Distribution and biology of *Neogobius fluviatilis*, *Ponticola kessleri* and *Babka gymnotrachelus*

Prof. dr. sc. Marina Piria

University of Zagreb, Faculty of Agriculture, Department of fisheries, beekeeping, game management and spec. zoology

Neogobius fluviatilis (Pallas, 1814) – monkey goby

- second dorsal fin ray (first branched ray about **twice as long as penultimate ray**),
- nape scale structure,
- pelvic disc fraenum with **small rounded** lobes
- scales in midlateral series
- First dorsal without black spot

Ponticola kessleri (Günther, 1861) – bighead goby

- second dorsal fin ray (first branched ray about **as long as penultimate ray**)
- Nape complitely covered with ctenoid scales
- pelvic disc fraenum with **angular** lobes
- First dorsal without black spot

Babka gymnotrachelus (Kessler, 1857) – racer goby

- irregular position and shape of diagonal bars on body;
- first branched ray of second dorsal about as long as penultimate ray;
- no scales on midline of nape, in front of preoperculum;
- pelvic-disc fraenum with small rounded lobes
- first dorsal without black spot

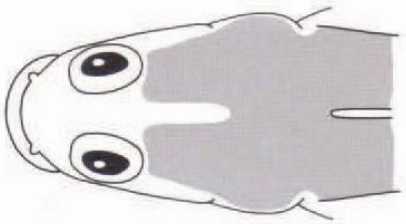


Figure 95 Scalation on nape missing on dorsal midline in some species of Gobiidae.

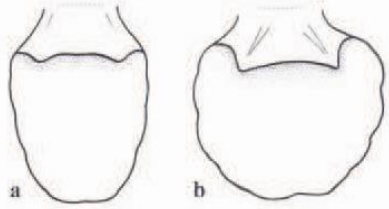
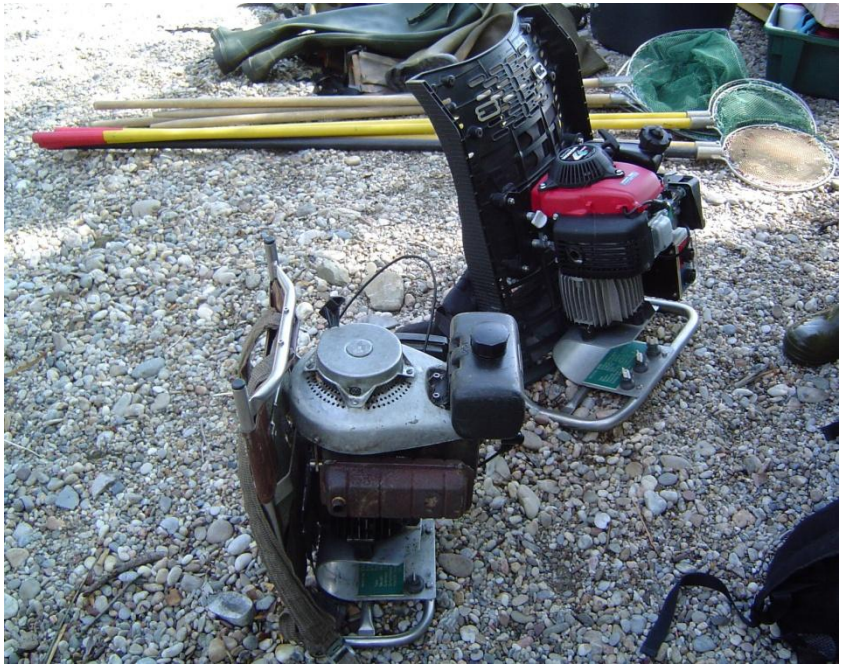


Figure 96 Pelvic disc fraenum in *Neogobius* species. **a,** with small rounded lobes; **b,** with angular lobes.

The sampling efficiency of electrofishing for Neogobius species (Polačik et al., 2008)

- Reyol et al. (2005)- estimetad electrofishing efficiency 55% in rock dominated habitats – for all bentic fishes
- Wiesner (2004)- estimetad electrofishing efficiency for *Neogobius* spp. under lab. conditions (artificial rip rap analogy)- 30-50%
- Single pass electrofishing is commonly used in large rivers, and this method is frequently used to sample *Neogobius* spp. In areas with rocky substrate



Aim of investigation

- To determine the efficiency of single pass electrofishing in areas with rocky substrate

- Hypotesis: expected lower efficiency of electrofishing for these bentic species in their natural riverine environment

Material and methods

- Fish was captured at main channel of the Danube River in the town of Vidin Bulgaria
- Backpach unit Lena, pulsed DC, 85Hz, 300 V with eliptical stainless steel anode 40x20 cm and 4 mm mesh size; 0.6 m long stripe shaped copper cathode

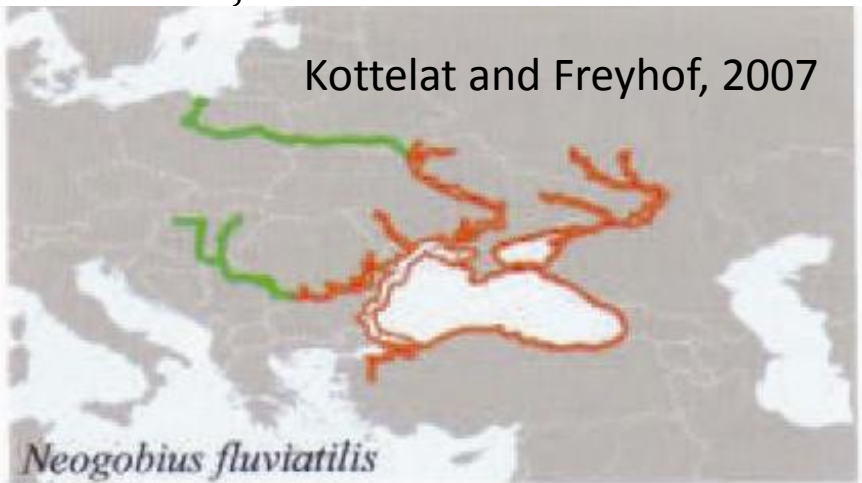
Results

Species	Mean efficiency
N. Fluviatilis	35.4
B. Gymnotrachelus	50.1
P. Kessleri	16.7
N. melanostomus	23.7
Neogobius spp.	29.7
Percids	74.6

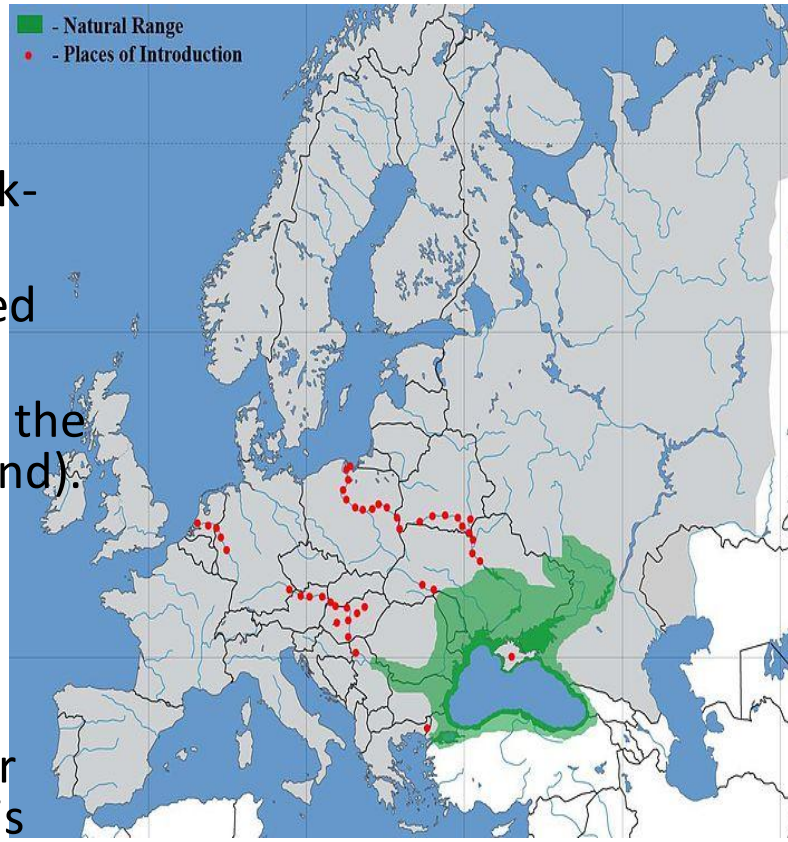
- Backpack and towboat electrofishing can be used to consistently capture *N. melanostomus* in clear, wadeable water, although this method requires the operator to focus on searching for fish on the bottom and may be aided by overturning rocks
- *N. elanostomus* lacks a swimbladder and does not float when electrofished (Phillips *et al*., 2003; Kornis & Vander Zanden, 2010).
- Beach seining is inefficient at sampling the preferred rocky habitat, but kick seining, whereby a short (*c.* 2 m) seine is placed downstream of rocky habitat to collect fish as the rocky habitat is disturbed by kicking, has proven effective (Jude *et al*., 1995)

N. fluviatilis

- The natural habitat of the monkey goby is the fresh and brackish waters of basins in the Black Sea and the Sea of Marmara.
- In the Black Sea and the surrounding areas, the monkey goby is common in all desalinated water including the Danube river and its tributaries, the lagoons and estuaries of the north-western part of the Black Sea, the Sea of Azov, and the rivers of Caucasus.



- Recently, the monkey goby has been registered as an invasive species in some countries of Europe.
- In 1970, the species was first declared as a non-indigenous in Lake Balaton in Hungary
- discovered in the Middle Danube in Hungary in 1984.
- In 2001 it was found to have spread to the Slovak-Hungarian sector of the Danube River.
- In the basin of the Baltic Sea it was first registered as an invasive species in 1997.
- The species has also become a common sight in the Włocławek Reservoir and Zegrze Reservoir (Poland).
- has been found in the German part of the river Rhine since March 2009.
- It has also been found in the Waal River, near Nijmegen, the Netherlands
- In August 2011 the monkey goby is registered for the first time in the Evros River (Greece), which is inflows to the Aegean Sea
- In Croatia – Danube River, Sava river and its tributaries



Biology

- Occurs in inshore habitats, estuaries and brackish- and fresh-water lagoons and lakes; large to medium sized rivers and streams; on sand or mud bottom
- It is one of the most abundant fish in lowland rivers.
- This species lives up to 5 years; The average adult monkey goby measures 7–10 centimeters, but has been known to grow to lengths of 18–20 centimeters

Spawning

- spawns for the first time at 2 years;
- spawning season in April to July, locally until September, when temperature is above 13°C
- females may repeat spawning during a season.
- Males with body completely black with yellow fin margins during the spawning season;
- these excavate nests under any kind of hard substrate and guard eggs until hatching;
- with adhesive eggs deposited on stones, shells and aquatic plants

Feeding

- the diet of the monkey goby consists of amphipods, molluscs, and Oligochaeta

Joanna Grabowska, Michał Grabowski, Anna Kostecka (2009):
Diet and feeding habits of monkey goby (Neogobius fluviatilis) in a newly invaded area

- **how this new species influences native freshwater communities especially when the invader is a predator such as the monkey goby?** One impact may be the reduction in size of the populations of indigenous prey species

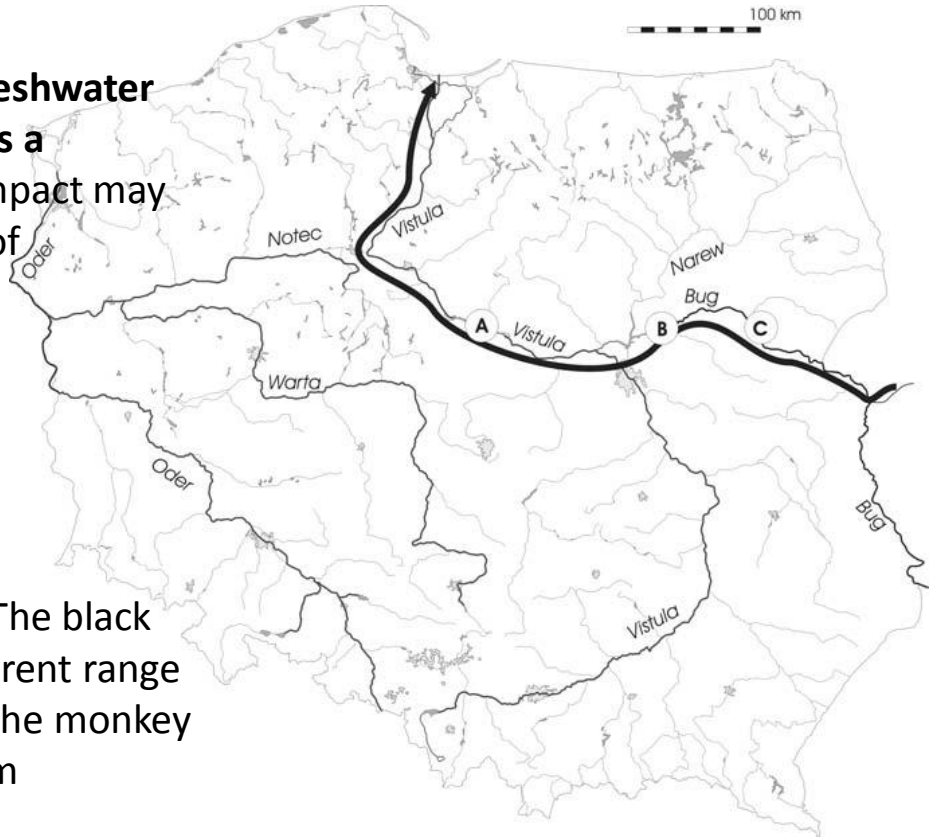


Fig. 1 Sampling site locations. The black line and arrow indicate the current range and direction of expansion of the monkey goby in the Vistula River system

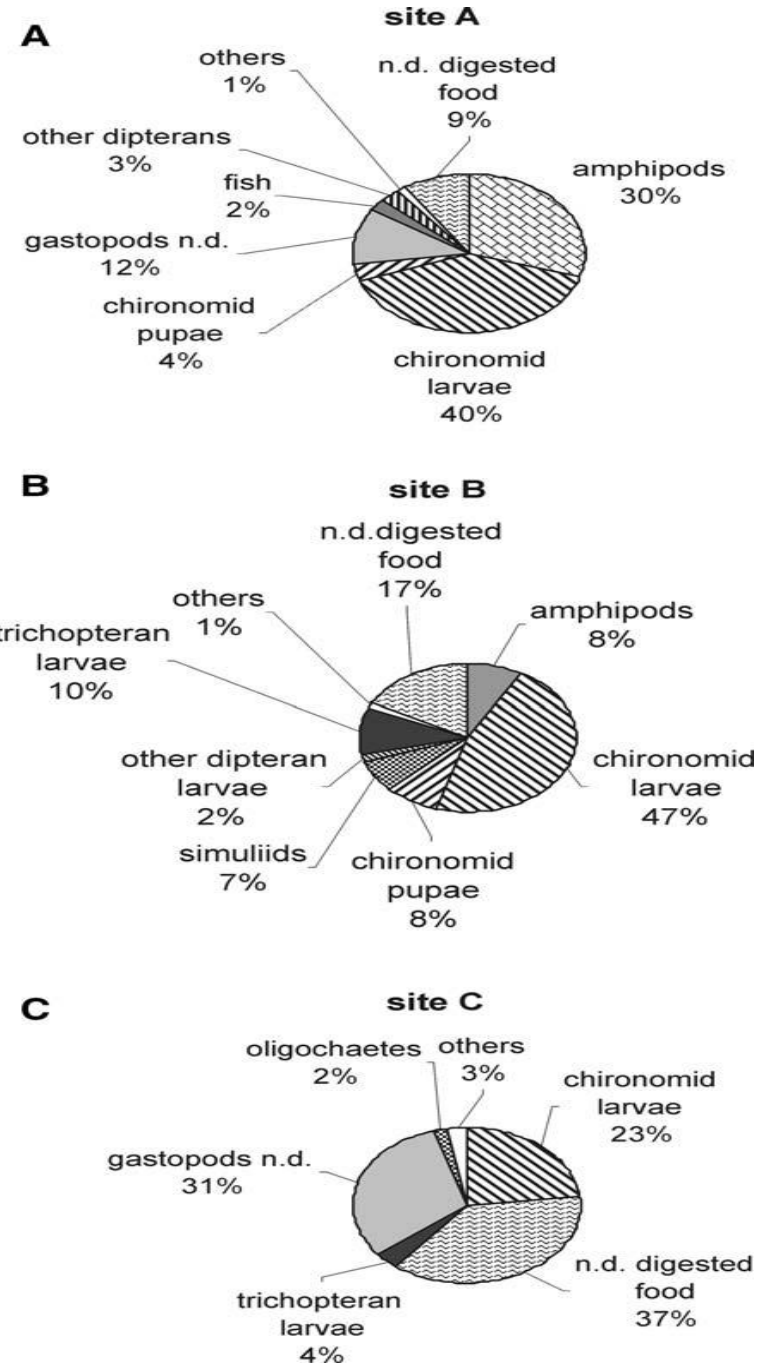
- In the majority of habitats in its natural range, both marine and freshwater monkey goby were significant mollusc consumers, although a wide range of prey were observed, based chiefly on macroinvertebrates (annelids, crustaceans, insects) rather than on fish (see Pinchuk et al. 2003 for review).
- An ontogenic, seasonal and geographical variation in diet was observed (see Pinchuk et al. 2003 for review).
- The broad spectrum of diet described for the species in its natural range may be a crucial factor for its success in invading new territories.
- The information on the monkey goby diet outside its natural range is very limited (Biro´ 1995; Kakareko et al. 2005).
- The purpose of our study was to define the monkey goby diet spectrum, feeding preferences, spatial and size related changes in diet, its diurnal feeding activity, as well as to predict which groups of native preys would be most affected by the presence of this exotic predator in a newly invaded location such as the Vistula River system

Table 1 Diet of the monkey goby expressed as relative abundance (%N) of prey at the three studied sites

Food categories	Site A $n = 99$	Site B $n = 70$	Site C $n = 31$
Crustacea			
Amphipoda			
Pontogammarus robustoides	4.24		
Dikerogammarus haemobaphes	5.05	1.17	
Chelicorophium curvispinum	6.66		
Amphipoda n.d.	5.15	0.47	
Ostracoda	0.10		
Cladocera		4.69	
Copepoda	4.14		
Insecta			
Diptera larvae			
Chironomidae	66.60	68.70	89.90
Ceratopogonidae	1.21		0.52
Simuliidae		4.69	1.04
Tipulidae		0.82	0.78
Others	0.71	0.23	
Diptera pupae			
Chironomidae	2.02	5.28	1.55
Simuliidae		4.81	0.52
Trichoptera larvae		8.56	1.55
Coleoptera larvae		0.12	
Zygoptera larvae	0.10		
Ephemeroptera larvae	0.20		
Oligochaeta	1.72		3.11
Hirudinea	0.10		
Mollusca			
Gastropoda n.d.	0.30	0.47	0.26
Fish	1.72		

n number of analyzed alimentary tracts

- The fish consumed insect larvae and pupae, crustaceans, annelids, gastropods and fish
- Chironomid larvae were a prevalent food category in all sampling sites, followed by amphipod crustaceans at one site and by trichopteran larvae and chironomid pupae at another



Food

- According to the values of the Ivlev's selectivity index, the preferred food category were chironomid larvae.
- No significant differences in diet were found over the 24-h cycle.
- There was no variation among different fish size groups.
- the species, due to its ability to use locally available food resources, displays a generalistic and highly flexible feeding strategy.

Fig. 2 Percentage of biomass (weight of given prey category in relation to the total weight of gut content: %B) of food categories in the diet of the monkey goby at the three studied sites

M. Polačik, M. Janač1,2, P. Jurajda1, Z. Adamek1, M. Ondračkova, T. Trichkova, M. Vassilev (2008): Invasive gobies in the Danube: how do they utilize the new environment?

In addition to the Austrian and Bulgarian stretch, the Croatian stretch of the Danube (which is the non-native range of *Neogobius* spp., was sampled in early November 2005

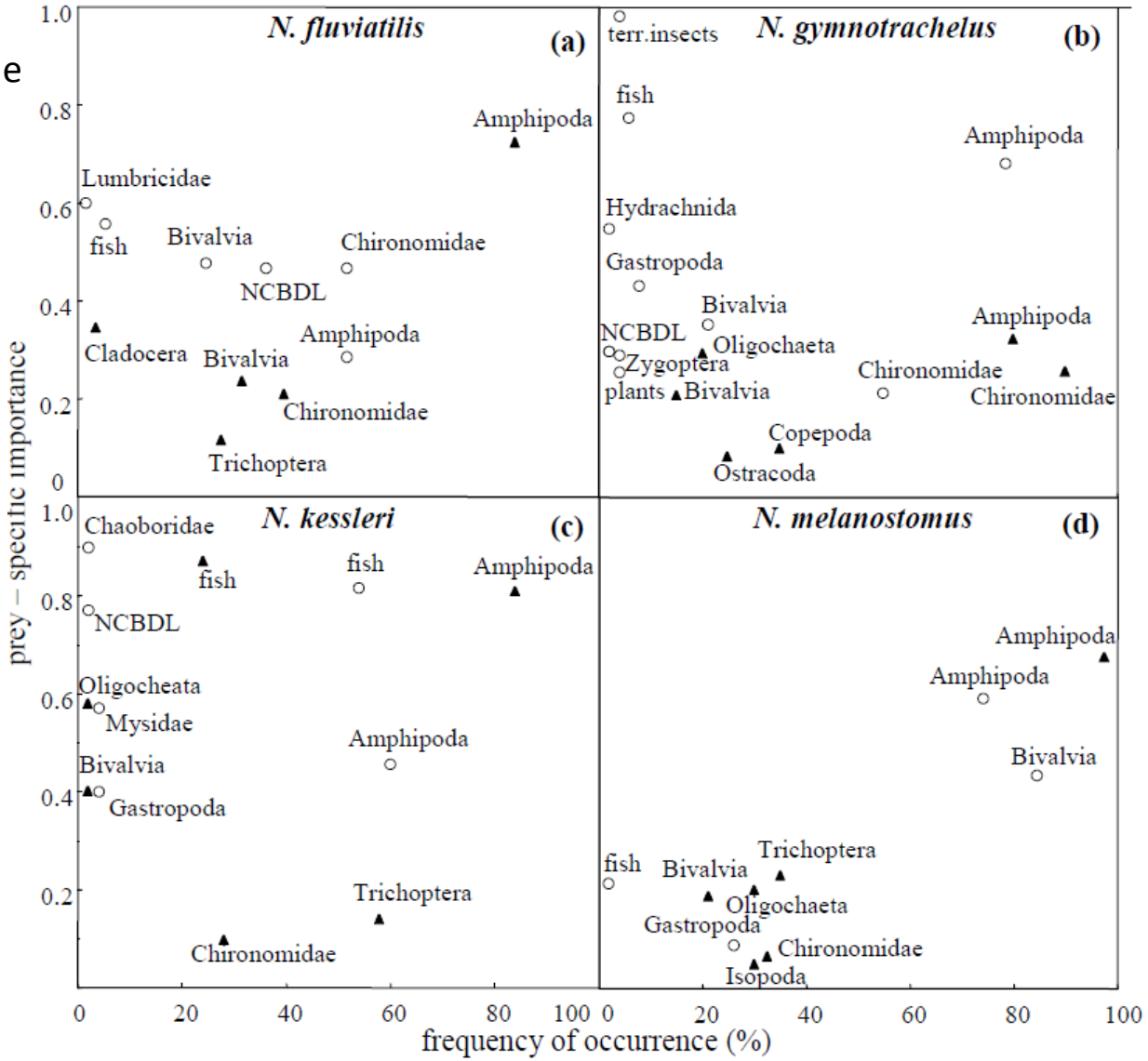


Fig. 4. The Costello's plots of monkey goby (a), racer goby (b), bighead goby (c) and round goby (d). The prey items consumed by native populations are denoted by circles and those consumed by the non-native populations by triangles. The prey items of low prey – specific importance (< 0.2) and consumed with low frequency (< 20 %) were omitted from the plots. NCBDL = Non-chironomid benthic Dipteran larvae.

Maria Capova, Ivana Zlatnicka, Vladimır Kovac
Stanislav Katina (2008): Ontogenetic variability in the external morphology of monkey goby, Neogobius fluviatilis (Pallas, 1814) and its relevance to invasion potential

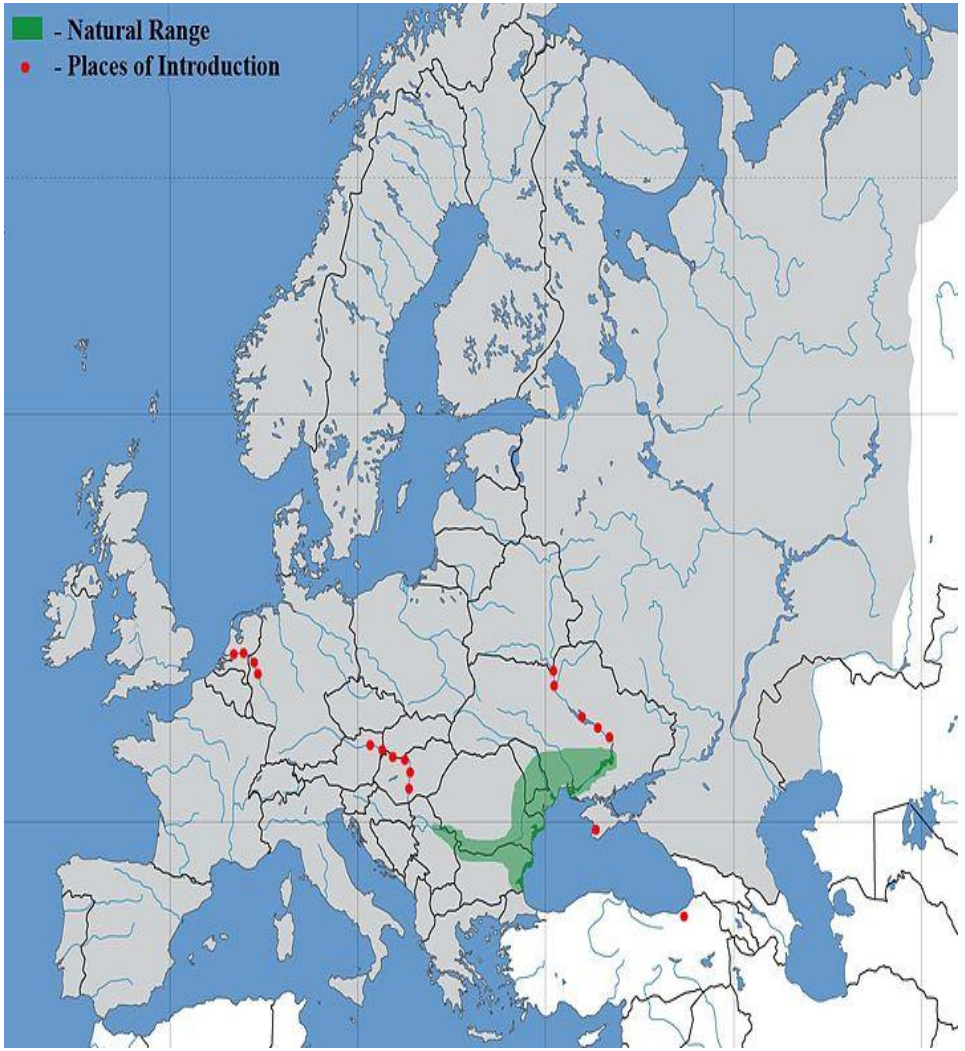
- Monkey goby has significantly smaller lower jaw length and maxilla length than the round and bighead gobies, which indicates a smaller mouth gap.
- This demonstrates specialization of monkey goby on smaller diet items compared to both round and bighead gobies.
- the diet of monkey goby in Slovakia is composed mainly from Chironomid larvae and small Crustaceans
- the prey of bighead and round gobies also include bigger items, such as Molluscs, Amphipods and Trichoptera larvae, with bighead goby preying even on small fishes (Kosco et al., 2006; Adamek et al., 2007).

- Monkey goby reach their definite phenotype very early in their ontogeny and thus represent a strongly precocial (=specialized) species with direct development (Flegler-Balon, 1989).
- The morphological differences between monkey goby and the two other goby species discussed in the present study also refer to its strong specialization to sandy substrata and smaller prey.
- This corroborates previously reported data on habitat and items preferences of monkey goby (Berg, 1949; Kazancheev, 1963; Svetovidov, 1964; Eros et al., 2005; Kosco et al., 2006; Adamek et al., 2007).
- Therefore, it can be expected that monkey goby should not spread to new areas as fast as round and bighead gobies and if they do, they should be limited to habitats with sandy and/or sandy gravel bottom.
- If this assumption is correct, then it follows that the potential impact of monkey goby on native fauna or even ecosystem is likely not to be as negative as it can be in the case of bighead and round gobies.

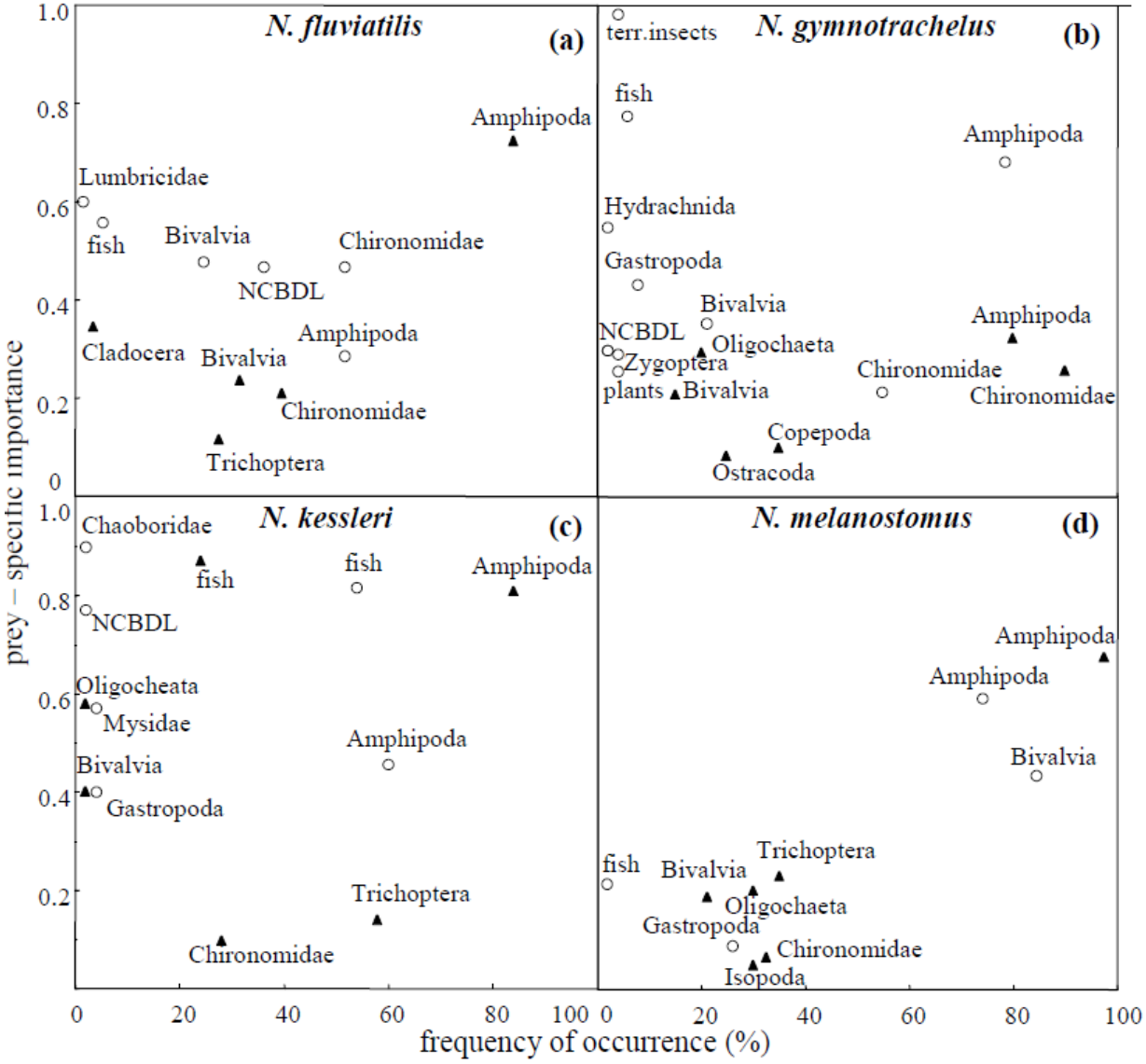
P. kessleri

- It is present in lagoons and estuaries of the north-western Black Sea, near the Bulgarian coast, especially in lakes Mandra, Vaya, Varna, Beloslavsko
- In the Danube River the original distribution of the bighead goby reached Vidin and was common in the lakes of the Danube delta.
- It inhabits the rivers Dniester up to Kamianets-Podilskyi, small rivers Zbruch and Bystrytsia.
- Dnieper up to Dnipropetrovsk, also in the Southern Bug River.

- The bighead goby was recorded as non-indigenous species in the Slovak section of the Danube River in 1996 and until 2004, this species had the widest density and distribution among the four Gobiidae species.
- In the Danube River basin, species is also mentioned as non-indigenous in the Tisza River.
- In the Upper Danube it was registered in Austrian and German parts up to the City of Straubing
- During 2000-2002 - registered in small streams of the Black Sea coast of Eastern Turkey
- Since March 2009 the fish is registered in the North Sea basin, in the Waal River, the Netherlands
- At the German part of the Lower Rhine, between the cities of Cologne and Rees, this species consists of 52% of gobies catchments in 2009



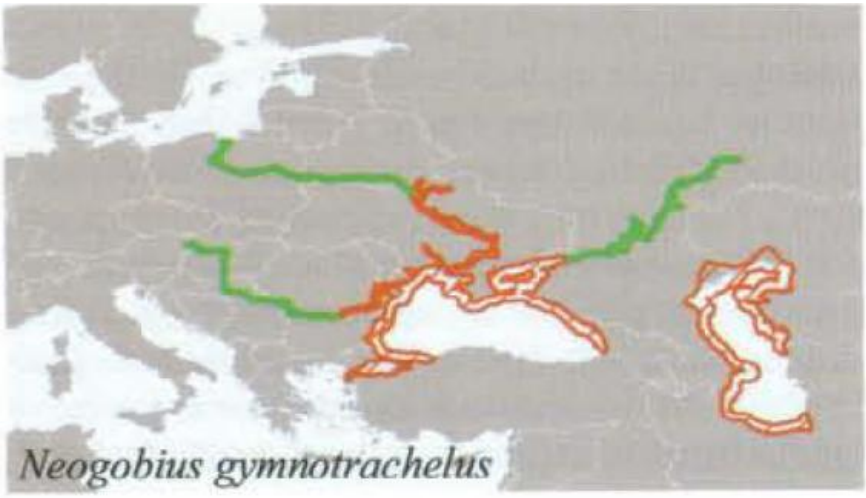
- Found usually in freshwater and brackish water with very low salinity (< 2 ppt); in lower rivers and lagoons, lakes, large rivers, harbours on rocky or well-vegetated bottom (reed thickets) in still waters as well as rapids.
- Initial spawning at 2 years, in March to May, where adhesive eggs are deposited on stones, shells and aquatic plants; while males guard the eggs until hatching.
- Feeds on crustaceans (mysids, corophiid amphipods) and small fish (gobies)



The prey items consumed by native populations are denoted by circles and those consumed by the non-native populations by triangles.

Babka gymnotrachelus

- This goby inhabits the coasts of Turkey, the rivers of the Caucasus, including Inguri, Rioni and the rivers of Kolkhida, including Lake Paliastomi, Lake Suzha.
- In the north-western Black Sea it inhabits the Dnieper-Bug Estuary, Dniester Estuary, near the Tendra sandbar and Berezan Island.
- In the Danube River it is widspread up to Vidin, and lives in tributaries and lakes of Danube delta, including Brateş, Kahul, Yalpug, Katlabuh, Kitay, Razelm, etc.
- It inhabits the Dniester River and its tributaries, including Zbruch, Zhvanchik, Smotrych, Răut, Bîc, Dubăsari Reservoir.
- It is common in the Southern Bug River and in the Dnieper River as far as Kiev. It lives in the Kamchiya River and Lake Shablensko in Bulgaria.
- In the Sea of Azov it is in Taganrog Bay and the Don, Aksay, Seversky Donets rivers.
- Also inhabits the Caspian Sea, where presented by the subspecies *Babka gymnotrachelus macrophthalmus*.



- Occurs in brackish- and fresh-water habitats with low salinity (< 2 ppt); lagoons and lakes; large rivers to small, fast-flowing streams; on sand or mud bottom; mainly in well vegetated or high-complexity habitats.
- Abundant in backwaters and still channels
- Longevity is 4-5 years; spawns for the first time at 2 years; spawning season in April to June, occasionally until mid-August; females may repeat spawning during a season; usually spawns for a single season.
- Males guard eggs until hatching; with adhesive eggs deposited on stones, shells and aquatic plants
- Feeds on crustaceans (esp. Corophiid amphipods), aquatic insects (mostly chironomid larvae), polychaetes, also small fish and mollusks

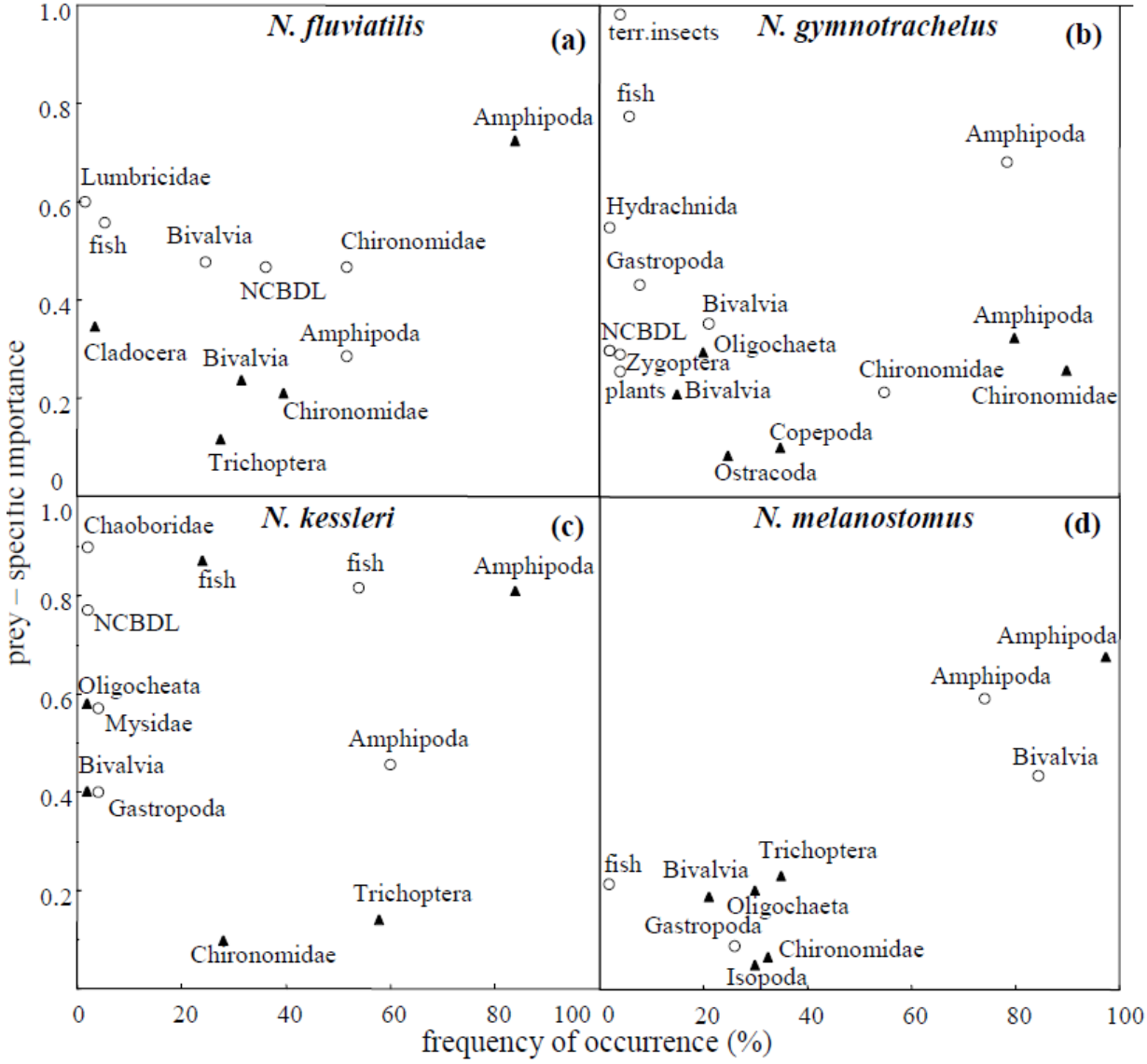
Diel-feeding activity in early summer of racer goby *Neogobius gymnotrachelus* (Gobiidae): a new invader in the Baltic basin

By J. Grabowska[1] and M. Grabowski[2] (2005)

- Amphipods constituted 11–70% of total gut content biomass and were found on average in 84% of analysed alimentary tracts.
- The second prey types were chironomid larvae (16–63% of total food biomass; frequency occurrence: 61–91%), and to a lesser extent chironomid pupa, ceratopogonid larvae, oligochaets, dipteran imagines and copepods, with fish larvae found in the gut of eight gobies.
- racer goby forages mainly on benthos and has a nocturnal feeding activity.

	Size class of fish					
	Small		Intermediate		Large	
Food categories	%B	%F	%B	%F	%B	%F
Amphipods (57.6)						
Pontogammarus robustoides	36.0	55.0	33.4	56.5	42.0	14.3
Dikerogammarus haemobaphes	2.9	8.3	2.8	4.4	16.7	21.4
Chelicorophium curvispinum	3.7	16.7	8.4	30.4	2.4	28.6
Gammaridea (not determined)	2.1	8.3	13.7	23.9	16.5	50.0
Dipteran larvae (1.3)						
Chironomidae	39.1	78.3	21.2	76.1	12.0	71.4
Ceratopogonidae	1.5	5.0	1.1	6.5		
Other Diptera	1.2	3.3	0.1	6.5		
Dipteran pupae (5.3)						
Chironomidae	2.7	8.3	5.1	17.4	6.0	28.6
Other Diptera			1.5	2.2		
Terrestrial arthropods (1.8)						
Chironomidae imagines			0.8	6.5		
Other dipteran imagines	0.3	1.7	0.7	2.2	1.7	7.1
Orthoptera			0.1	2.2		
Thysanoptera	0.1	3.3	0.6	2.2		
Araneida	0.6	1.7	0.1	4.4		
Others (2.5)						
Copepoda	1.4	11.7	0.1	6.5		
Ostracoda	0.1	5.0	0.1	10.9		
Oligochaeta	0.6		1.1	8.7	0.2	7.1
Gastropoda	0.7	1.7	0.4	2.2		
Hemipteroidea	0.2	1.7	0.2	2.2		
Zygoptera larvae			0.5	2.2		
Coleoptera larvae			0.1	2.2		
Ephemeroptera larvae			0.6	4.4		
Fish (2.3)						
Larvae	4.5	10.0	0.6	2.2	0.5	7.1
Eggs			0.8	4.4	0.4	7.1
Detritus (3.8)	2.5	13.3	6.0	23.9	1.8	21.4

Table 1
Food categories expressed as biomass percentage (%B), which for main taxa in combined values is given in parenthesis, and frequency of occurrence (%F) for small (n = 60), intermediate (n = 46) and large (n = 14) racer goby from Włocławski Reservoir (River Vistula, Poland) over a 24-h period on 29 May 2003


N. fluviatilis
(a)
Amphipoda
Lumbricidae
fish
Bivalvia
Chironomidae
NCBDL
Cladocera
Amphipoda
Bivalvia
Chironomidae
Trichoptera
terr.insects
N. gymnotrachelus
(b)
fish
Amphipoda
Hydrachnida
Gastropoda
Bivalvia
Amphipoda
NCBDL
Oligochaeta
Zygoptera
Chironomidae
plants
Bivalvia
Chironomidae
Copepoda
Ostracoda
N. kessleri
(c)
Chaoboridae
fish
fish
Amphipoda
NCBDL
Oligocheata
Mysidae
Amphipoda
Bivalvia
Gastropoda
Trichoptera
Chironomidae
N. melanostomus
(d)
Amphipoda
Amphipoda
Bivalvia
Trichoptera
fish
Bivalvia
Oligochaeta
Gastropoda
Chironomidae
Isopoda
prey – specific importance
frequency of occurrence (%)
0
0.2
0.4
0.6
0.8
1.0
0
20
40
60
80
100

T. Kakareko, J. Z_ bikowski and J. Z_ ytkowicz (2005): Diet partitioning in summer of two syntopic neogobiids from two different habitats of the lower Vistula River, Poland

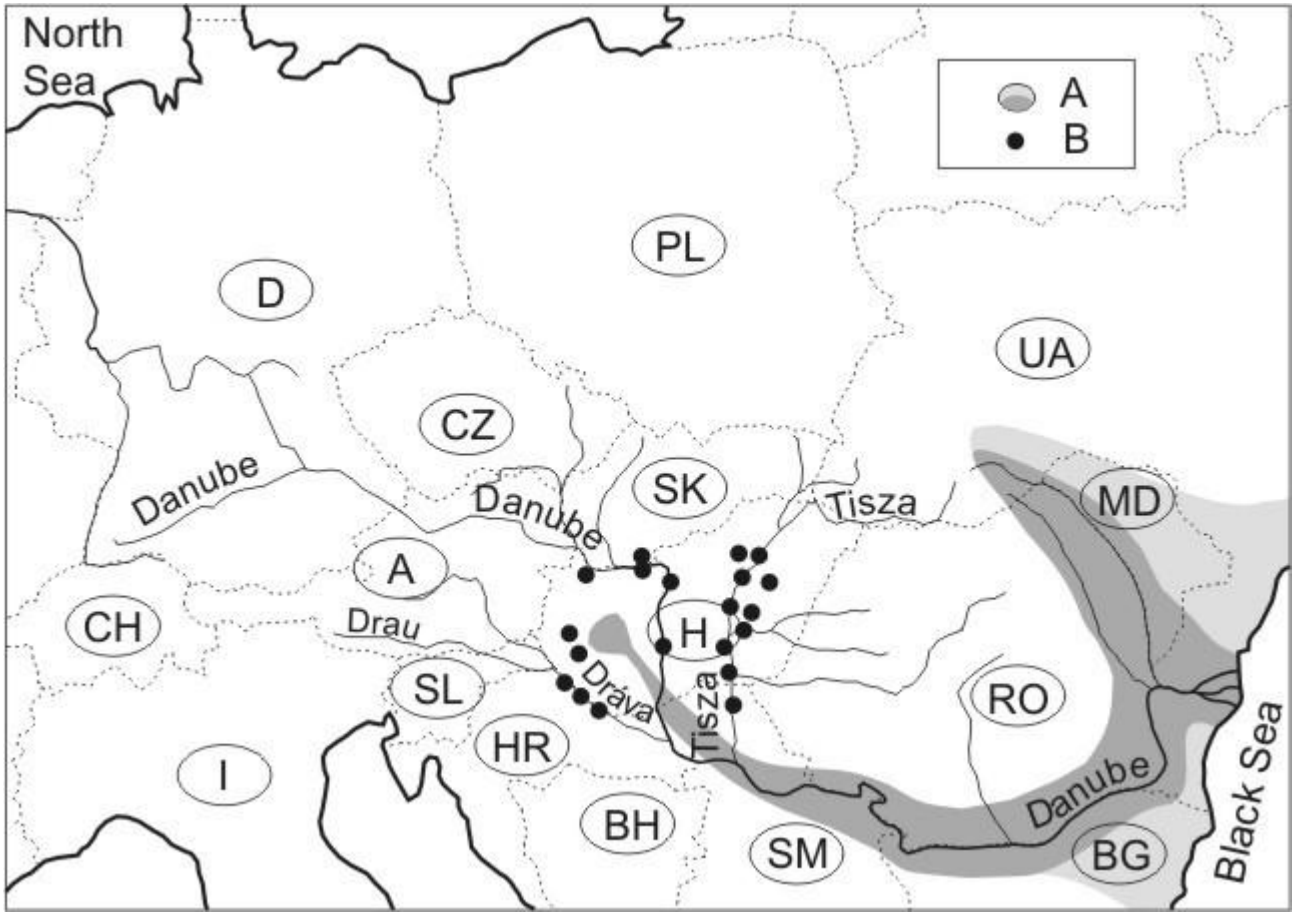
Table 2
Percentage of total weight (%W) and frequency of occurrence (%FO) of particular components in the diet of monkey goby and racer goby in the Włocławek Reservoir (10 July, 22 August, 25 September, 23 October 2001, combined) and the River Vistula (29 and 30 September 2003), Poland

	Włocławek Reservoir				River Vistula			
	Monkey		Racer		Monkey		Racer	
Diet components	%W	%FO	%W	%FO	%W	%FO	%W	%FO
Chironomidae larvae	34.2	65.5	14.2	41.7	67.2	95.7	40.6	88.9
Chironomus sp.	19.0	55.2	6.5	20.8	61.7	91.3	31.1	58.3
Cladotanytarsus sp.	–	–	–	–	+	13.0	+	8.3
Cricotopus sp.	–	–	–	–	1.1	30.4	3.5	44.4
Cryptochironomus sp.	7.1	31.0	1.0	2.1	–	–	–	–
Dicrotendipes sp.	–	–	–	–	1.8	47.8	2.5	50.0
Glyptotendipes sp.	3.7	13.8	2.7	8.3	1.9	26.1	2.1	22.2
Paratendipes sp.	–	–	–	–	–	–	+	5.6
Polypedilum sp.	+	13.8	+	6.3	+	21.7	+	13.9
Tanytarsus sp.	–	–	–	–	+	13.0	+	8.3
Chironomidae larvae n. det.	3.9	31.0	3.6	29.2	+	13.0	–	–
Mollusca	20.6	58.6	31.2	58.3	5.6	17.4	5.1	16.7
Dreissena polymorpha	–	–	–	–	3.6	4.3	4.1	11.1
Pisidium sp.	–	–	3.1	12.5	+	8.7	1.0	8.3
Potamopyrgus sp.	–	–	–	–	+	4.3	–	–
Sphaerium sp.	–	–	8.9	20.8	1.2	8.7	–	–
Sphaeriidae n. det.	18.5	55.2	8.1	27.1	–	–	–	–
Bithynia sp.	–	–	9.7	20.8	–	–	–	–
Valvata sp.	–	–	+	4.2	–	–	–	–
Gastropoda n. det.	2.1	3.4	+	4.2	–	–	–	–
Amphipoda	7.6	27.6	17.2	27.1	15.2	39.1	41.7	80.6
Oligochaeta	29.1	93.1	24.6	56.3	–	–	+	2.8
Ostracoda	3.4	34.5	5.4	27.1	3.8	56.5	1.9	36.1
Chironomidae pupae	+	10.3	1.5	4.2	–	–	–	–
Hirudinea	1.5	3.4	2.1	2.1	–	–	–	–
Trichoptera	–	–	1.5	8.3	6.0	26.1	6.0	36.1
Cladocera	+	17.2	+	18.8	2.1	47.8	4.5	66.7
Copepoda	+	3.4	–	–	+	4.3	–	–
Rotatoria	+	3.4	+	2.1	–	–	–	–
Pisces	3.1	3.4	1.9	2.1	–	–	–	–

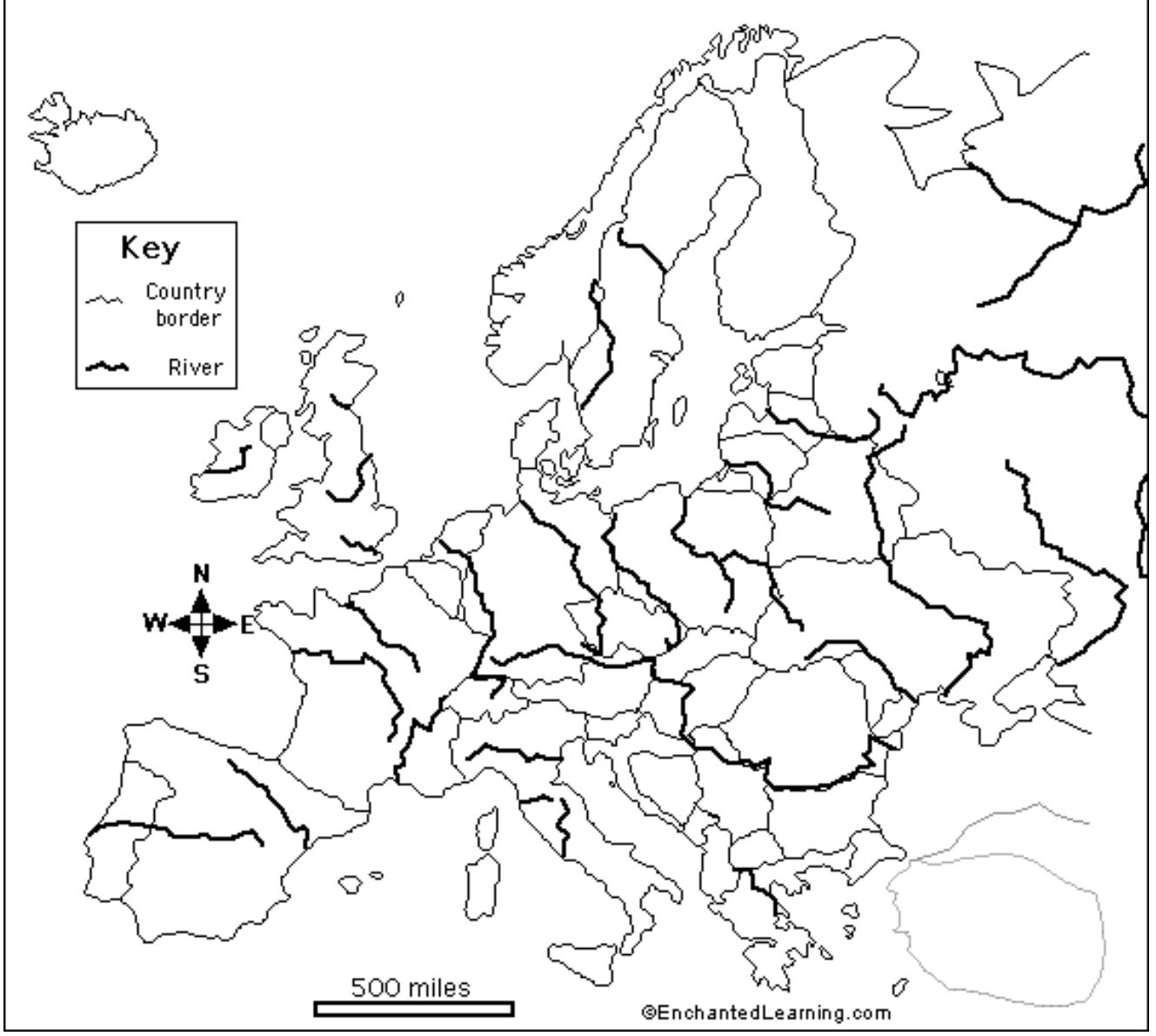
+ indicates <1%.

- the diet of Neogobius species in the lower Vistula varied according to prey availability, which itself was associated to the character of the habitat from which the fish were taken.

Thank you


North Sea
A
B
PL
D
UA
CZ
Danube
Danube
SK
Tisza
MD
A
CH
Drau
H
Dráva
Tisza
SL
RO
HR
I
Danube
Black Sea
BH
SM
BG

- In successive years its expansion seemingly stopped, but in 1993 its explosion-like propagation was observed in a reservoir constructed at the middle section of River Tisza („Tisza-tó” reservoir), as earlier in Lake Balaton (Harka 1993), respectively.
- That time this appeared as isolated habitat, but later on it was discovered that the species was present in both the lower and middle reaches of the river in Serbia and Hungary (Guelmino 1994, Györe et al. 2001).
- During the last decade the monkey goby expands in rivulets flowing into L. Balaton (Bíró & Paulovits 1994, Bíró et al. 2002), in the Hungarian-Croatian border-section and in River Tisza and its side rivers (Sallai 2002).
- In River Danube, the species moves upstream: in 2001 it was collected at the Hungarian-Slovak section (Stráňai & Andreji 2001; Sallai 2003; Holčík et al. 2003), and in 2003 it was caught at the lower section of R. Raba, near to R. Danube and the Austrian border (G. Guti personal communication).


Key
Country border
River
N
W
E
S
500 miles
©EnchantedLearning.com