EuLakes

European Lakes Under Environmental stressors

(Supporting lake governance to mitigate the impact of climate change)

Lake Balaton and its aliens

This project is implemented through the CENTRAL EUROPE Programme co-financed by the ERDF

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Analysis of the historical data on introduction of alien fish species and their present status

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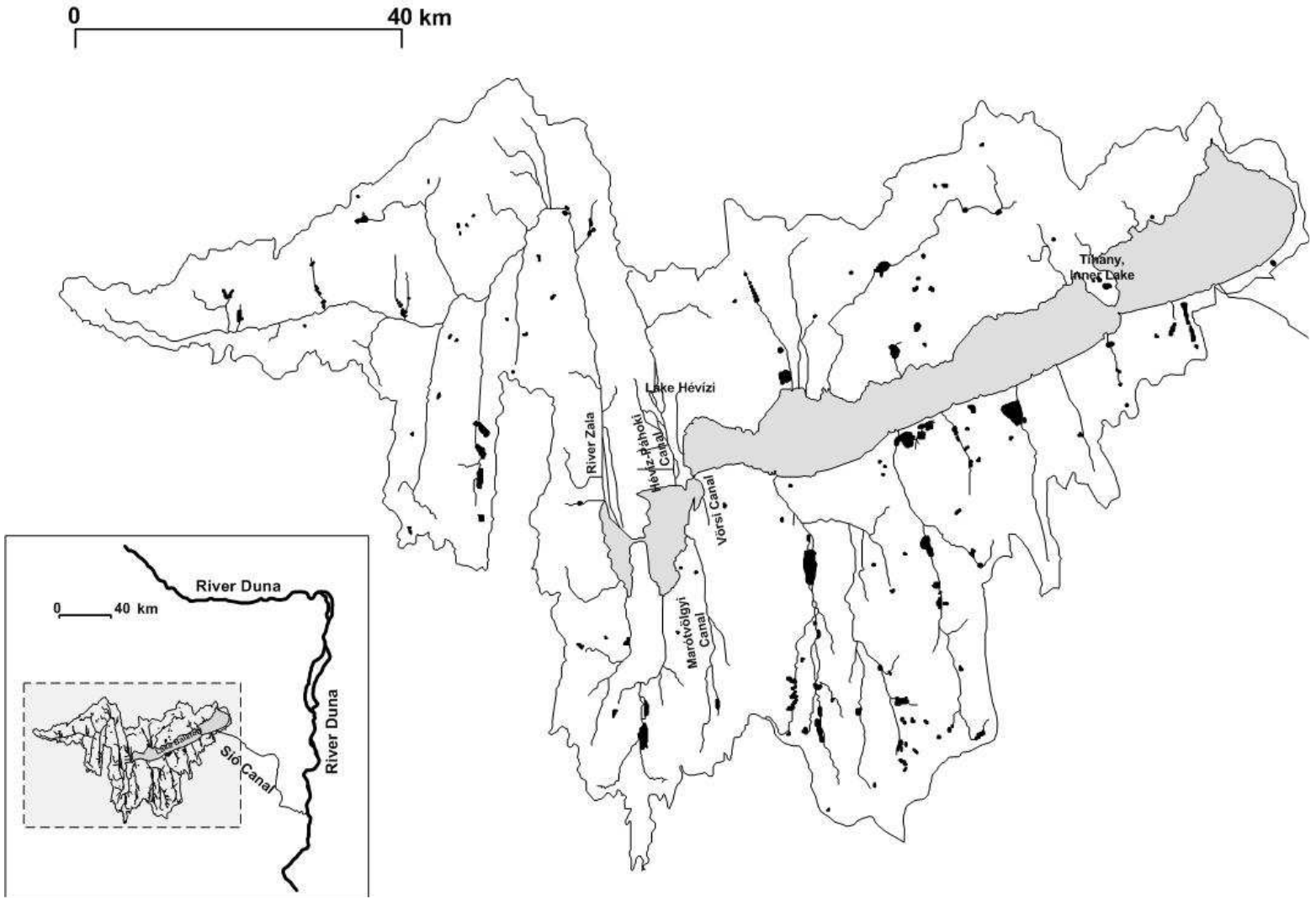
Main points addressed

- The history of the problem: introduction of alien fish species to Lake Balaton
- Their present status
- Ecological risk posed by aliens
- Possible effect of climate change on lake ecosystem with regard to aliens

Reference conditions

- Before 1863, Lake Balaton and its tributaries formed a „closed” system: no connection with other watersheds

- In 1863, a chanal (Sió-chanal) was built, connecting the lake to the watershed of River Danube



- Fish stock structure before/in 1863 is regarded as reference/baseline condition
- (somewhat arbitrary, as there are data about introduction of the common carp */Cyprinus carpio/* by Romans)

- In parallel, in the second half of the 19th century the organized fishing activity became more intense in the lake (and in River Danube as well), which resulted in the intentional introduction of species from other watersheds. These species were either considered economically important or interesting. Along with intentional introductions, other alien species could be brought to the lake.

- 150-year historical records are available about (1) introduction and (2) present status of aliens (survived/did not survive)

- Alltogether 6 species can be still found identified as non-native, such as…

Eel (*Anguilla anguilla*)

Hypophthalmycthys molitrix (silver carp) and *Hypophthalmycthys nobilis* (bighead carp) HIBRIDS

Ecological Risk Assessment (ERA) of Alien Species

- ERA: estimates the likelihood a given stressor cause negative impacts on a recipient
- Stressor: alien/exotic/non-indigenous/non-native species
- Recipient: whole ecosystems
- ERA: quantitative (mathematical estimate of the likelihood) or qualitative (risk classes: low-moderate-high)

- Algorithm: a combination of Ecological Risk Assessment (ERA) and Life-Cycle Assessment (LCA)

Life-Cycle of an invasion

- Introduction
- Getting acclimatized
- Becomes abundant
- Spread
- Becomes nuisance: causes ecological problems

What kind of ecological problems emerge?

In general:

- Competition with native species
- Predation/parasitism
- Pathogenicity/toxicity
- Altered habitat structure

The steps/phases do not necessarily follow each other

- Example: eel (*Anguilla anguilla*)
- The story:
  - In the 1880's, by the initiative of the German Fishery Association, 300 000 specimens (!) were stocked to River Danube at Budapest, some of them must have reached Lake Balaton
  - During the first recorded stocking to the lake, app. 20 000 specimens were released in 1890
  - After 1920, eel was regularly stocked (according to the statistics, the average was 3 million specimens per year). (!!!)

- Got acclimatized
- But did not reproduce
- Still, it did cause problems

- Massive fish kills in the 1990's
- Possible causes: chemicals (insecticides used for mosquito control)and/or infection by *Anguillicola* sp. (Nematode)
- Human/environmental health risk
- This exotic species functions as a vector: by now, several fish species living in the lake have become host of this non-native nematode

- The intense stocking of eel to Lake Balaton might have been the cause of the extinction of *Astacus leptodactylus* (Turkish crayfish), as well as of the significant decrease in the stock of indigenous fish species

Species which could even not get acclimatized

Gambusia affinis ssp.*Holbrooki* (mosquitofish)

- Source: intentional introduction to Lake Hévízi which has a temperated water the whole year (24-36 C) for controlling mosquito populations Lake Hévízi is connected to lake Balaton via the Hévíz-Páhoki Canal.
- Fate: cannot overwinter in Lake Balaton

And of course there are species which have got acclimatized, reproduce and might cause ecological problems

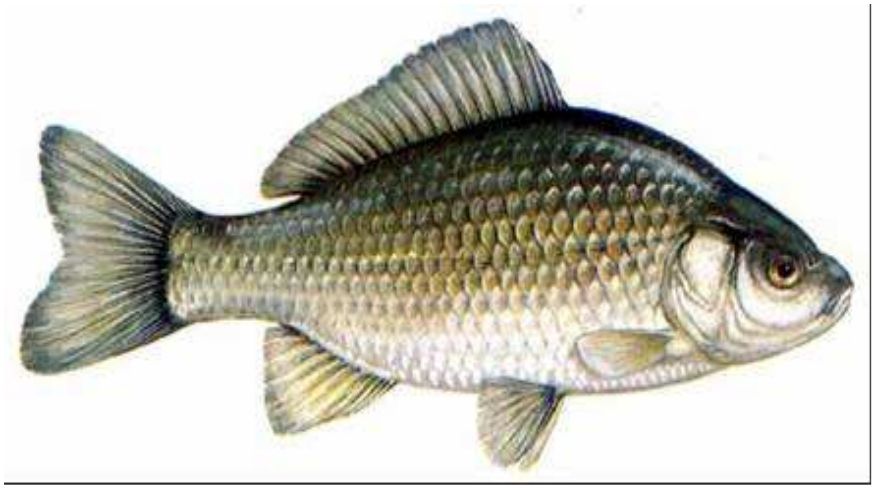
- Candidate species for ecological risk assessment

A succesful invader: the Gibel carp (*Carassius gibelio* BLOCH)

- **Original area: Far East**
  - Ottó Herman' s „stone" carp (1887)
  - **Non native in Europe**
  - **1954 import**, from Bulgaria
  - Discrimination in fisheries catch since this date
- Occourence in the catchment: **1970's**
- **Fast invasion, cause of**
  - Special oxigen-deficit tolerance mechanism
  - Omnivorious feeding
  - Efficient predator - avoidance
  - Alternative gynogenetic reproductive strategy
  - **Regional scale invasion ended**
- **Problems:**
  - Completely crowded out the native Crucian carp
  - Food competition with other Cyprinids
  - Sexual competition (gynogenetic form)

Photo: Á. Ferincz

Painting: from book of K. Pintér



- Further studies to determine its ecological role/risk: competition for food with native species: studies (both in the field and in the lab) are going on

Final conclusion (and the biggest problem in assessing what risk aliens pose in Lake Balaton)

- Fish community of the lake is heavily controlled by man
- Even for indigenous (native) species, the input and output are controlled (stocking and fishing)

Possible effects of climate change

- Environmental (abiotic) parameters change
- Human use changes

Environmental parameters

- Water level fluctuations
- Temperature regime changes

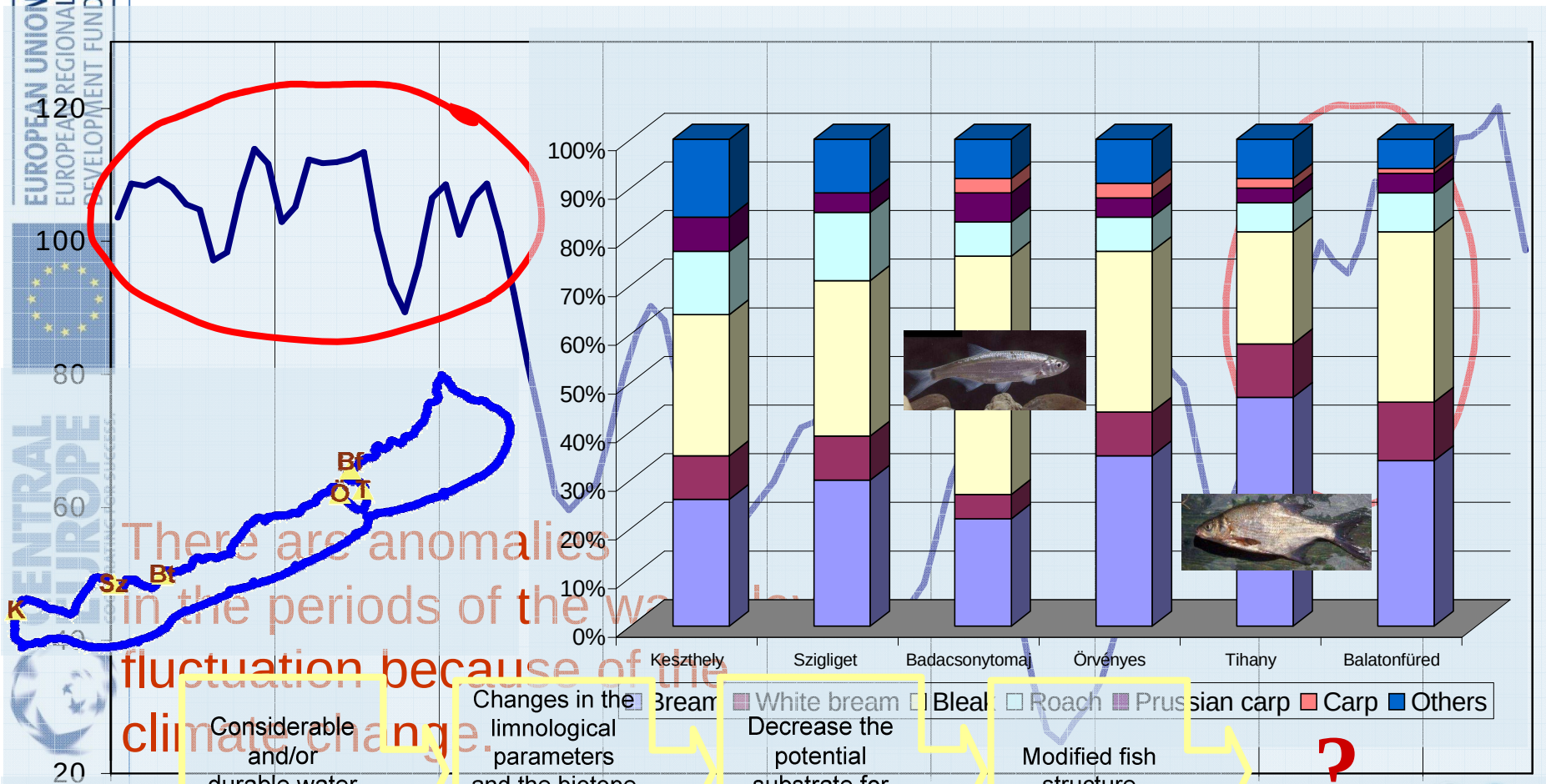
Temperature???

- Most possibly will never be such a great change to provide possibility for subtropical aliens to overwinter

Water level fluctuations

- Water level fluctuations: availability of different habitats in the shorezone (littoral) will change

Case study



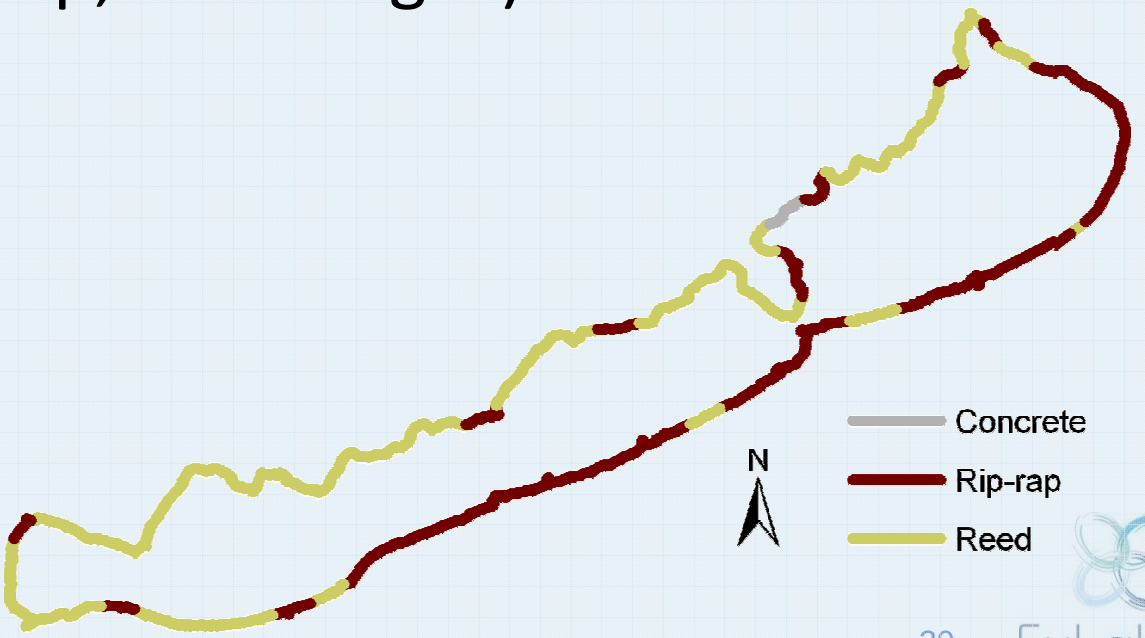
There are anomalies in the periods of the water level fluctuation because of the climate change.

Considerable and/or durable water level fluctuation → Changes in the limnological parameters and the biotope structure of the shoreline → Decrease the potential substrate for spawning → Modified fish structure → ?

There are approx. 80 fish species occur in the lake, of which 7 are dominating. All of them like laying their eggs onto the rip-rap of the shoreline.

- Define the shoreline section based on various habitats
- Identification of dominant shoreline types (concrete, rip-rap, reed or grit) into these sections

Rip-rap: ~42%
Reed: ~57%
Concrete: ~1%
Grit: 0%



Estimated underwater rock surface area

[m^2], as a function of water level

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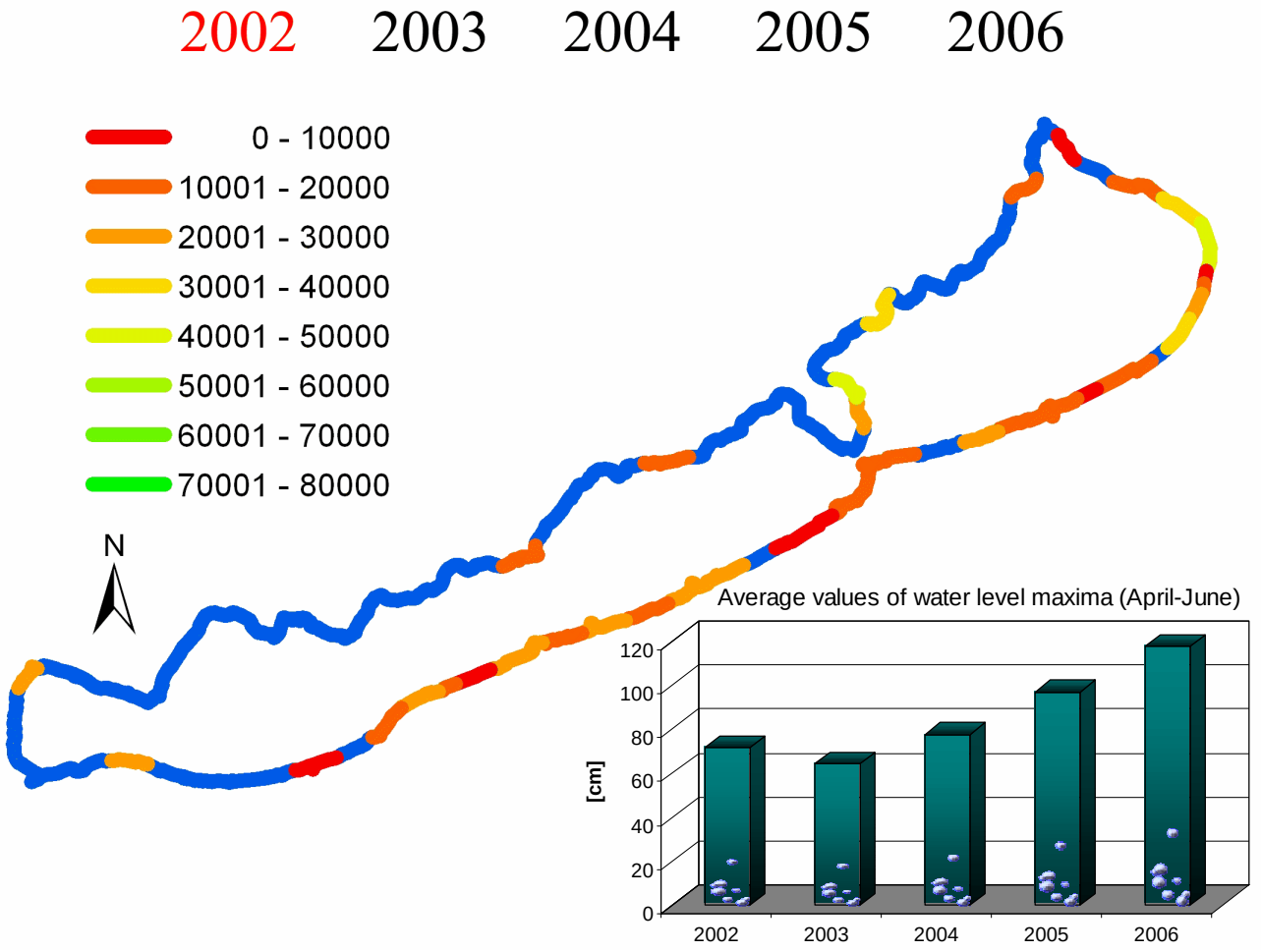
Estimated underwater rock surface area

[m^2], in the spawning periods (April to June)



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A probable scenario

- Climate change causes extreme wet years
- High water level in Lake Balaton: the Sió-floodgate open permanently
- Gobiids can migrate from the Danube trough the Sió-canal

N. melanostomus

N. gymnotrachelus

N. kessleri

Probably introducing and invasion of ponto-caspian Gobiids

- *Neogobius kessleri* (Kessler's goby), *Neogobius melanostomus* (Round goby), *Neogobius gymnotracheus* (Racer goby)
- Invasive in Danube, from late 1990s
- Can reach Lake Balaton trough the Sió-canal

Possible changes in human use

- Human use will increase (in fact, it is continously increasing)
  - Aquaculture: young of the year fish stocked are often contaminated by exotics
  - Recreation
  - Other: intentional introduction of (ornamental) species kept first in aquaria, than released to the lake

THANK YOU FOR YOUR ATTENTION!