TROPHIC AND PARASITIC RELATIONSHIPS BETWEEN FISHES AND OTHER AQUATIC SPECIES IN THE SELENGA DELTA OF LAKE BAIKAL

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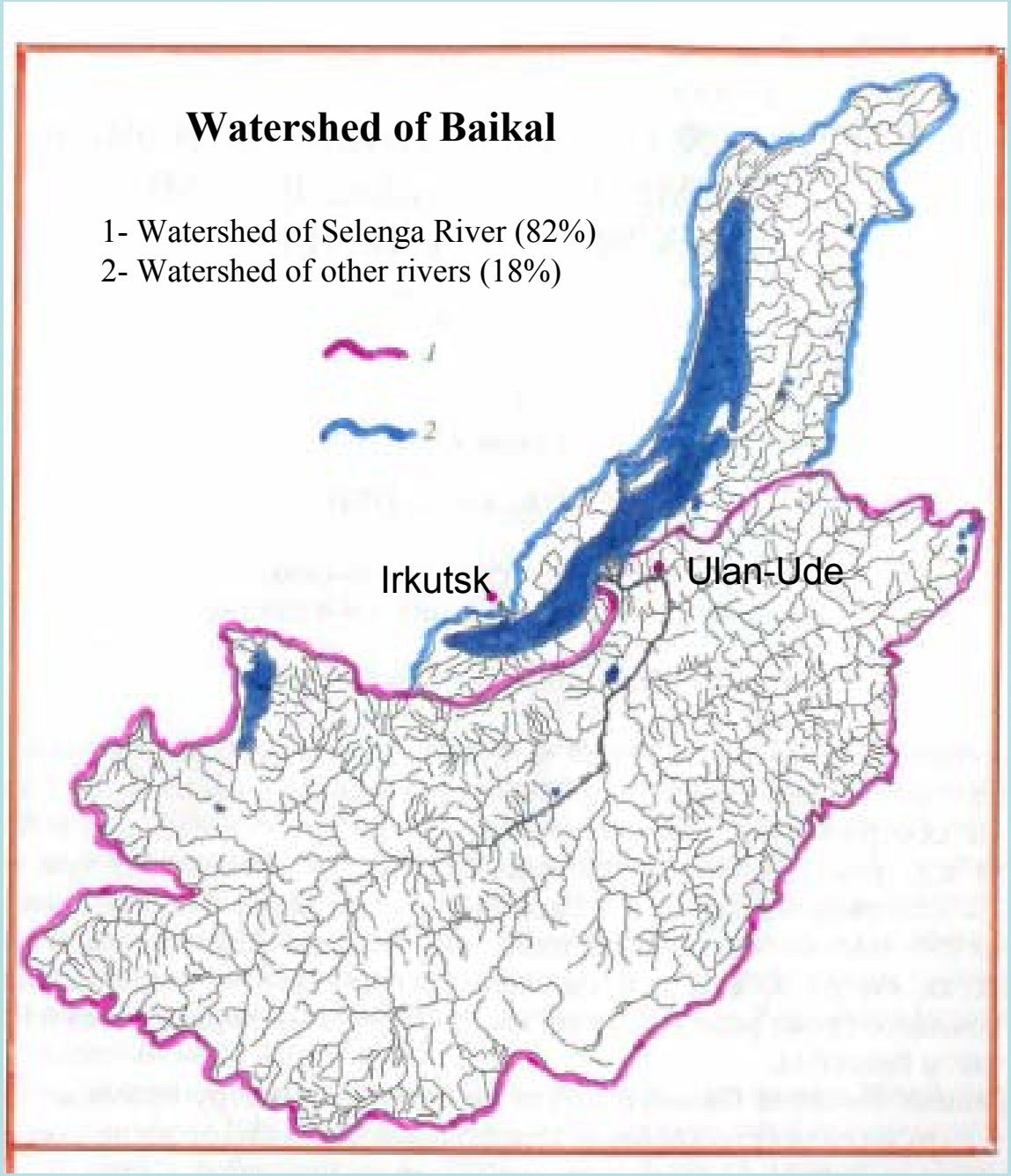
The watershed of the Selenga River, the main inflow of Lake Baikal occupies a surface area of 447,000 km^2; 82% of the Lake Baikal watershed

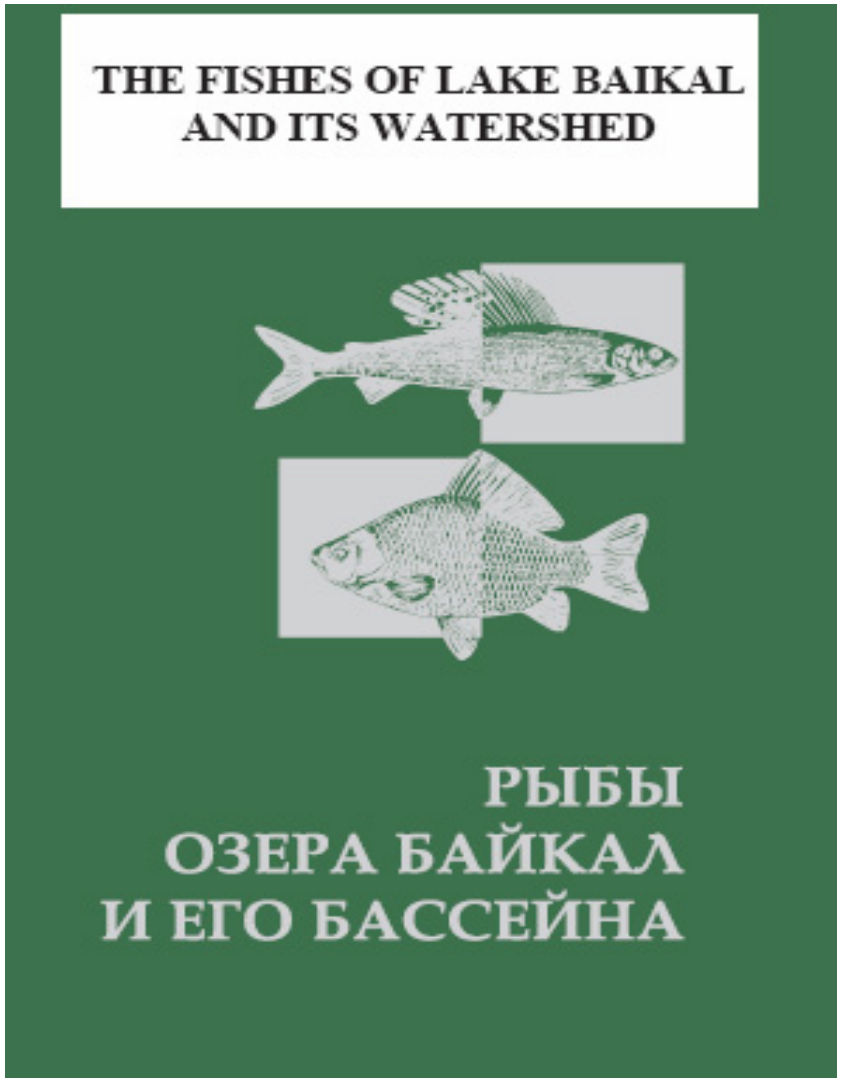


This report presents some excerpts from the authors' two books, currently in the process of being printed:

- N.M. Pronin, A.N. Matveev, V.P. Samusenok et al. Fishes of Lake Baikal and its Watershed. - Ulan-Ude, 2007 (in press, December)

- L.M. Sorokovikova, N.M. Pronin, Z.V. Khazeeva et al. Delta of the Selenga River as a Biofilter and Indicator of the State of Lake Baikal. – Novosibirsk, 2008 (in press, March)

The cover and abstract of the book “Fishes of Lake Baikal and its watershed



Fishes of the Lake Baikal and its Basin / N. M. Pronin, A. N. Matveev, V. P. Samusenok et al. – Ulan-Ude: Publishing Buryat Scientific Center, Siberian Branch of Russian Academy of Science. 2007. – 284 p. ISBN 978–5–7925–0216–1

This book gives a brief review of the categorization and sub-categorization of the fish of Lake Baikal and its watershed. Here we provide an Ichtyological classification scheme. In a special chapter the authors give a brief evaluation of the fish habitat of different sub-basins (Lakes Baikal, Gusinoe, Kotokel, Irkana, Ivano-Arakhleiskoe and other lakes in the region). Some chapters and paragraphs give brief characteristics of: common diseases and types of parasites affecting the fish populations, the situation regarding rare species or species which are considered to be near extinction, the efficacy of the fish-preserves, the naturalization of non-native species, the process of biological invasions, and the ecological consequences of invasive species.

This book will be useful to ichthyologists, hydro-biologists and people care about nature, for example, specialists in environmental science and people working in institutions that work to protect natural resources. It can be used as an aid to teaching manuals in special courses in: ichthyology, studies of Lake Baikal, Ecology and protection of the environment for the students in faculties of bio-geography and ecology in different institutions of higher education of the Baikal-Siberian region (Ulan-Ude, Irkutsk, Chita) and other regions. It can be also useful to professors in biology and geography in different specialized institutions of higher education and schools of the region.

This publication is supported by the Agency of the republic for the Natural Resources and the Protection of the Environment within the program «Baikal Day» and «Baikal» Ed ucational-Scientific Center of Irkytsk State University

The delta of the Selenga River occupies a surface area of 1120 km^2 has the shape of a fan (600 km^2)

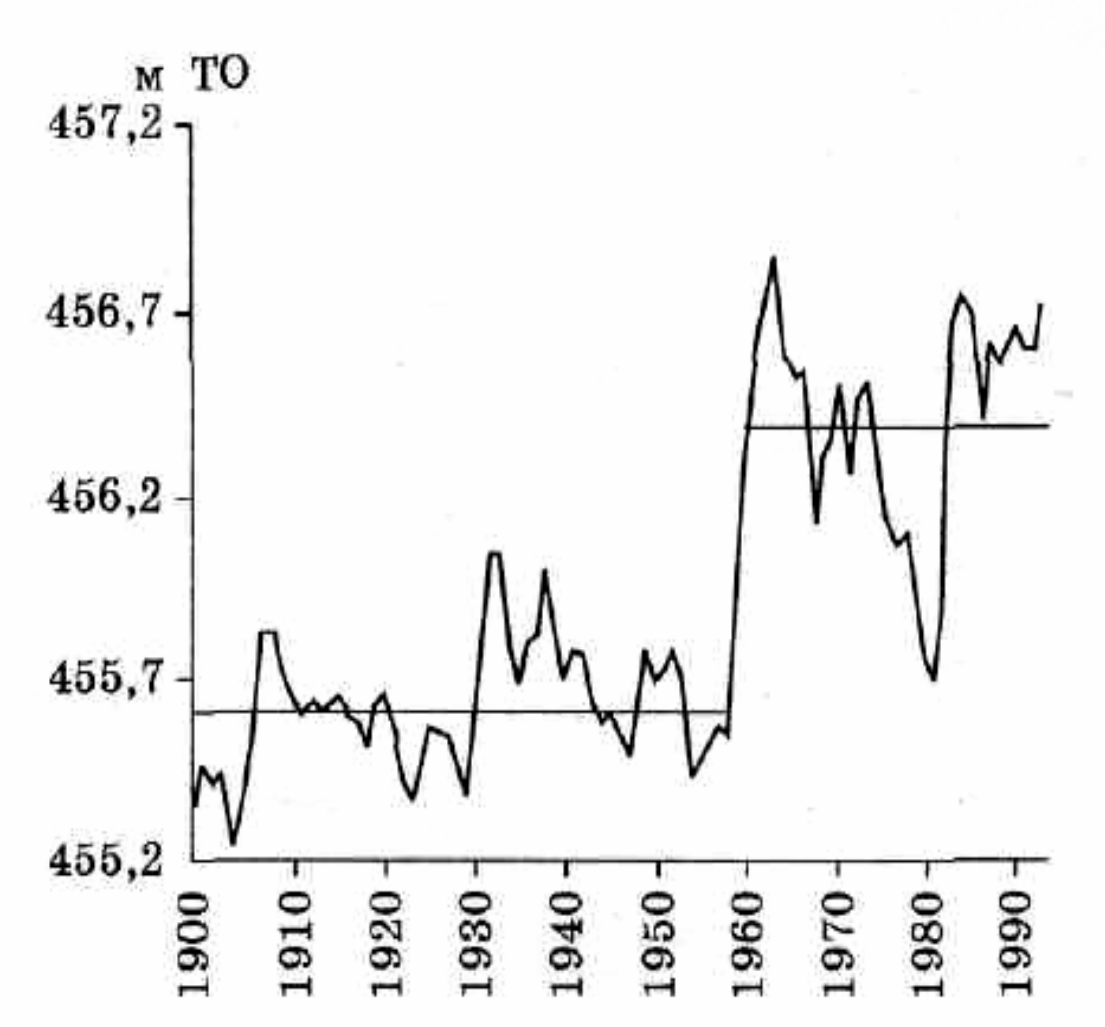
Space image (left) and map (right)

- In the second half of the 20-th century there were two factors that had the most important effect on the state of the Lake Baikal ecosystem and its biota:

- the alteration of the flow regime of the Angara River by the dam in Irkutsk city (the Angara is the only outflow from Lake Baikal)

- the introduction of non-indigenous aquatic species

Average water level in Lake Baikal before (1899-1958) and after (1959-1994) the construction of the dam on the Angara River in Irkutsk

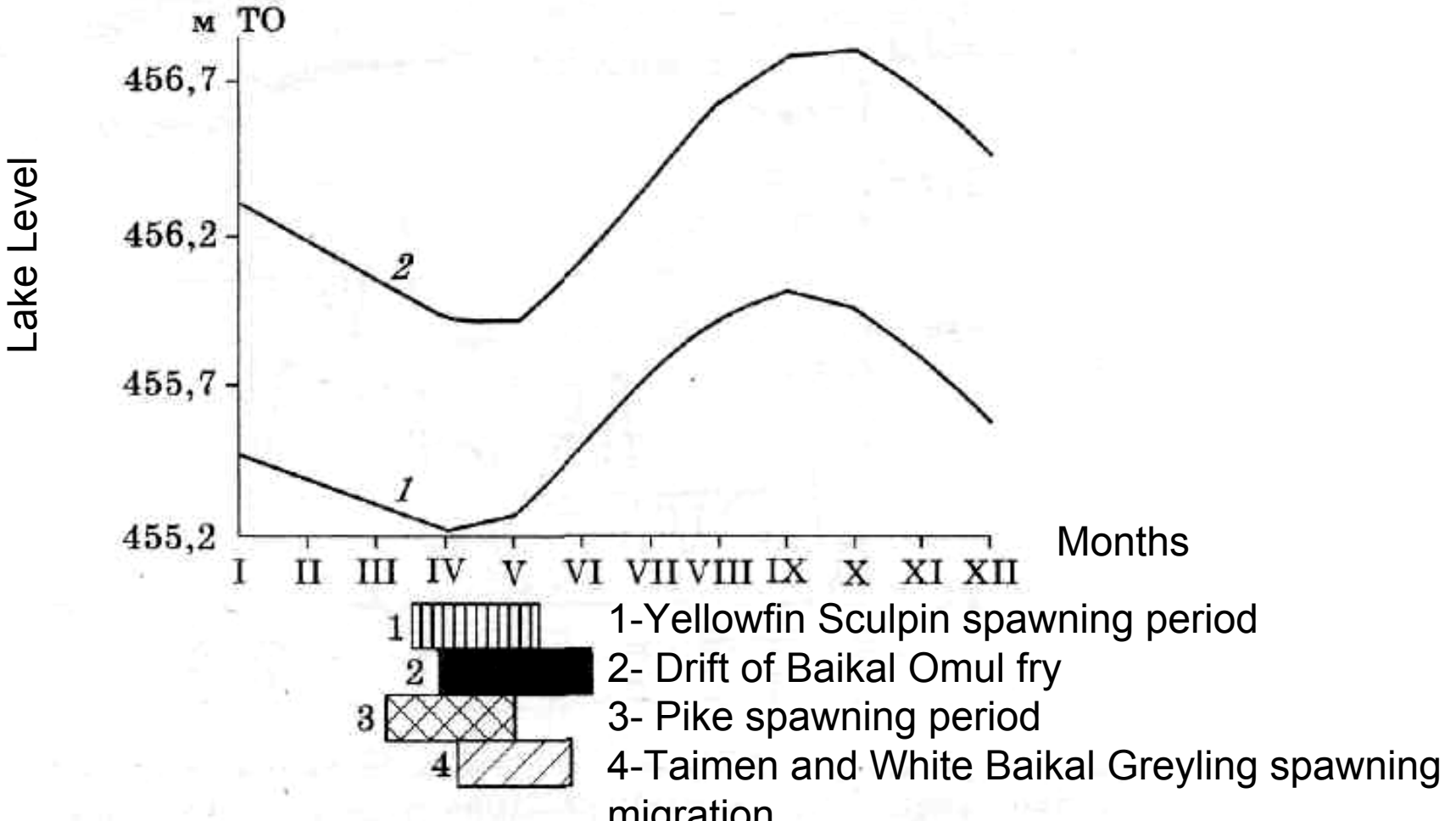


During 50 years after construction of the dam, components of ecosystems has been adapted to new conditions.

Seasonal average of the water level in Lake Baikal before (1) and after (2) the regulation of the flow of the Angara River

Minimal and maximal levels after regulation are shifted forward for 1 month.

The “critical periods” of the annual physiological cycles of certain species of fish are shown below (1–4).



1-Yellowfin Sculpin spawning period

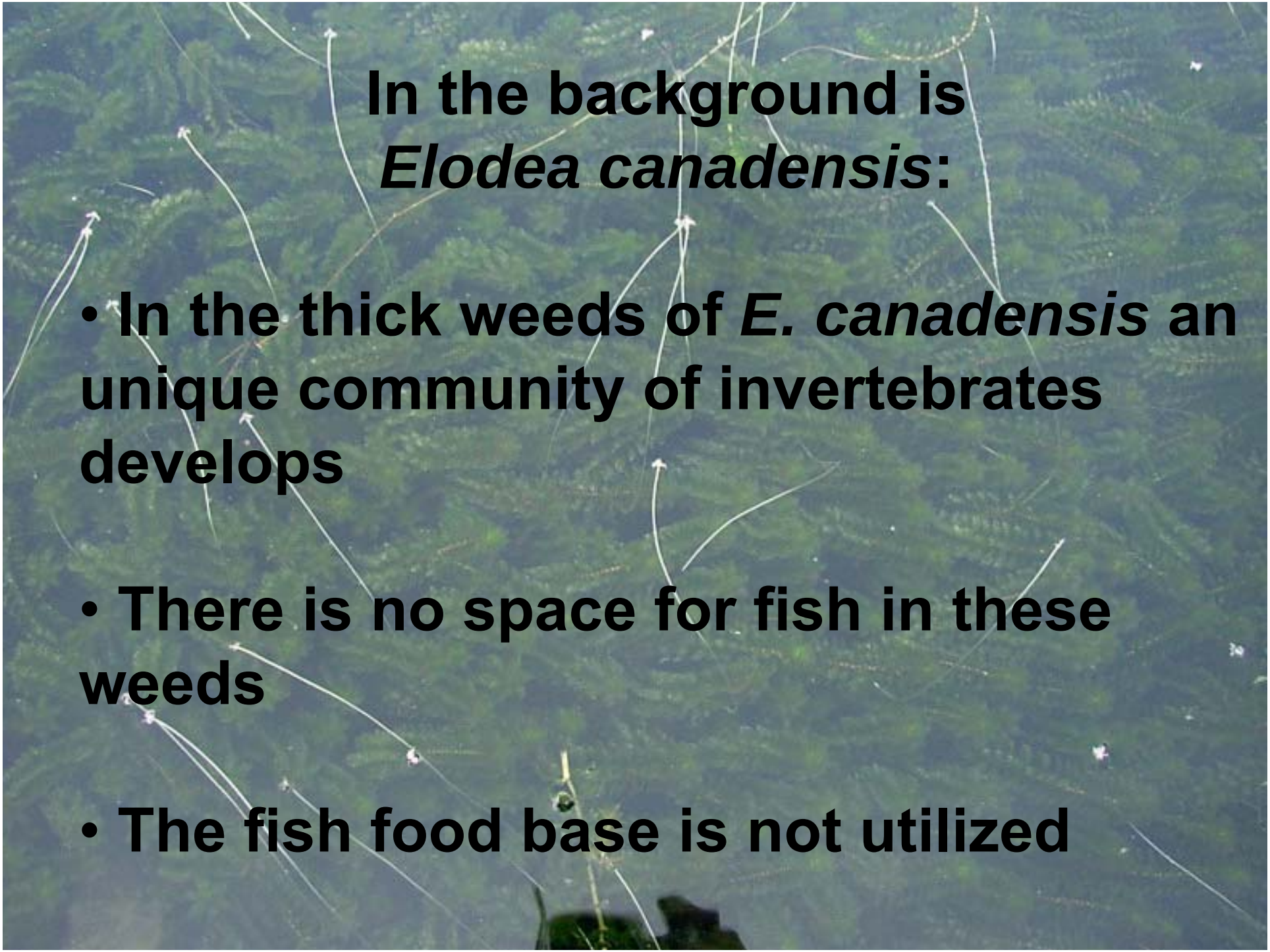
2- Drift of Baikal Omul fry

3- Pike spawning period

4-Taimen and White Baikal Greyling spawning migration

The introduction of non-indigenous aquatic species:

In a period covering 30 years the invasive macrophyte *Elodea canadensis* has taken over a specific ecological “niche” in the near shore littoral zone of Lake Baikal (which is the most productive zone of the lake)



In the background is *Elodea canadensis*:

- In the thick weeds of *E. canadensis* an unique community of invertebrates develops
- There is no space for fish in these weeds
- The fish food base is not utilized

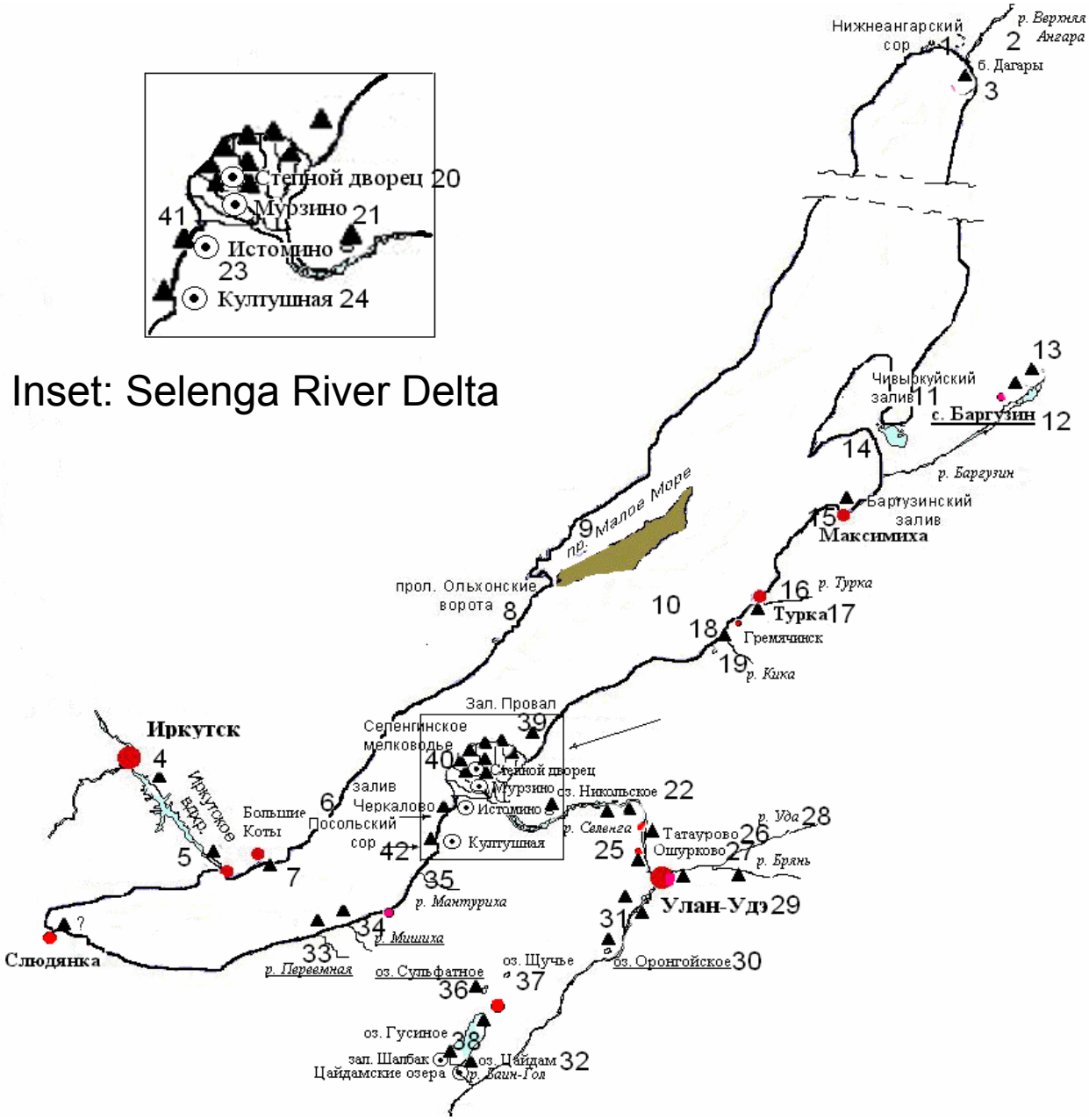
The introduction of non-indigenous aquatic species:

Invader from Amur River – the Amur Sleeper

Percottus glenii

(Perciformes: Odontobutidae)

The results of 20 years of observations on the distribution of the Amur sleeper *Percottus glenii* in the Lake Baikal basin indicate that this species colonized all the water bodies that have characteristics similar to those in its natural area. Mainly these are floodplain water bodies with sluggish water inflow and shallow waters near river mouths in the coastal zone of Lake Baikal. In the first stage of expansion of the sleeper into the Lake Baikal basin the principal direction of its expansion was downstream of the Selenga River and further in the bay zone of Lake Baikal, to the south and to the north of the Selenga Delta. At present its distribution is also recorded upstream in the tributaries of the Selenga River. Colonization by the sleeper of highly mineralized lakes indicates both to its high adaptive potential and its genetic predisposition to a high range of salinity gradients.



Inset: Selenga River Delta

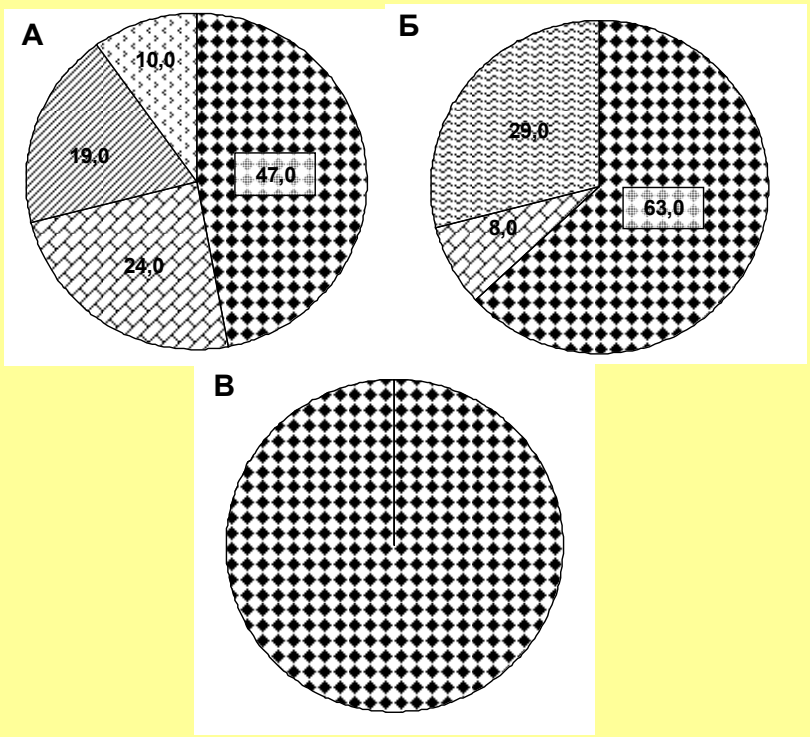
A schematic map of the distribution of the Amur Sleeper (*Percottus glenii*) in the Baikal Natural Territory.

- Triangles designate the areas inhabited by the Sleeper
- Red Circles are human population centers

The Amur Sleeper negatively exerted on the ecosystem of Selenga Delta as a consumer of food supply, fryes and young fishes.

The Amur Sleeper has become an important food source for the Spotted Pike in the Selenga River Delta

Stomach Contents (by percent mass) of Pike in the Delta of the Selenga River: Amur sleeper is very important component of the Pike's ration – 47 to 100 % in different seasons.



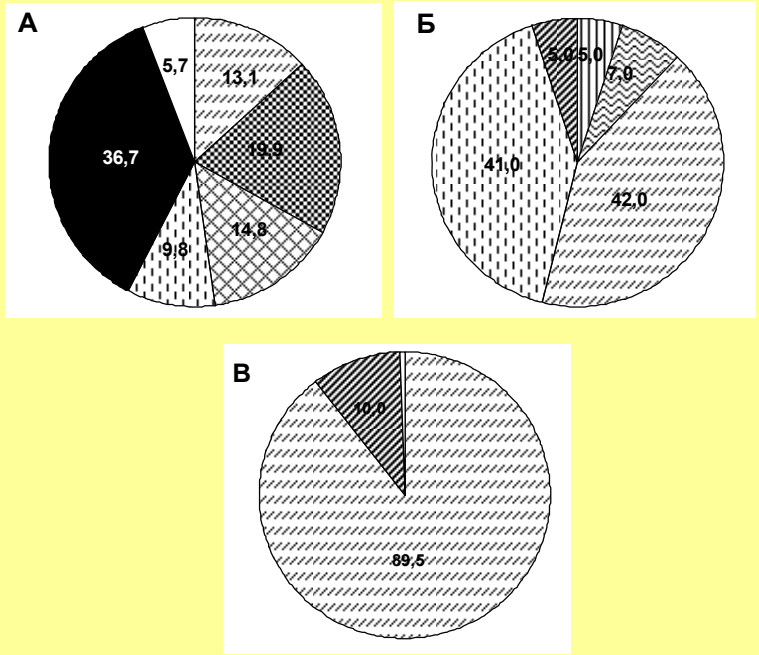
А. September to October 1998
Б. May to June 1999
В. September to October 1999

Of 56 species of fishes in Lake Baikal, in the ichtyofauna of the Delta it has been established that there are 13 widely common species, 2 Baikal neoendemic, and 4 invasive species. In the Selenga shallow water the ichtyofauna is enriched to the account of generation-littoral and trophic-pelagic sculpins.

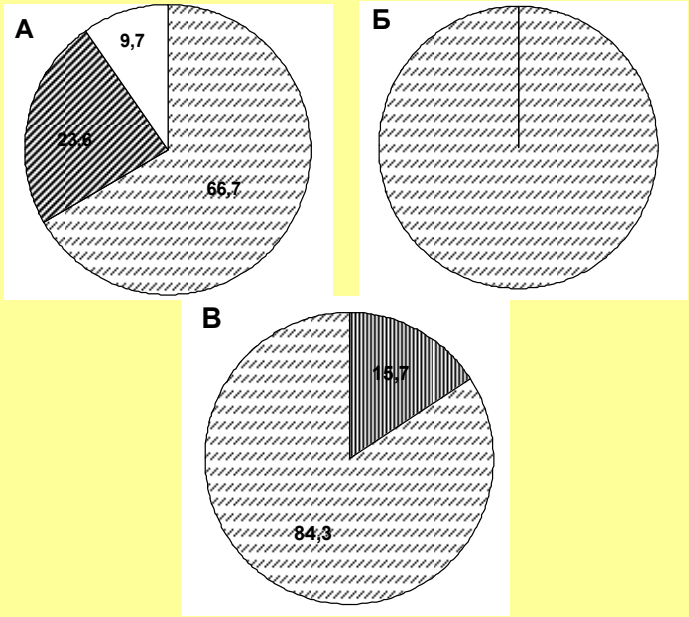
In the following slides we will present the food web characteristics of :

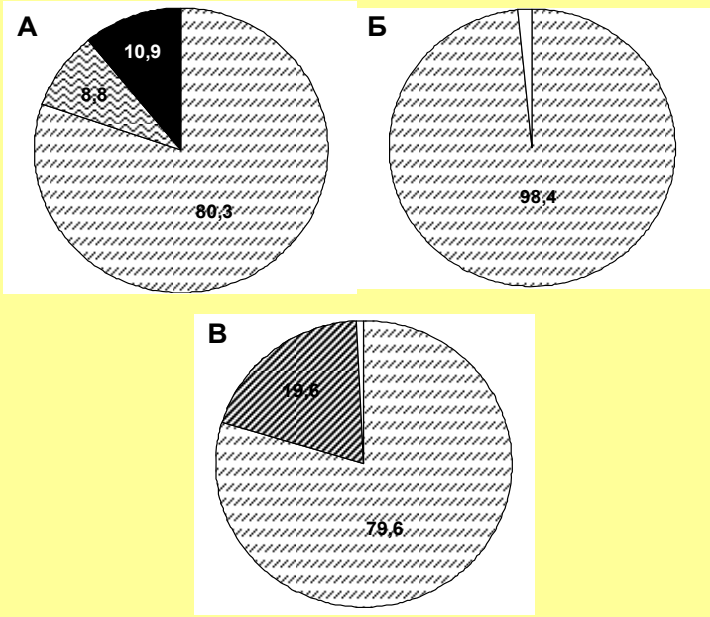
- the Baikal sturgeon in the delta waters
- Sand Sculpin (*Leocottus kesslerii*) in the Selenga shallow water (predelta)
- Multicolored Sculpin *(Battrachocottus multiradialis)* in the Selenga shallow water (predelta)

Stomach Contents (by percent mass) of Baikal Sturgeon: А – In the Selenga shallow water (2001 – 2003); Б - In the Proval Bay (2002 – 2003); В – In the Istominski Bay (2000). Amphipods consist of 14,6 to 89,5 % of ration.



The diets of two bottom-dwelling Sculpins [*Leocottus kesslerii* (left fig.) and *Battrachocottus multiradialis* (right fig.)] in the Selenga shallow water is consists of 11 components; Amphipodes are absolutely prevails among them (80–100 % of mass).





Oligochaeta

Mollusca

Epishura baicalensis

Amphipoda

Macrohectopus branickii

Ephemeroptera, l

Odonata, l

Chironomidae, l

Pisces

Detritus

Others

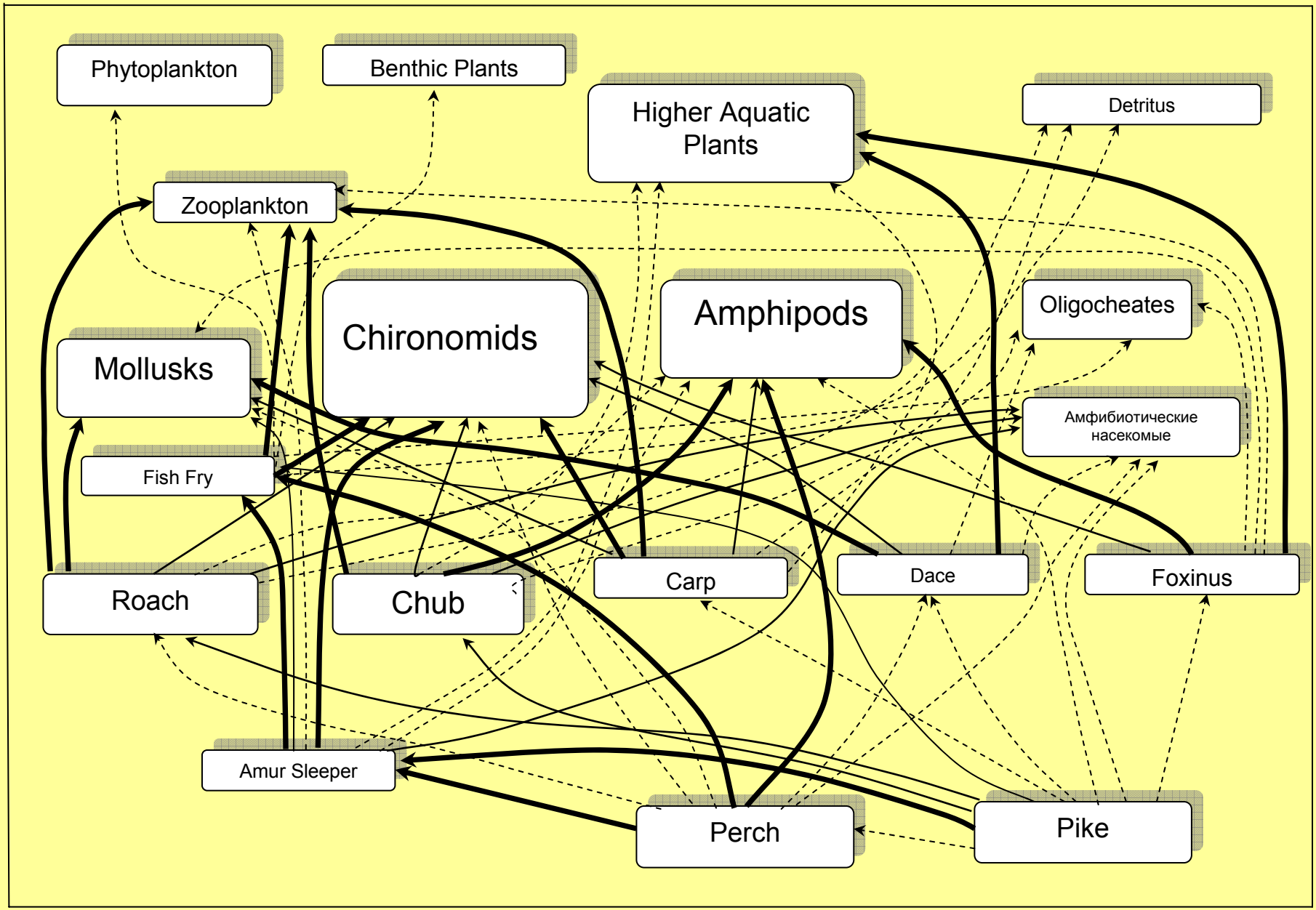
The four following slides show the various food webs for fishes:

- in the delta of the Selenga river
- the littoral in the shallow waters of the Selenga River
- in the lake at 100 to 300 m
- In the pelagic zone of the lake

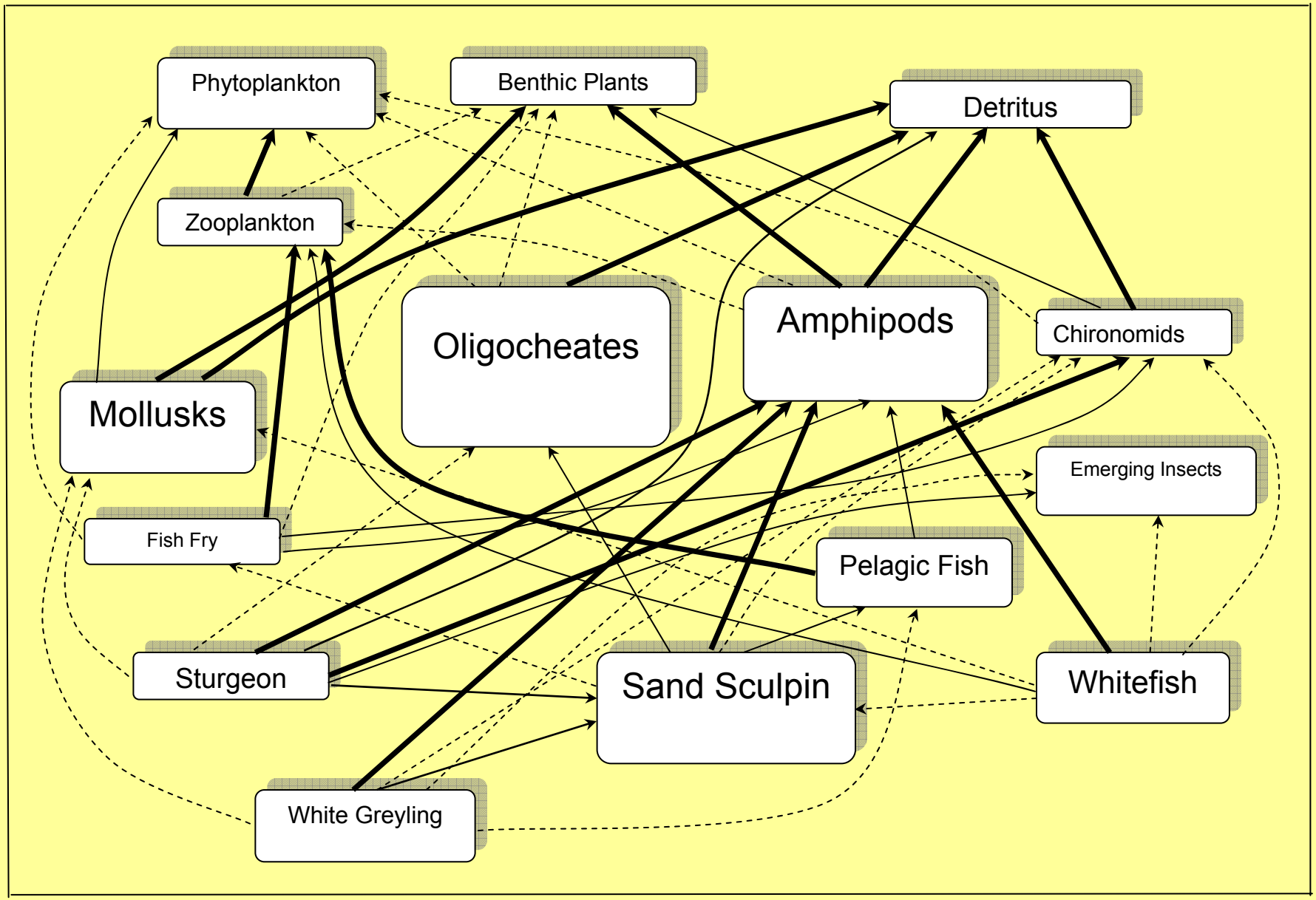
The first 3 slides show prevailing of amphipods. In the pelagic zone (slide 4) the central position is occupied by plankton copepod *Epishura baicalensis*.

In proportion to the decrease of biological diversity, the taxonomic and ecological diversity “the frequency” of the food web decreases from the delta to the pelagic zone.

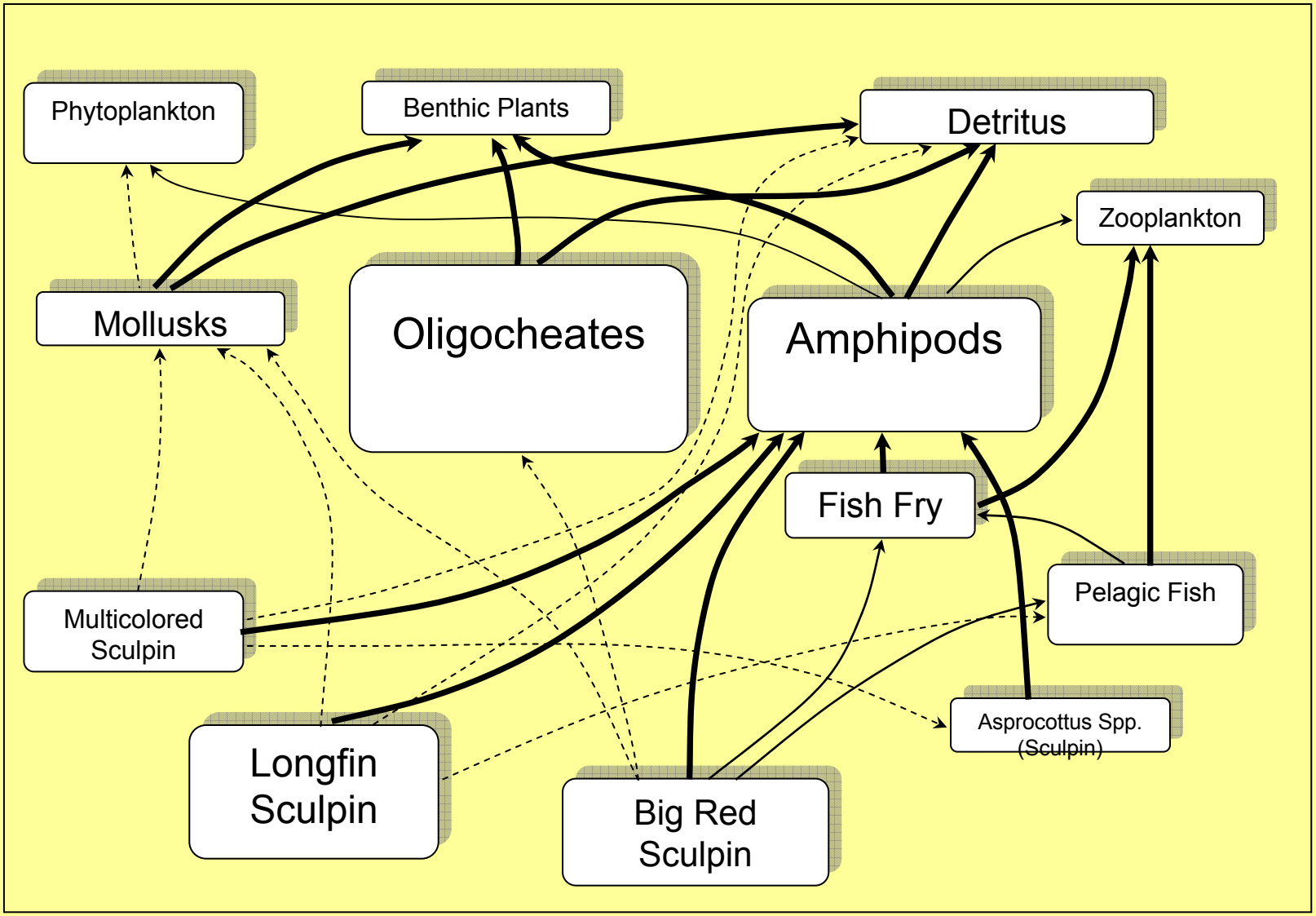
Food Web Relations of Fish in Lake Baikal



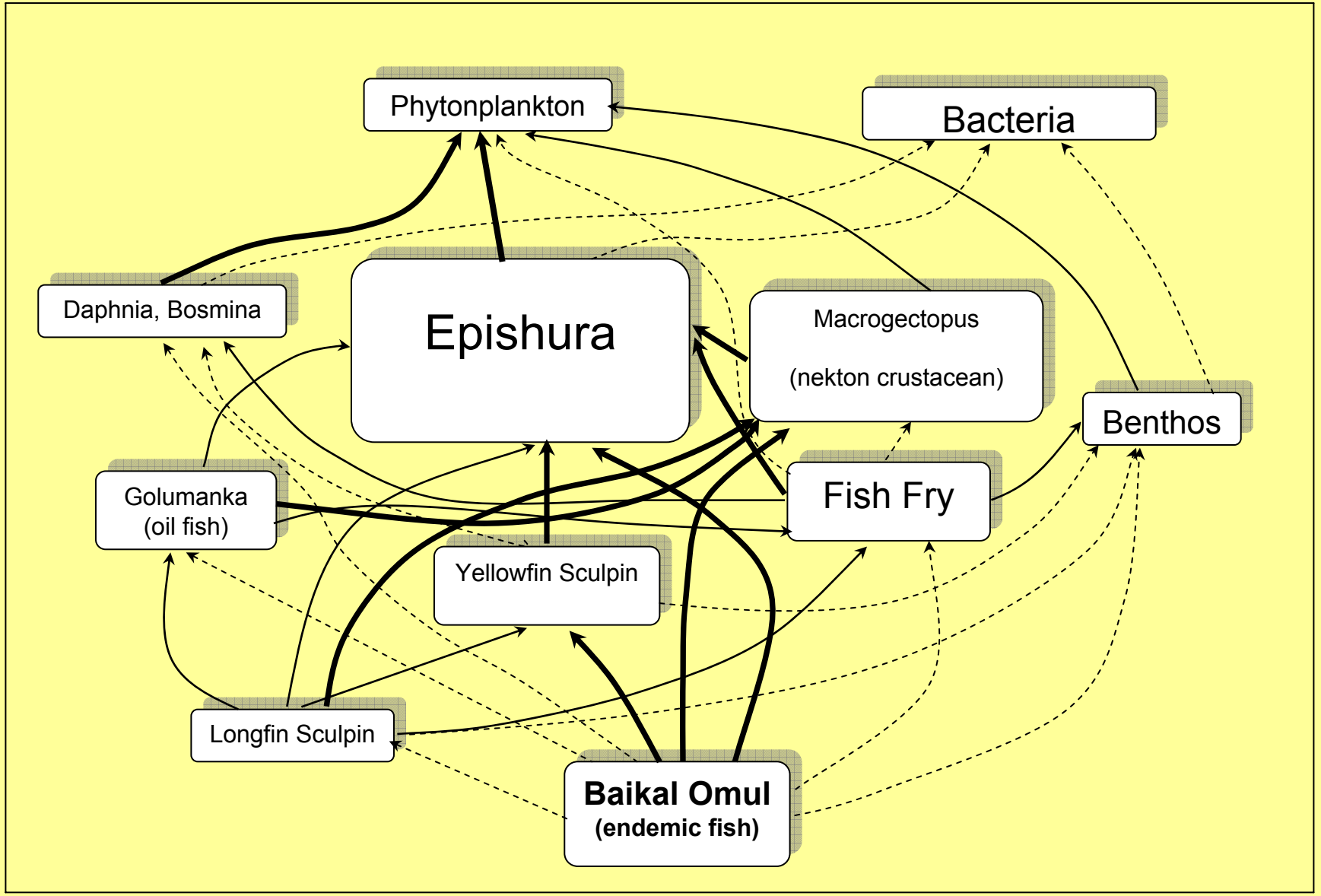
Food Web of the Selenga Shallow Water



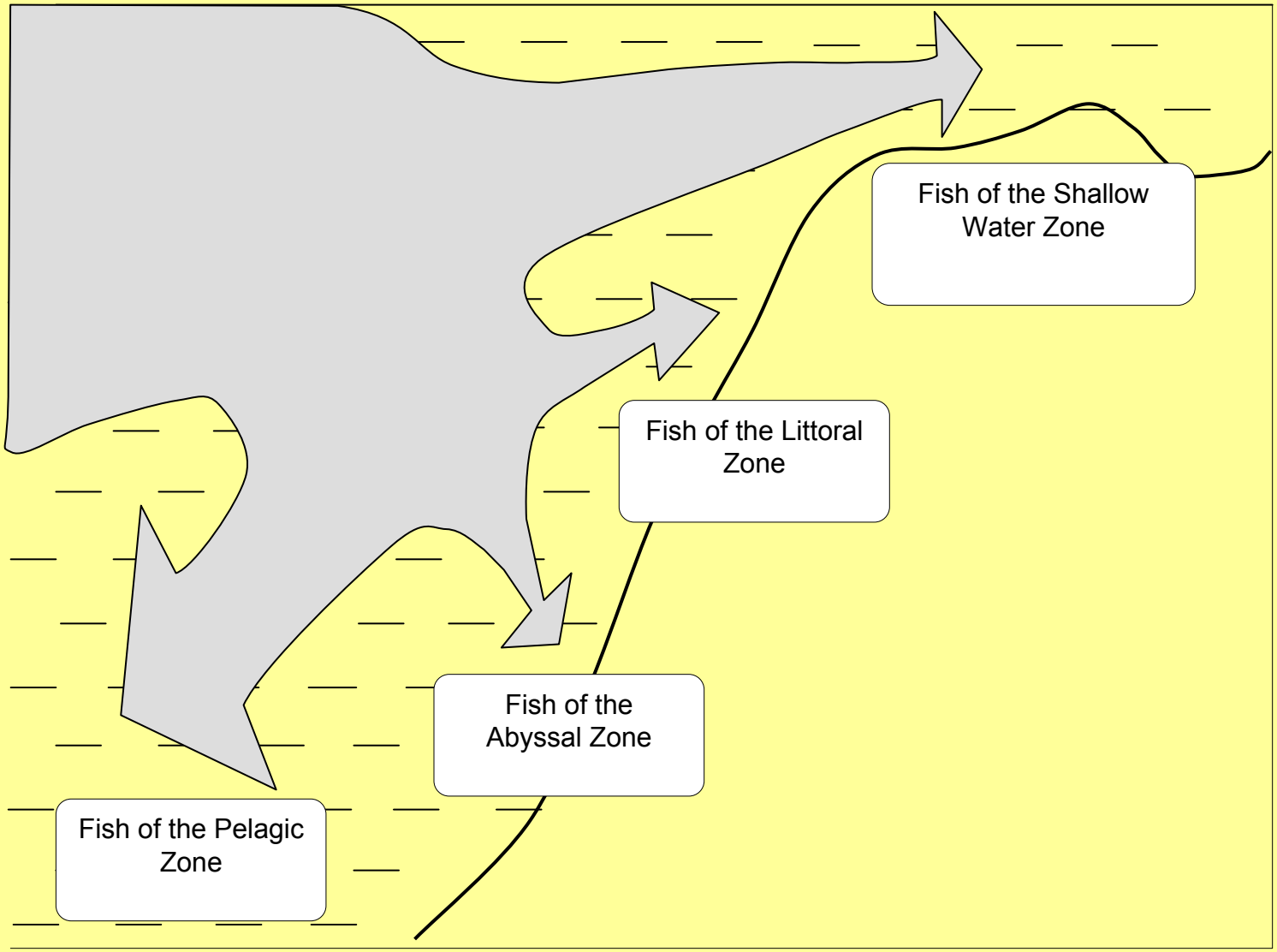
Food Web of the Selenga Shallow Water from 100-300 m Depth



Food Web of the Pelagic Zone of Lake Baikal

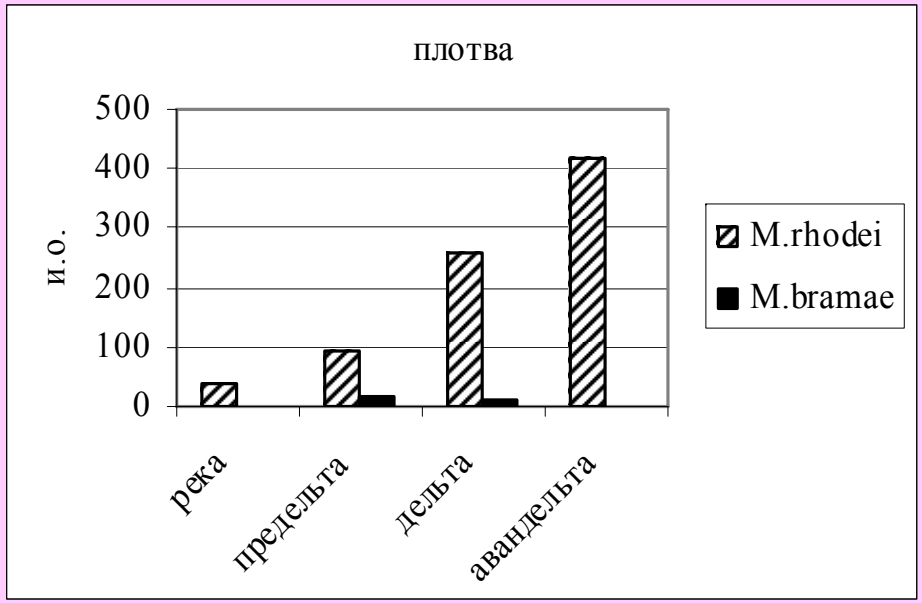


Energy Flow in the Selenga River Shallow Water Ecosystem



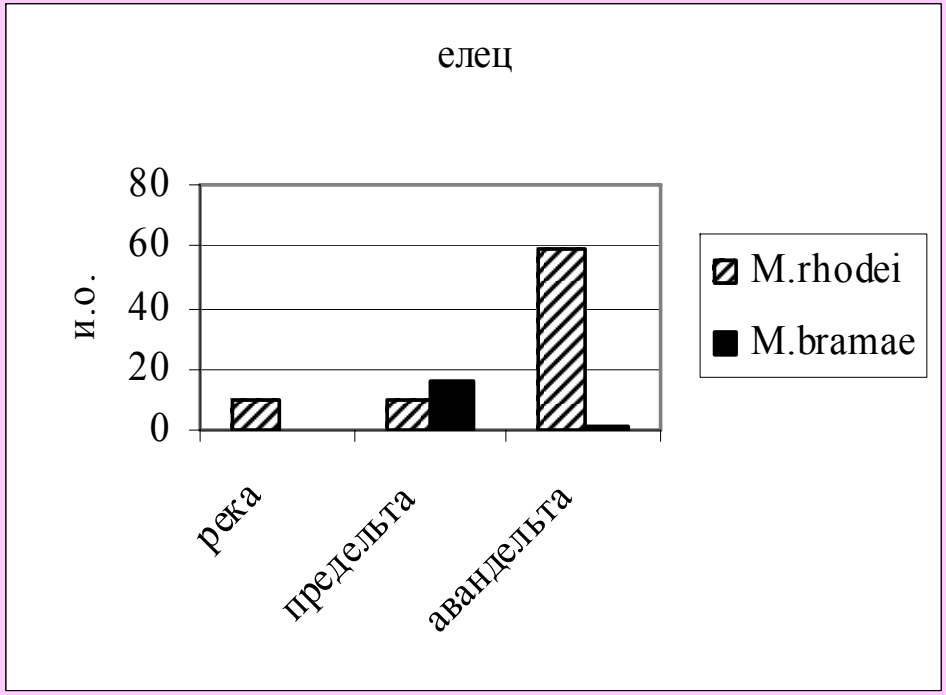
Changes in infection rates of Roach and Chub in the transect from (Selenga River > Delta > Lake Baikal): Myxosporidium, *Myxidium rhodei, Myxobolus bramae*

Infected Roach:



River, Pre-delta, Delta, Lake

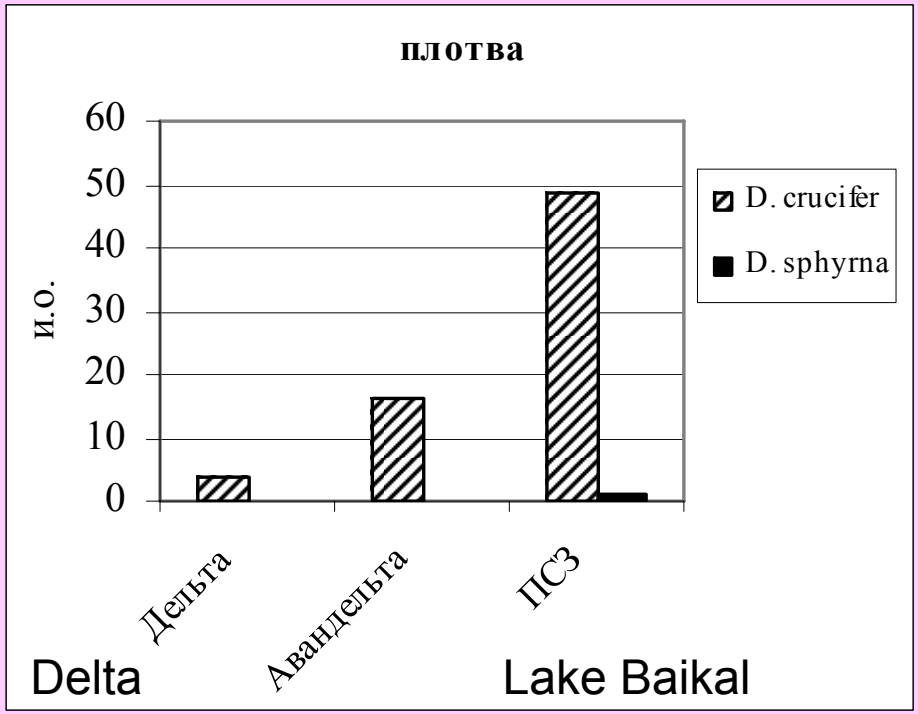
Infected Chub:



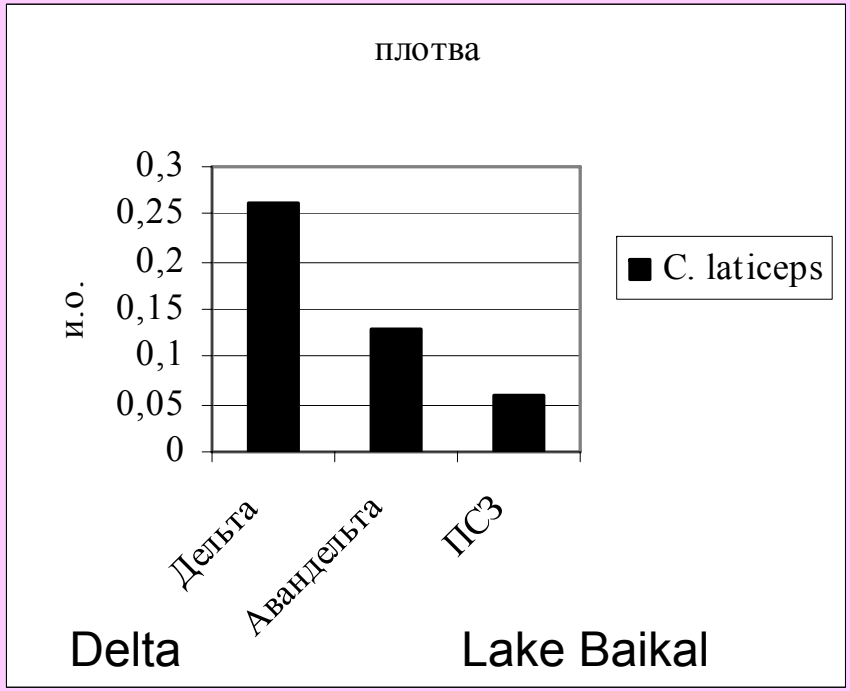
River, Delta, Lake

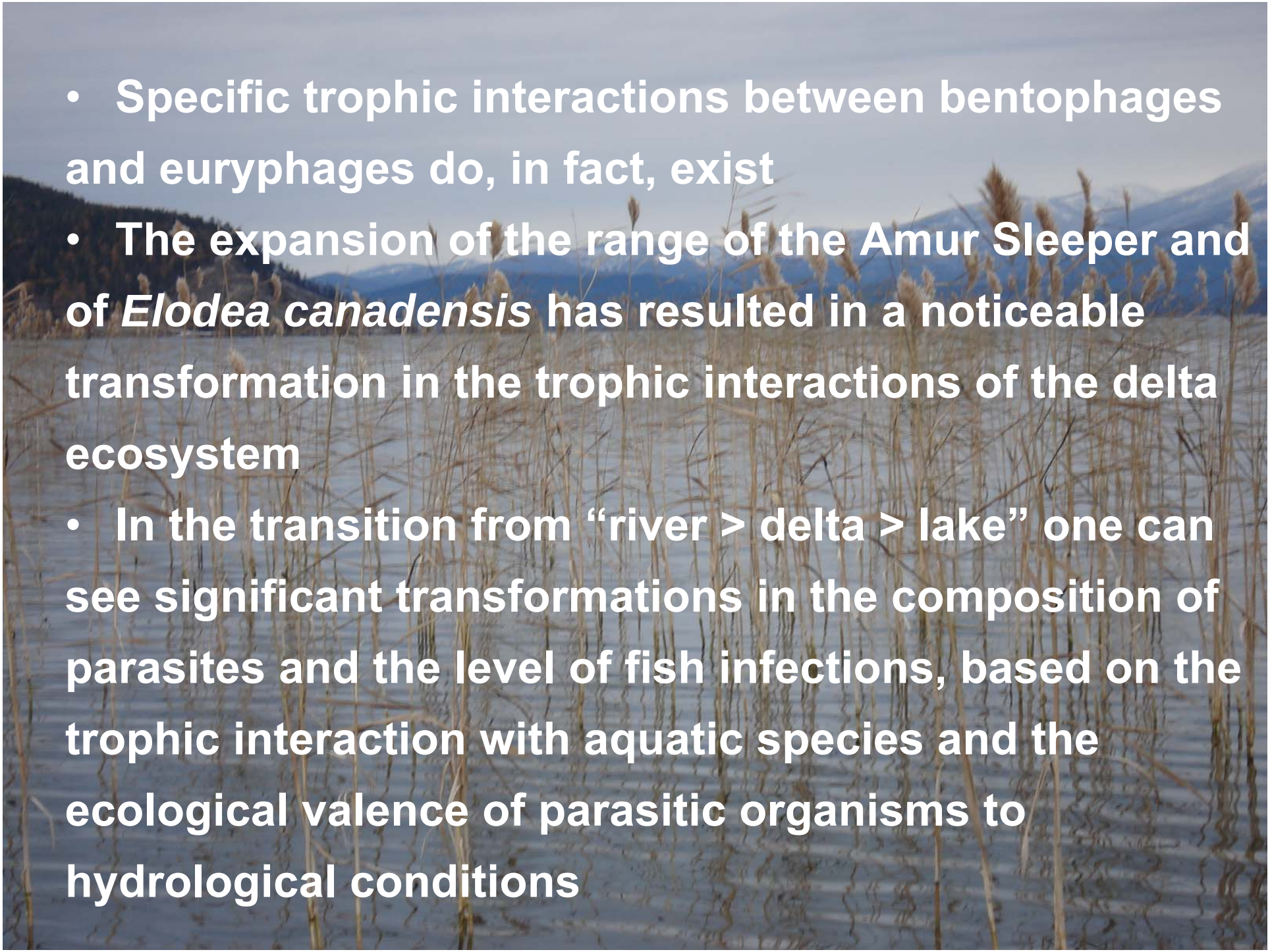
Changes in infection rates of Roach in the transect from (Delta > Shallow Water > Lake Baikal): (1) monogenae *Dactylogirus crucifer* and *Dactylogirus sphyrna,* (2) tapeworms *Cariophylidea laticeps*

(1)



(2)





- Specific trophic interactions between bentophages and euryphages do, in fact, exist
- The expansion of the range of the Amur Sleeper and of *Elodea canadensis* has resulted in a noticeable transformation in the trophic interactions of the delta ecosystem
- In the transition from “river > delta > lake” one can see significant transformations in the composition of parasites and the level of fish infections, based on the trophic interaction with aquatic species and the ecological valence of parasitic organisms to hydrological conditions


Thank you for your attention!
8 9 2006

Welcome to Ulan-Ude - the capital of Buryatia


Welcome to my biological station
in Chivyrkuy Bay of Lake Baikal
7 9 2006

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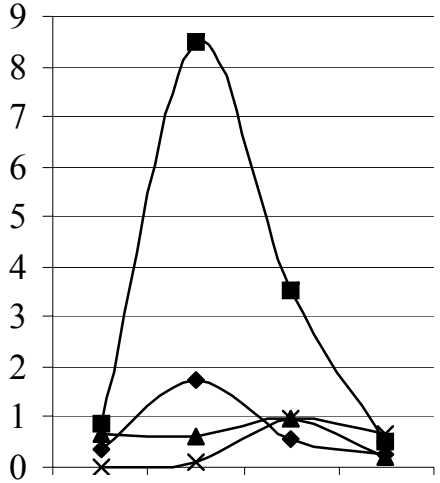
Схема жизненного цикла *Diphyllobothrium dendriticum* в экосистеме оз. Байкал (Пронин, Толочко, 2007)

СОДЕРЖАНИЕ Cu и ZN В МЫШЦАХ РЫБ В РАЗЛИЧНЫЕ СЕЗОНЫ ГОДА (ДЕЛЬТА Р. СЕЛЕНГА, 2001-2002ГГ.)

Плотва

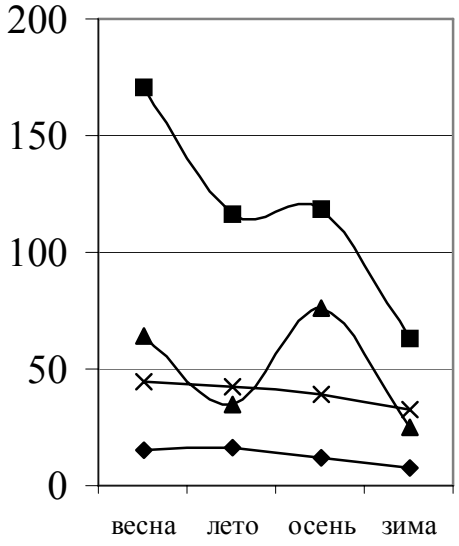
мг/кг

Cu



мг/кг

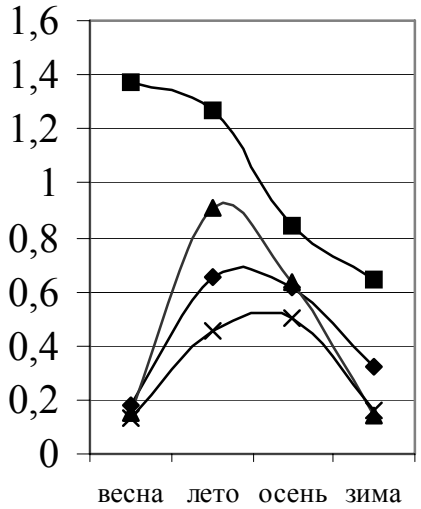
Zn



Щука

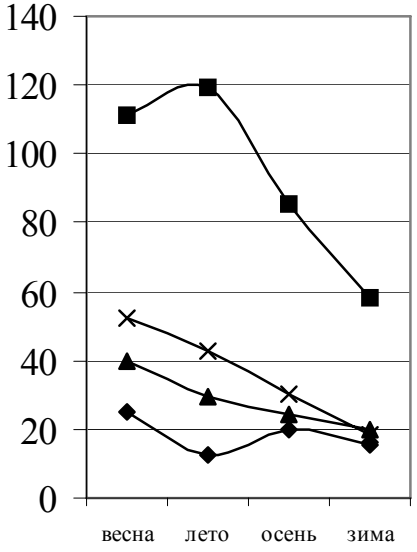
мг/кг

Cu



мг/кг

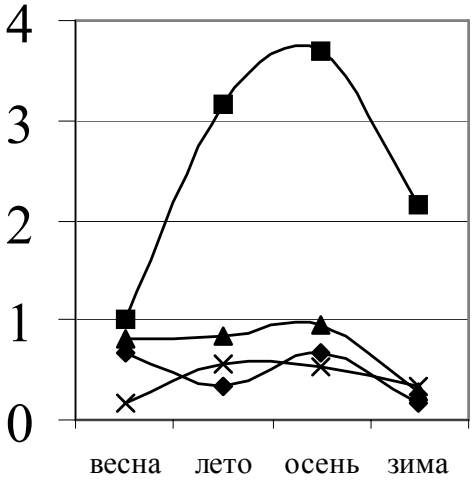
Zn



Окунь

мг/кг

Cu



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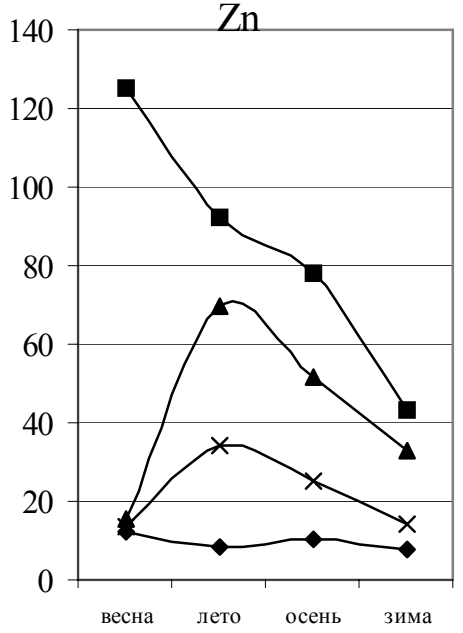
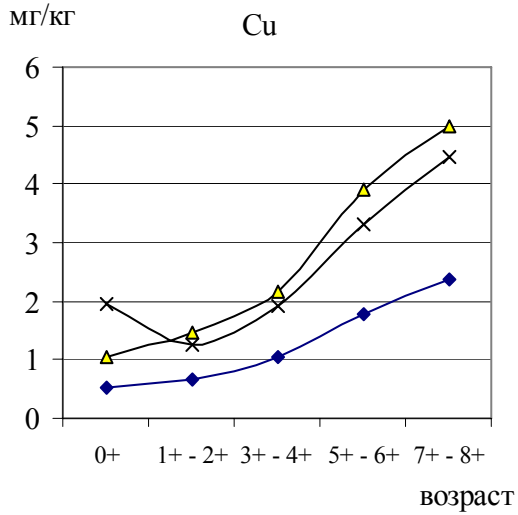
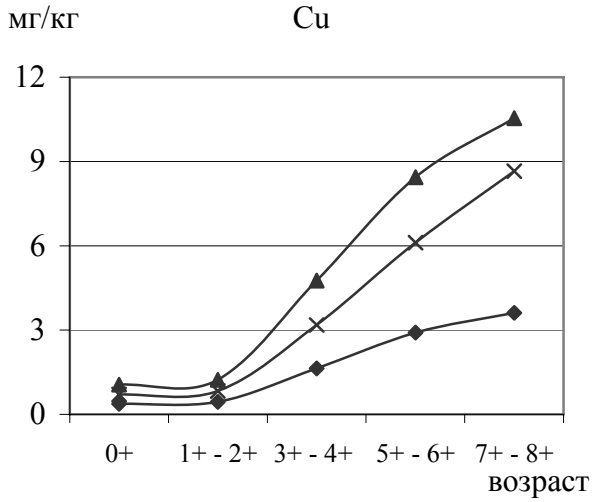


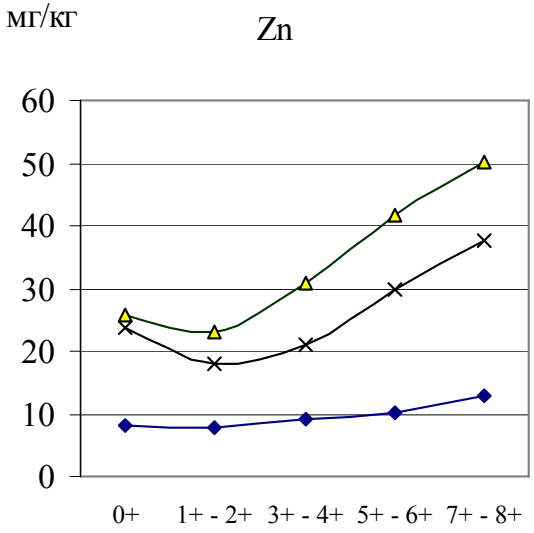
Содержание меди, цинка в органах и тканях плотвы и щуки дельты р. Селенга (2001-2003 гг.) закономерно увеличивается с возрастом рыб

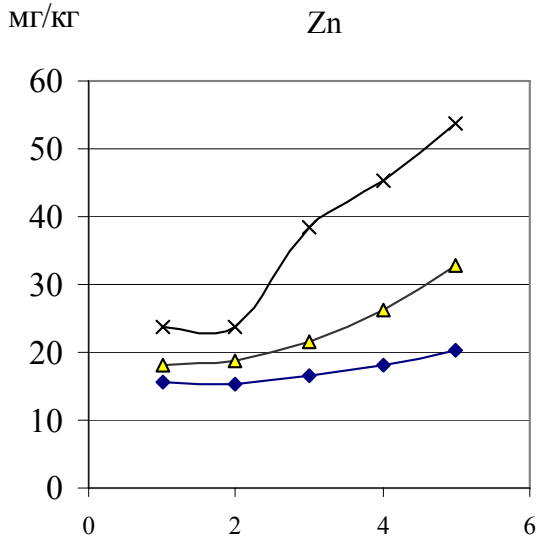
Roach



Pike







THE MAIN AUTHORS' PUBLICATIONS ON AMUR SLEEPER:

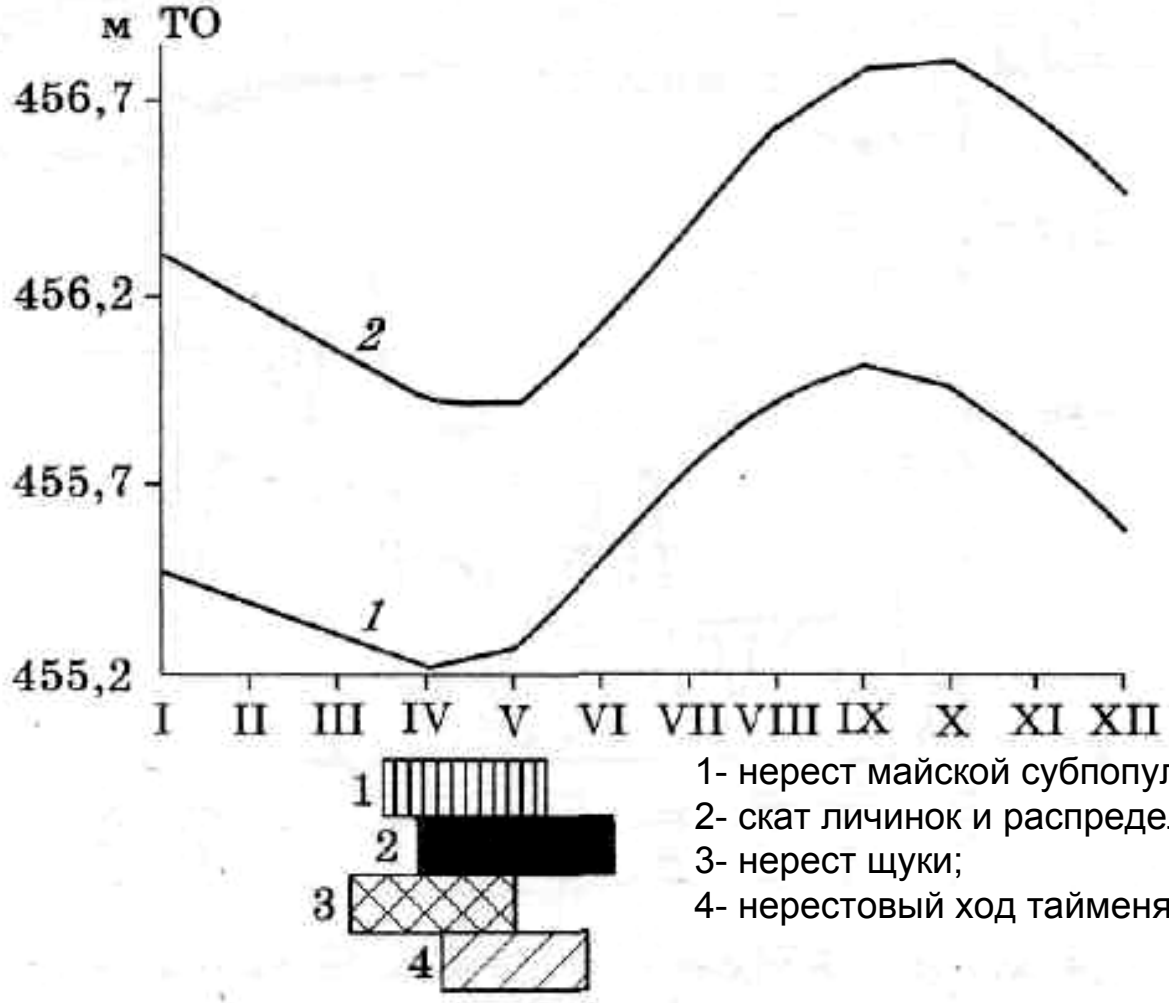
1. N. M. Pronin and E. M. Bolonev. On the Modern Geographical Range of the Amur Sleeper *Perccottus glenii* (Perciforemes: Odontobutidae) in the Baikal Region, and Its Penetration into the Ecosystem of Open Baikal // *Russian Journal of Ichthyology*, 2005.
2. Пронин Н.М., Болонев Е.М., Дугаров Ж.Н. Распространение амурского вселенца ротана-головешки в водоемах Северной Евразии и ситуация с экспансией его в экосистему озера Байкал // Использование и охрана природных ресурсов в России: информационно-аналитический бюллетень. - 2005. - № 5. – С. 80-84.
3. Болонев Е.М., Пронин Н.М. Особенности размерно-возрастной и половой структуры локальных популяций ротана *Perccottus glenii* Dybowski (Perciformes: Eleotrididae) в водоемах и водотоках бассейна озера Байкал // Вестник БГУ. Сер. Биология. – Улан-Удэ, 2005. – Вып. 7.
4. E. M. Bolonev, N. M. Pronin, and Zh. N. Dugarov. Amur Sleeper - "Amur Conqueror" in the Baikal Region. - BNTs SO RAN, Ulan-Ude, 2002.
5. N. M. Pronin, D. Kh. Selgebi, A. G. Litvinov, and S. V. Pronina. Comparative Ecology and Parasitofauna of Exotic Invading Species in the Great Lakes of the World: *Percottus glehni* in Lake Baikal and Ruffe (*Gymnocephalus cernuus*) Superior Lake // *Siberian Journal of Ecology*, 1998, № 5, 397-406.
6. Pronin N.M., Litvinov A.G. Ecology of *Perrcottus glehni* Dybowski-Exotie Invader of Baikal Region // Baikal as a Natural laboratory for global Change (International Workshop): Abstracts Lisna Publishers. - Irkutsk, 1994. - V. 5. - P. 27-28.

Во второй половине 20-го века наибольшее влияние на состояние экосистемы озера Байкал и его биоты оказали два фактора:

1- зарегулирование стока реки Ангары плотиной Иркутской ГРЭС;

2- вселение чужеродных видов водных животных и растений

Среднемноголетняя сезонная динамика уровня воды в оз. Байкал «до» (1) и «после» (2) зарегулирования стока и «критические» периоды в годовом физиологическом цикле некоторых видов рыб.



1- нерест майской субпопуляции желтокрылки;
2- скат личинок и распределение мальков омуля;
3- нерест щуки;
4- нерестовый ход тайменя и белого хариуса.

Ротан стал одним из основных объектов питания щуки в водоемах дельты р. Селенги

Ниже приводим характеристику спектров питания:

байкальского осетра в водоемах дельты,

песчаной широколобки на Селенгинском мелководье (аванделька) и

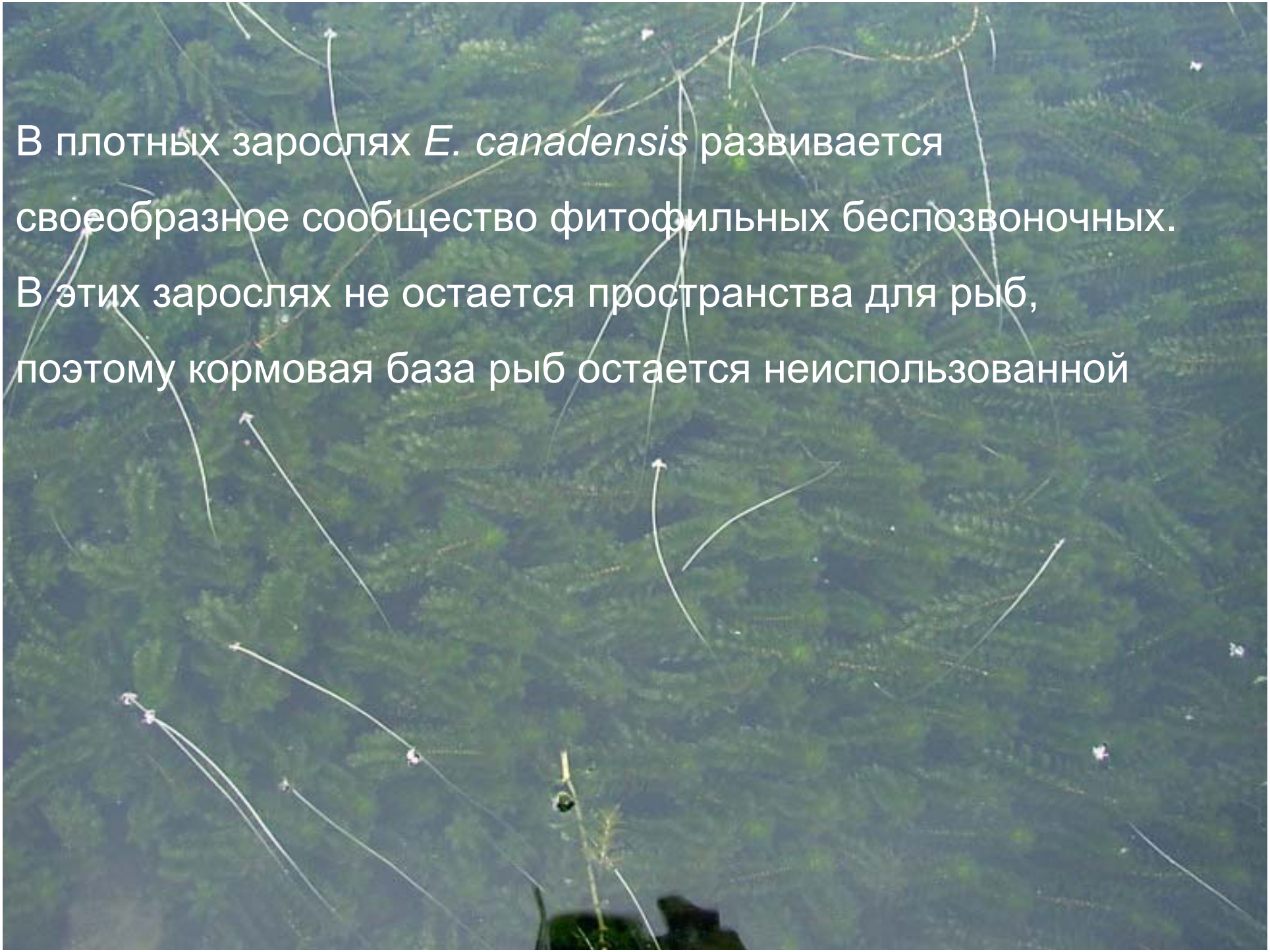
пестрокрылой широколобки на Селенгинском мелководье (аванделька)

На следующих четырех слайдах показаны пищевые сети рыб:

- В дельте реки Селенги
- Литорали Селенгинского мелководья
- На глубинах от 100 до 300 м
- Пелагиали оз. Байкал

В соответствии с уменьшением разнообразия биотопов, таксономического и экологического разнообразия гидробионтов «частота» пищевых сетей рыб уменьшается от дельты к пелагиали

За более чем 30-летний период экспансии чужеродного вида E. canadencis заняла специфическую экологическую нишу в прибрежно-соровой зоне Байкала, которая является наиболее продуктивной частью озера



В плотных зарослях *E. canadensis* развивается своеобразное сообщество фитофильных беспозвоночных. В этих зарослях не остается пространства для рыб, поэтому кормовая база рыб остается неиспользованной