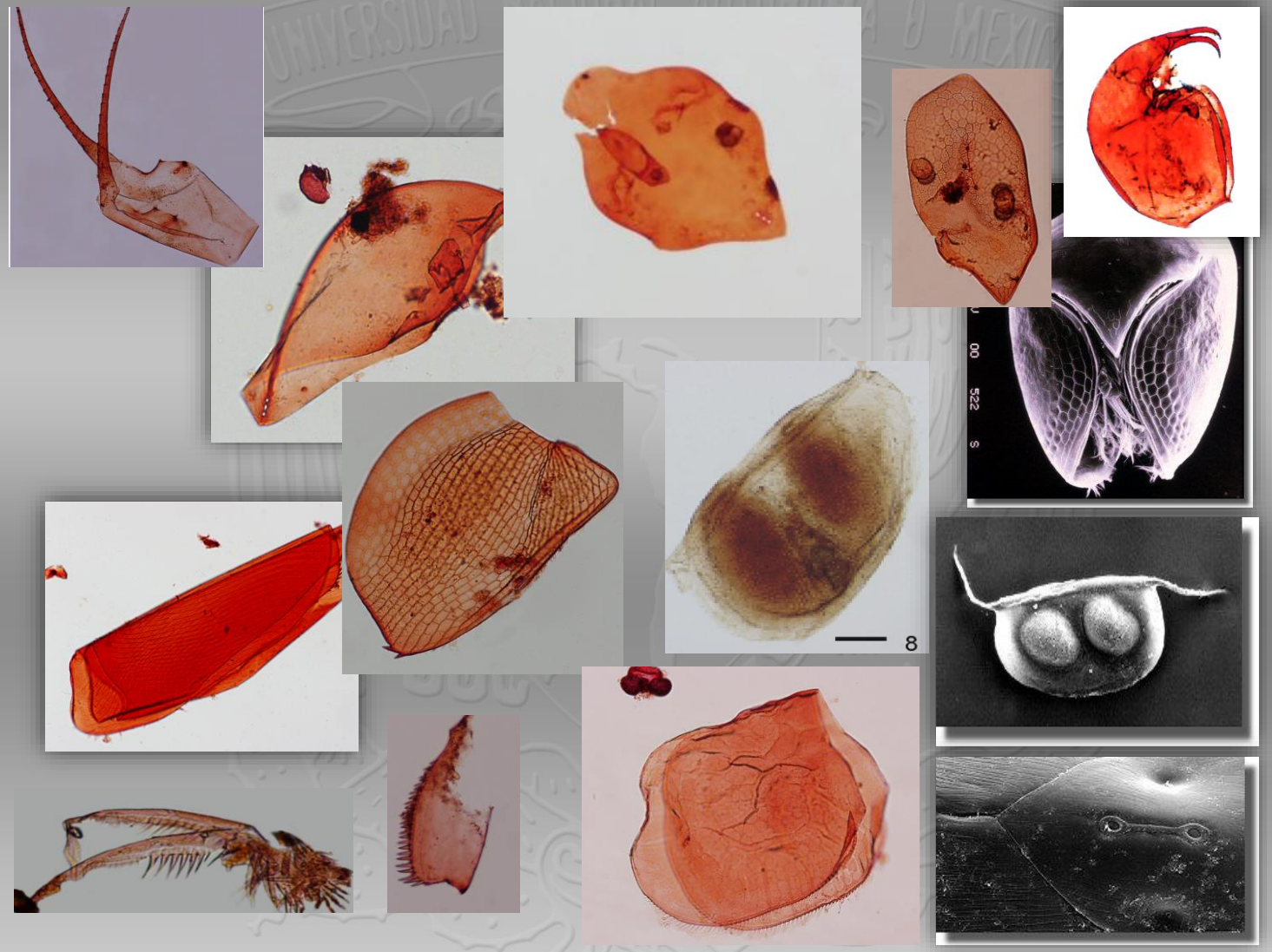

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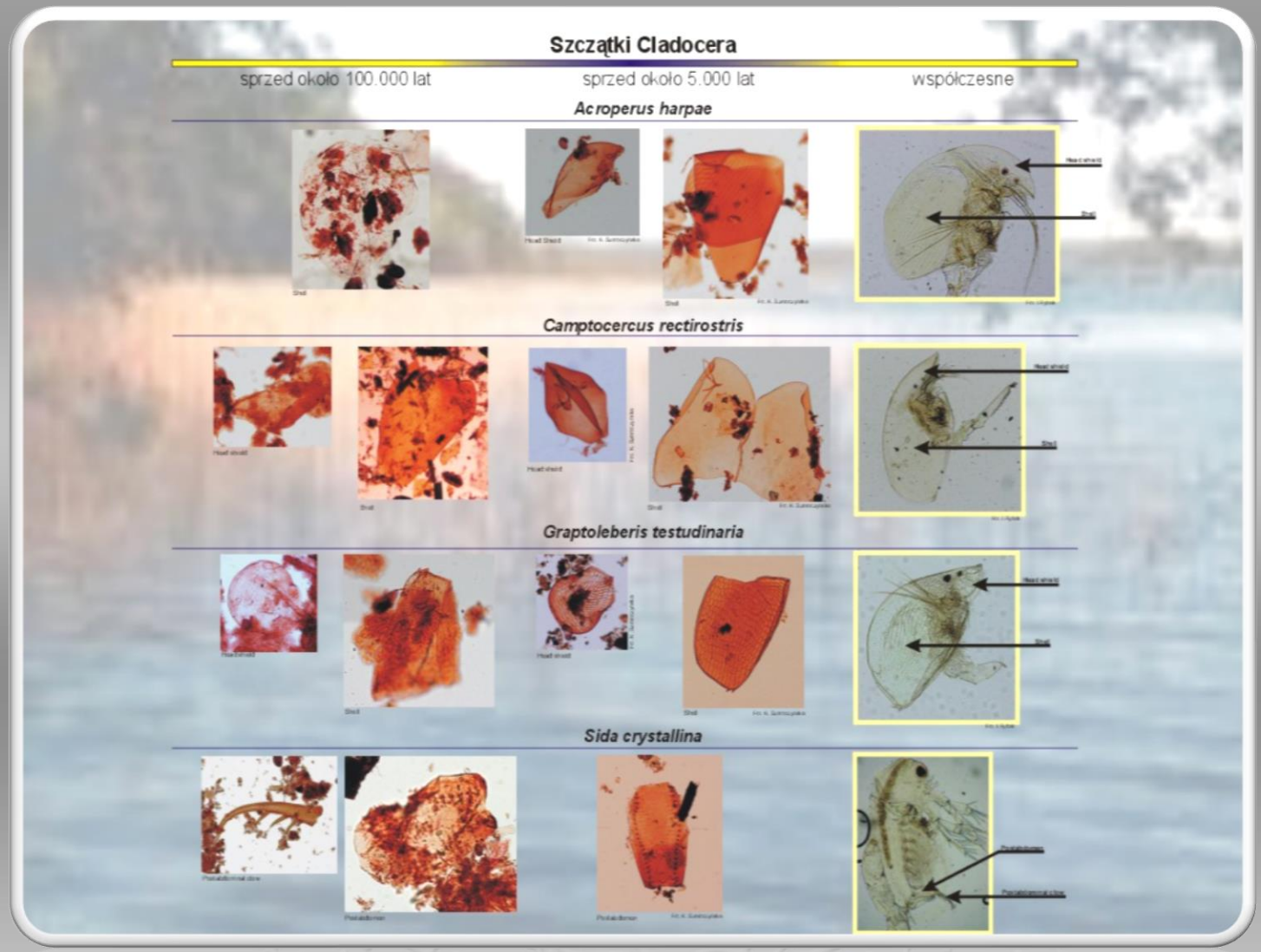
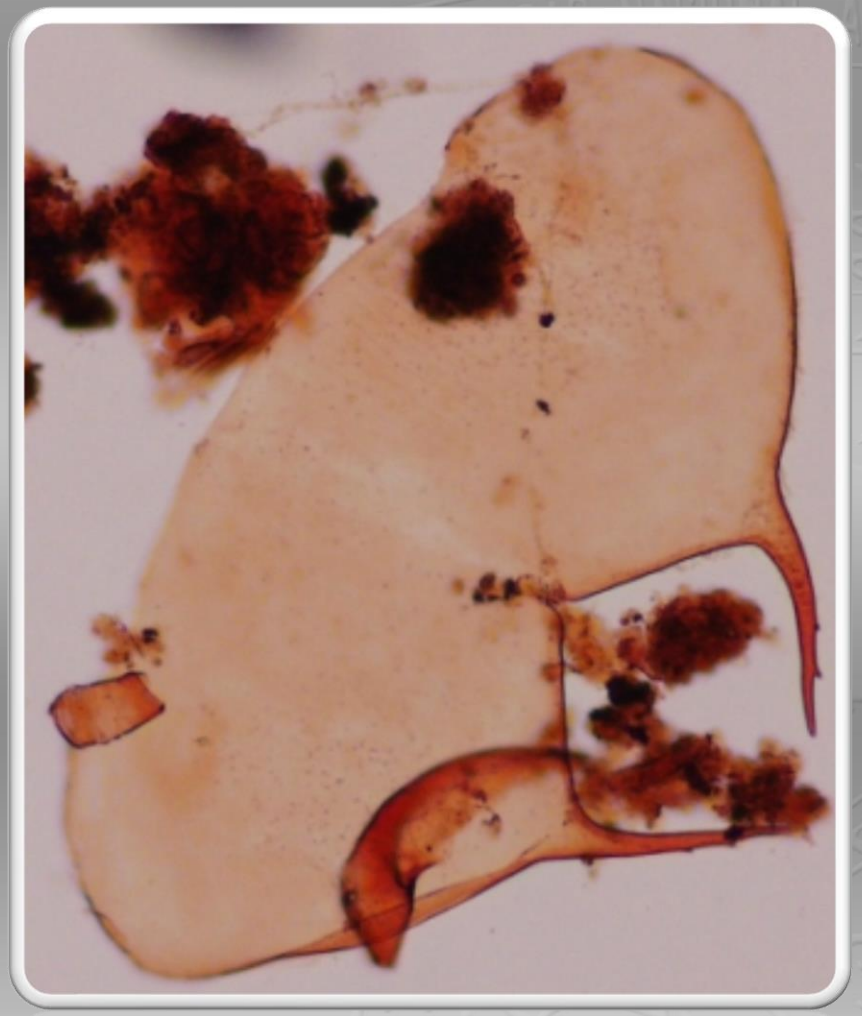
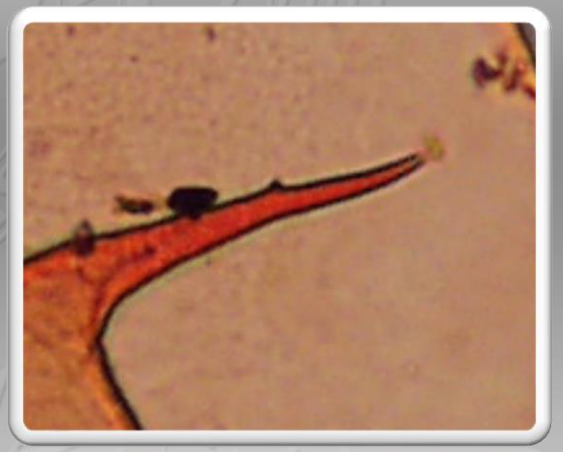


PAPITT IV 100215

Diseño: Felipe Herrera Lozano
Servicio Social: 2019-12/62-680



Bosmina longispina shell



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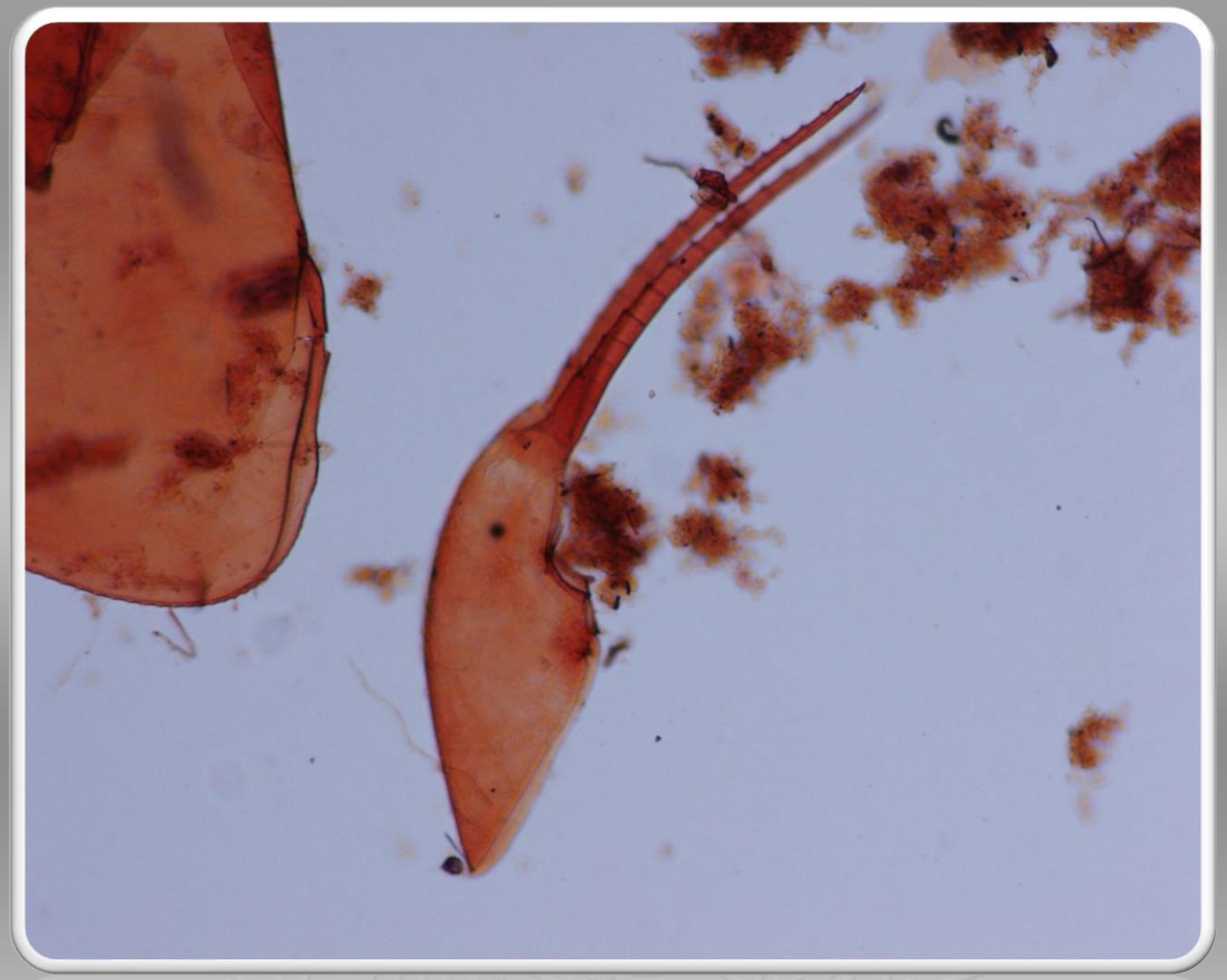

Bosmina coregoni headshield

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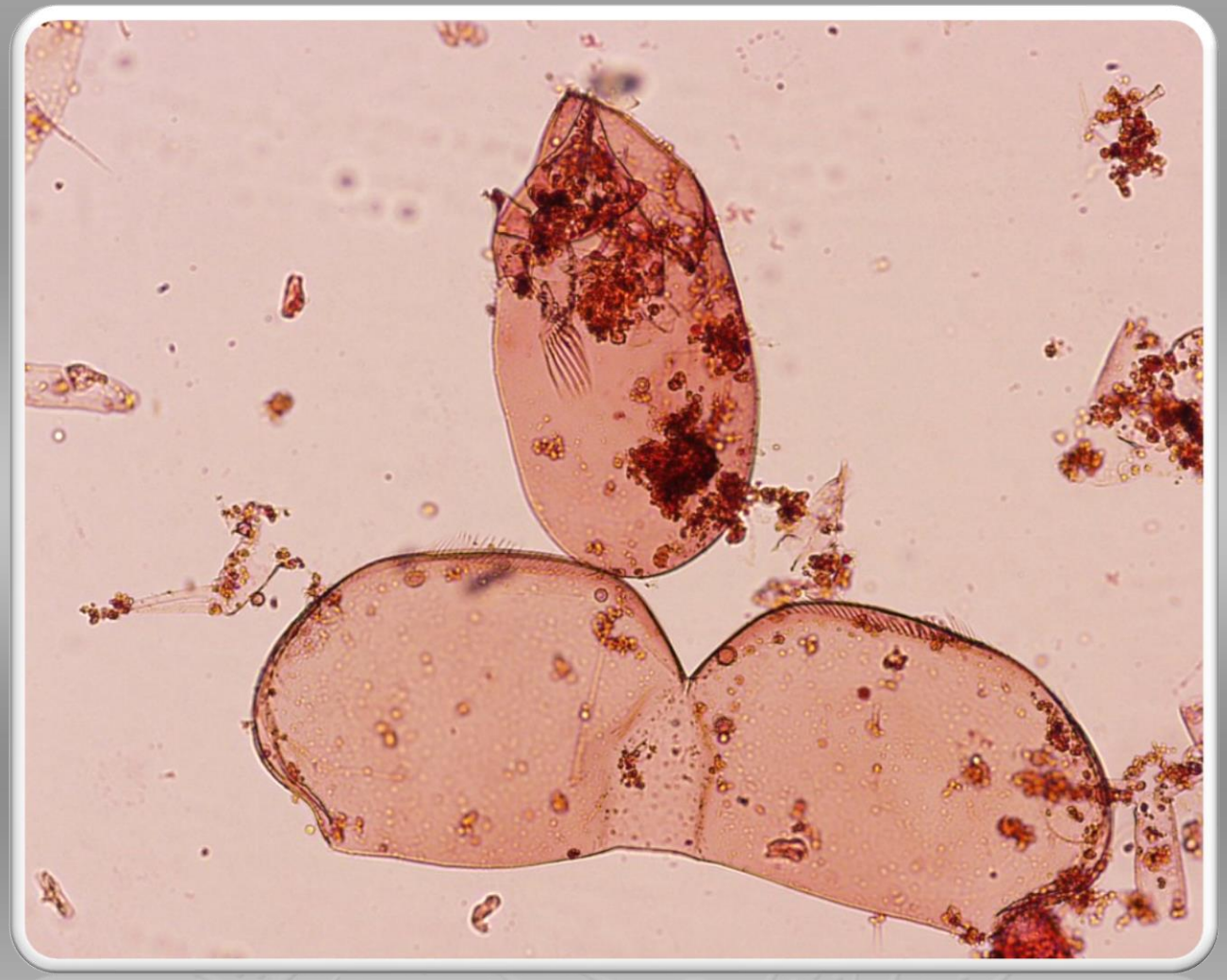

Chydorus sphaericus
headshield and shell

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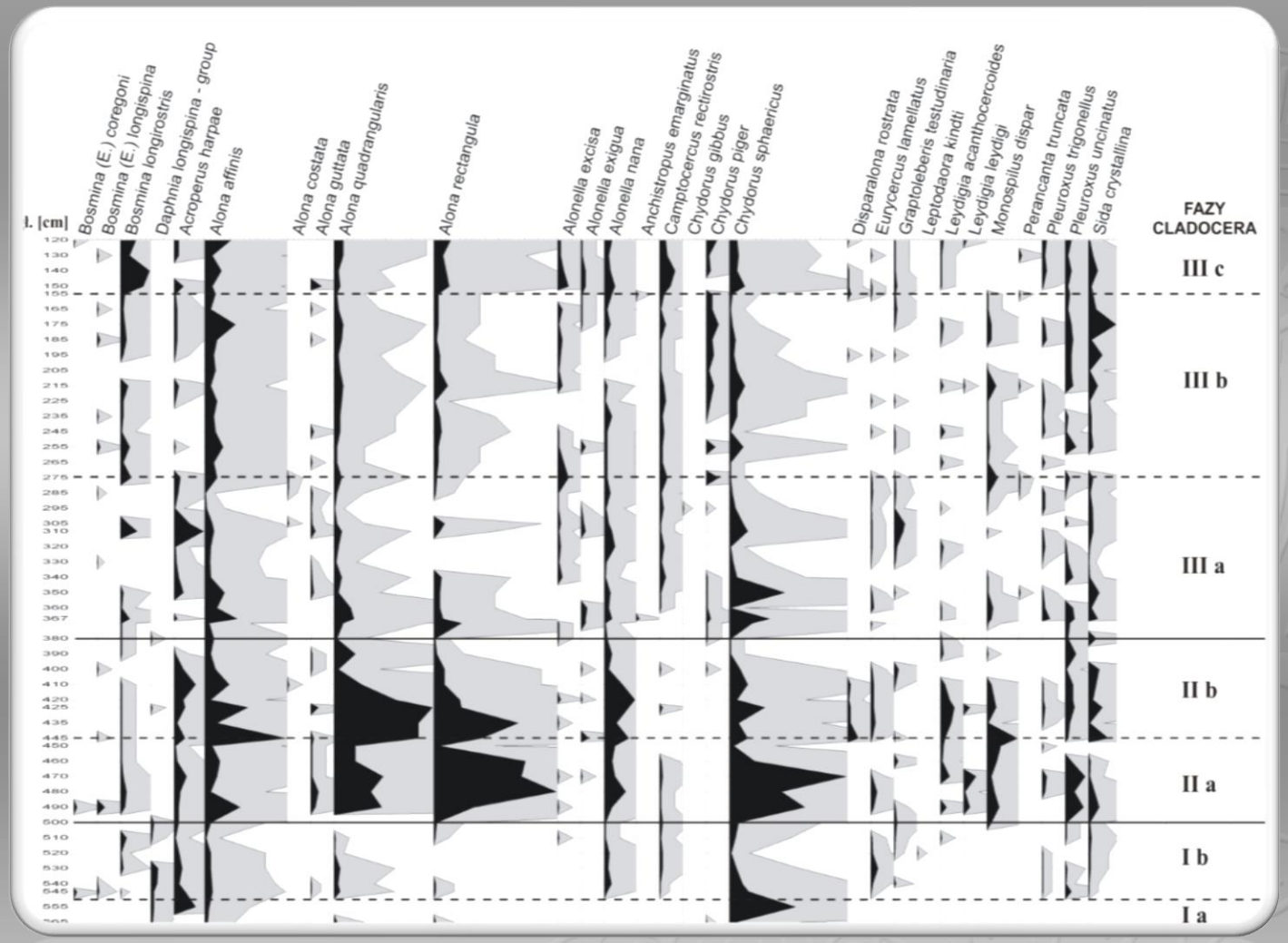

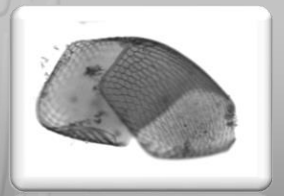

Absolute Cladocera diagram

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