GENERAL INFORMATION

Synonyms:

Perccottus Glenii Dybowski, 1877: 28 (Ussuri R., Amur R. system; Russia). Syntypes: unknown.

Eleotris Pleskei Warpachowski, in Warpachowski & Herzenstein, 1887: 19, Pl. (fig. 2) (Ilistaya [Lefu] R., Khanka Lake basin).

Eleotris Dybowskii Herzenstein & Warpachowski, in Warpachowski & Herzenstein, 1887: 21 (Chingan [Khingan] mts., Heilong [Amur] R. basin; China).

Misspelled as *glehni* (Берг, 1913: 21; Линдберг, Таранец, 1929: 259; Розов, 1934: 84; Berg 1949:1056; Никольский, 1956: 433; Vidthayanon 1995:241; Diripasko, 1997; and many others) or *glenhi* (Zhu 1995:175) in literature.

Common names: Amur sleeper, rotan (English); Amurgrunde (German); rotan – golovjeshka, rotan (Russian).

There are rather detailed morphological descriptions from the native range (Kirpichnikov, 1945; Glukhovtsev & Dukravets, 1986) and from the non-native one (Kudersky, 1980, 1982; Vasilieva & Makeeva, 1988).

NATIVE DISTRIBUTION

Rotan was found in Ussuri River and described by B. Dybowski in 1877 (see Synonyms).

The natural distribution range of P. glenii is situated in the Russian Far East (Amur Region, Southern Khabarovsk Territory, Primorski Krai, north-west of Sakhalin Region), in north-eastern China and in the north of Northern Korea (Taranets, 1937; Berg, 1949; Nikolsky, 1956). A large part of natural distribution range of rotan includes Amur River basin, where rotan inhabits most flood plain water bodies of this river and its tributaries, among them large tributaries, such as Zeya, Sungari and Ussuri. In the north distribution range of rotan reaches basin of Tugur River. In the south from the Amur drainage, rotan is known from rivers of the Sea of Japan including Suifun, Tumen-ula, Liao River, and from the region of Liushung city (former Port Arthur) (Yakovlev, 1925; Taranetz, 1937; Berg, 1949; Kirpichnikov, 1945; Nikolsky, 1956). In the Sunguri River basin, this “goby” (under that name it was known in Harbin) inhabits every where preferring, however, stagnant waters or marshes (Jakovlev, 1925). In the upper part of the Sunguri River rotan is apparently absent. In the west this fish probably does not occur up the Amur River higher than Dzhalinda (Nikolsky, 1956). Reference of V.N. Elovenko (1981) to the discovery of rotan by B.I. Dybowski (1877) in the rivers Onon and Ingoda is not correct. Taranetz (1937) indicates occurrence of rotan in the north-west of Sakhalin, opposite Amur Liman and makes a supposition that historically it had recently crossed the Tatar Strait.

In the literature there is reference to its appearance in sea water (Soldatov, Lindber, 1930; Karedin, 1966, Dmitriyev, 1971). Elovenko (1981) noted that rotan was not found in the sea unless after flood. It probably is carried from lakes by flood and does not live long in salt water. Occurrence of this species in fresh waters of the North-West and Sakhalin Island was recently confirmed (Ivanov, Ivanova, 2002).

NON-NATIVE RANGE.

Baikal basin

Appearance of rotan in Gusino-Ubukunskiye Lakes is an example of self-invasion in the basin of Lake Baikal. The staff of "Baikalrybvod" (Baikal Fish Inspection) began recording rotan since 1979. In the middle of June 1980 a sample of rotan was caught in a small bay of the eastern part of the lake near Rybpunkt settlement. In 1981 rotan was noted in other lakes of Gusno-Ubukunskaya group. In Lake Gusinoe rotan was evidently unintentionally introduced during the last release of the young of wild carp from Khabarovsk fish farm in 1969. Sorting of the young of wild carp from the young of "weed" fishes in fish farms is laborious and not secure. The insufficient purity of stocking material is the reason of rapid dispersal of rotan in the European part of the USSR as well, where it becomes devastator of pond fishery causing serious harm to commercial fishes of natural water bodies. In 1982 there appeared information of catching rotan from Selenga River in the region of settlements Oshurkovo, Tataurovo and Talovka below Ulan-Ude (Pronin, 1982)

In catches of 1979 rotan in Lake Gusinoye was recorded as a rare species. In 1986—1991 it became a common species (Pronin, Litvinov, 1994). The supposition that it was introduced into the lake during discharge of live fish tank in 1969 with wild carp from ponds of Khabarovsk fish farm was supported by cluster analysis and parasitological analysis. High infection by cestode Nippotaenia mogurndae Yamaguty, a specific parasite of rotan indicates clearly its introduction during introduction (acclimatization) because in aquarium fish breeding helminths with a complex cycle are not retained (Pronin, Litvinov, 1994). Later it became widely spread in delta of Selenga River, Posolsky Sor, Proval Bay. In 1996 rotan inhabited littoral of the southern and middle hollows of Lake Baikal. This was to a large extent favoured by warm summer seasons of 1992—1995 and lack of competition of aboriginal speices in connection with their low abundance. Predatory species (taimen, lenok, pike and others) capable to "control" abundance of rotan are on the verge of extinction. Further increase of abundance of rotan will lead to notable negative consequences, primarily because it major habitation localities are shallow water bays and near delta areas of large rivers, i.e. feeding areas of omul and other commercial fishes in the first year of life. Without decisive measures littoral of the lake will soon be definitively colonized by rotan. In the future growing impact of this predator on endemic fauna of cottoid fishes from Baikal is possible. At present, further extension of its distribution range in Lake Baikal is noted (Matveyev, 1997; 2001; Skryabin, 1988; Litvinov, 1990; Litvinov, O'Gorman, 1996; Sideleva, 2001). Its regular spread out from river mouth to river mouth of middle-sized and small rivers permits predicting its appearance in the littoral of south-eastern coast of Southern Baikal. Probably its penetration and expansion of rotan to bays of Irkutsk water reservoir and Maloye More, where it may find favourable conditions and its abundance may grow rapidly (Bolonev et al., 2002)

According to the results of the expeditions of the past few years (Bolonev et al., 2002), abundance of rotan in water bodies of Baikal Basin declines in the recent years. Regulating factors are predators for which rotan is a major kind of food (pike, perch, gulls) and natural factors among which the major one is the absence of warm water habitats and flow through the water bodies restricting expansion and increase of rotan abundance in south-western direction. It is no mere chance that in the coastal zone of Lake Baikal within Irkutsk Region only single occurrences of this introduced species have been recorded. However its dispersal in river mouths of middle-sized and small rivers of south-eastern coast of Lake Baikal should be expected. As has been noted above, it is not improbable that there may be danger of expansion of rotan in bays of Irkutsk reservoir and Maloye More where it will find favourable conditions and where its numbers will increase rapidly. But how does it happen that rotan relatively rapidly invades nearly every suitable water body situated close to the one already inhabited? Possible factors leading to transfer of rotan from water body to water body is sticking of eggs to the body of water fowl (domesticated and wild), which may be due to sticky filaments characteristic of eggs of rotan and also transfer by sportfishermen as a bait and, moreover, it easily endures transportation at long distances.

It has been established that in those water bodies where predatory fishes (pike, perch) are absent rotan becomes a common species. In such water bodies it usually displaces roach, dace and even crucian carp that before the invasion of rotan was mass species, although both species of Carassius in the majority of water bodies meet competition with rotan.

In the water bodies inhabited by many fish species including also predators, abundance of rotan is low, because there are nearly no free food resources and invader species have small chance to survive and the more so to increase their abundance when invading such water bodies. It inhabits mostly coastal zone, in macrophytes and has no pronounced effect on the composition of ichthyofauna of these water bodies. Nevertheless many authors (Shatunovsky et al., 1988, Alimov et al., 1998; Pronin et al., 1998) suppose that unless urgent measures are undertaken to prevent spreading of rotan, it may soon become the only object of sport fishing in many water bodies. Thus, the necessity to regulate abundance of rotan in water bodies is evident. For that purpose breeding of predators feeding on rotan (where possible) and search for new biological and other methods of rotan reproduction control are necessary.

Local populations of rotan in many lakes have peculiar age structure. Numbers of separate populations (generations) of fishes usually decline with age, i.e. yearlings are most numerous, next in numbers are 1+-2+ classes and then numbers of each subsequent age class declines steadily as a result of natural mortality. In rotan, the whole population in a separate water body may consist of 2—3 age classes, the generation of a single year (reproductively successful) is often predominant.

According to the data of Bolonev et al. (2002) in the basin of Lake Baikal rotan had the highest abundance in those water bodies of the Selenga River delta that had less current. Lakes had relatively complex configuration and are formed in the sites of gravel excavation and are situated 50—70 m from the main river bed of the Selenga River, are well warmed and are rich in vegetation.

However maximum peak of abundance – 6 individuals per a square meter was established by special investigations in 1986 through 1989 in an oxbow lake in the region of Shamanka stream inhabited apart from rotan also by roach and loach. In some lakes, oxbow lakes and streams it constituted 40 to 96 % of the total numbers of fishes (Litvinov, 1993; Pronin, et al., 1998). The same situation was observed in Posolsky Sor and Proval Bay of Lake Baikal where it became common species predominant in a number of coastal lakes of Lake Baikal Region (Lake Baklanye, and others), was noted regularly in gill-net catches in Selenga shallow water to a depth of 30 m. In sport ice-fishing for omul and grayling in Lake Baikal, rotan was caught by fishing rod opposite settlements Turka and Maksimikha. In the middle of September 1997 in the mouth of the Kiki River (near Gremyachinsk) several individuals of rotan 10 to 20 cm in length were caught. In the end of June - beginning of July 2000 one specimen of rotan was found in Dagary Cove (Northern Baikal) at a depth of 8—11 m, the only fish was female weighing 250 g caught by omul net. Rotan occurs at the beginning of August also on the western coast of Lake Baikal off the biological station "Bolshiye Koty" of Irkutsk University. Rotan had probably crossed Lake Baikal during transportation of juvenile fish from Posolsky Sor for experiments at the biological station. Rotan was not recorded south of Posolsky Sor in continental catches in mouths of rivers Mishikha, Kholodnaya and Snezhnaya. It is absent in the Pereyemnaya River (Baikal Reserve) either.

In Lake Gusinoye, where expansion of rotan through water basins of Lake Baikal had actually started, the major mass of rotan is concentrated in the region of Gusinoye Lake (southern part of the water body) with relatively numerous shallow water areas thoroughly warmed and rich in aquatic vegetation. It appeared in the northern extremity of the lake in the region of entry of warm waters from Gusinoye Lake Power Station, where it had not been noted before. However, its total abundance in the recent years declined considerably. It was with an effort that in August 2001 two dozens of specimens 3 to 8 cm in size were caught.

Nearly all water bodies adjoining Ulan-Ude including oxbow lakes on the left coast and down the stream of the Selenga River (Oshurkovo, Tataurovo and Talovka) are inhabited by rotan. Appearance of rotan in the fast-running mountain Turka River was surprising. However it inhabits not the river but numerous shallow water overflows, thoroughly warmed and marshy with a characteristic smell of hydrogen sulphide. Judging by the abundance of juveniles condition for rotan are quite favourable here.

Rotan has successfully adapted to the environmental conditions in the delta of the Selenga River and they are flourishing in the still-water areas.

Their success in colonizing the delta suggests that they will be able to establish populations at the mouths of most rivers entering Lake Baikal and in all of the shallow-water bays. Although the cold water and great depths of Lake Baikal were thought to preclude colonization of the main lake basin by rotan, they have reportedly been captured at 35 m in the open lake (pers. comm. from commercial fishermen to A. Litvinov). Highest densities of rotan were found in oxbow lakes where densities sometimes exceeded 4,000 fish per ha (Litvinov, O'Gorman, 1996).

In 1998—1999 single individuals occurred in control catches in Lake Bolshoye Miassovo (closed internal-drainage) in South Urals (Pereskokov, 2000).

There is evidence that this species became widely spread in south-eastern Kazakhstan and eastern Uzbekistan (Borisova, 1972; Vorobyeva, 1974; Seleznev, 1974; Smirnova, 1974; Diarova, 1975). It was noted in the basin of Ili River in shallow places of its plain section with tributaries where it was introduced as a result of acclimatization of white amur (Dubitsky, Rusinov, 1971). However since the first years of filling of Kapchagai Reservoir this species was no longer noted for Ili River basin. It is assumed that P. glenii could have been overlooked because of an abrupt decline in the numbers as a result of changing hydrological regime of the river (Dulravets, Glukhovtsev, 1983).

In water bodies of the European part of Russia rotan has been recorded since the beginning of the 20th century.

Baltic basin.

In 1912 it was brought by naturalist Ippolit Zalivsky from Zeya River to Lisii Nos settlement (St. Petersburg Region) where it was maintained in an aquarium, after which in 1916 it was released in a garden pond where it was breeding (Nabatov, 1914; Dmitriyev, 1971). In the second decade of the 20th century rotan was released by aquarians into small water bodies in the region of Sestroretsk and was spread in the coastal zone close to Petrodvorets and Gorskaya station (Lindberg, 1971; Kudersky, 1982). It inhabits, besides the coastal zone of the Gulf of Finland and water bodies of adjoining territories, also in ponds of parks of St. Petersburg (Kudersky, 1998).

Rotan is noted in the Baltic basin in Kaliningrad Region in the basin of the Pregolya River (Diripasko, 1996, 1997). The first specimen of Amur sleeper was caught by the author on June 11, 1982 in Lake Inzgener (south-eastern part of Kaliningrad). This lake belongs to the Baltic Sea basin and it is connected with the River Pregel falling down to the Vistula Lagoon (Vislinckij zaliv) of the Baltic Sea. In the Vistula River basin rotan was discovered for the first time in the Ukraine in the Vishnya River (tributary of San) on 23.06.1988. (Movchan, 1989). In Poland it was registered for the first time in 1993—1994 in water bodies of the old river bed of the Vistula River in Delnim and Kazimierz Dolny (Antychowicz, 1994; Terlecki, 1995). At present six isolated localities of the rotan occurrence in the basin of the Vistula River and Western Bug in Poland (Brylinska, 2000).

In the basin of the Danube River rotan was registered in Western Slowenia (Kautman, 1999) and in the Transcarpathian region (Ukraine). It was found in oxbow lake of the Latoritsa River (caught on 29.08.1999) (Tisza River basin) and the Chop Lake (caught on 5.06.1999) (note of the editor to the paper by Moshu & Guzun, 2002). In the recent years it began intensively spreading in the Transcarpathian region. Thus, according to the observations of Litvinchuk and Borkin (2002) it did not occur in water bodies in the vicinity of Chop, Bateva and Mukachevo in 1996, but was abundant in 2000.

In the basin of the Dniester River up the stream from the dam of Novodnestrovskaya Power Station up to the very upper reaches it is spread everywhere and quite common (Moshu & Guzun, 2002; authors' data).

In the basin of the Dnieper River it is known from small rivers and ponds and water reservoirs in the vicinity of Kiev (note of the editor to the paper by Moshu & Guzun, 2002; Sabodash et al., 2002).

In the Don system, rotan is known from ponds in Lipetzk Province (Kozlov, 1993) and from the Voronezh River (Matyrskoje Reservoir) at the town of Gryazi (Mishon, 2000).

Volga system

In 1948 rotan was brought to Moscow by participants of the Amur expedition. Next year the fish was in aquariums of many Moscow aquarians. Quite probable are other cases of introduction of rotan from aquariums into water bodies of Moscow and its suburbs (Golubtsov, 1990), the more so because rotan at that time was sold at Moscow bird market, where it was passed off as "Amur goby" (Tsepkin, 1999). It is very hardy and spread widely in Moscow ponds, sandpits, small lakes and other small closed water bodies with abundant vegetation. Its numbers are high everywhere. In the periods of high spring floods it spreads from these water bodies into rivers (Sokolov, Tsepkin, 1992).

In "Ozero Glubokoye" reserve, Moscow Region, rotan appeared in 1950. It is assumed that 4—6 specimens were released in a pond of Tarakanovo estate in the vicinity of Zvenigorod, Moscow Region where by 1961 it bacame abundant (Spanovskaya et al., 1964). Later rotan invaded also many other ponds situated close to Lake Glubokoye. In the lake the fish was noted for the first time in 1976. In 1981 in was common (Manteifel, Bastakov, 1986). In the spring—summer period rotan actively consumed larval and even some adult amphibians, which may be the reason of suppression of separate species in Lake Glubokoye. At present rotan occupies nearly all stable ponds (apart from three) and shallow area of Lake Glubokoye. Colonization of water bodies by rotan in this region continues. Thus among 26 permanently observed water bodies 6 water bodies inhabited by rotan were recorded in 1996, 7 in water bodies in 1997, and 8 such water bodies in 1998 (Reshetnikov, 2001).

Interest of aquarians in this fish is quite understandable. It survives well in cold water aquariums, in small ones (5 liters for a couple of fishes) and breeds there.

At present, as a result of uncontrolled spread out, rotan invaded many water bodies of the basin of the middle Volga River, Oka and Kama. Temperate climate, the regions of our country rich in reservoirs and lakes, man-made ponds and sandpits where sand and gravel were procured for building and road construction, abundant food, all these factors wide distribution of this fish in the Moscow Region (Korobeinik, 2001)

Rotan penetrated Gorky Region as a result of dispersal of the "Moscow population" and accidental introduction in 1970 in Ilevsky fish farm with the Amur carp. From growth ponds it penetrated flood plain of the Sarma River (Zaloznykh, 1984).

It inhabits shallow water regions of Saratovskoye and Kuibyshevskoye reservoirs. In 1981 rotan was discovered in Sviyazhsky Bay of Kuibyshev reservoir. In Saratovskoye reservoir it was noted for the first time in 1983. At present a large number of this fish is observed in some flood plain lakes of Saratov reservoir. Abundance apparently increases (Kozlovsky, 2001).

In the Volgograd Reservoir, it appears for the first time in spring 1996 at Vol'sk. According to the data of Naumenko (2002), rotan is mostly abundant in the shallow left-bank part of the reservoir from the town of Volsk to the village of Kvasnikovka, as well as in left-bank tributaries of the Volgograd Reservoir and in shallow lakes connected to the reservoir.

In Mordovia (Oka River) it is spread everywhere in stagnant waters. In 1979 this fish was reported for the first time from Temnikovsky Region, in 1981 this species was recorded in the basin of Sura River (Lake Gusinoye, Bolshebereznikovsky Region). In the middle 1980s rotan became common in flood plain lakes. Density and structure of populations of rotan attain peak values in the middle 1980s up to 100,000 individuals of varied age. In 1990 its numbers declined notably (Vechkanov, 2000).

Moreover, rotan became spread in a number of adjoining Volga regions of Tula, Ryazan, Kaluga, Vladimir, Nizhni Novgorod, Samara and also republics Tatarstan and Mari (Kudersky, 1980; Elovenko, 1981; Zaloznykh, 1982). According to the fisheries statistics catch if this fish in middle Volga in 1988 was 1.6 tons, in 1989 0.9 tons (Kudersky, Shimanovskaya, 1995).

In the basin of the Upper Volga rotan appeared in 1970 and in Yaroslavl Region it began spreading in the 1980s inhabiting in stagnant water bodies and water bodies with weak flow, mostly ponds and sand pits. In 1990 it was recorded in the region of Pleshcheyevo Lake, in Yaroslavl Region (Shlyapkin, Tikhonov, 2001; Kozlov, 1993). Rotan became spread in the national park Zavidovo (Upper Volga basin). It occurs in ponds, former river beds, ditches, overgrown shallow water areas of Shoshinsky reach of Ivan'kovskoje water reservoir (Fertikov, 1998).

Later it began occurring in regions situated further north. In the middle 1990s rotan was noted in ponds of Vologda and also in Lake Plestsy in Plesetsky District of Arkhangelsk Region (Northern Dvina drainage area, White Sea, Polar Ocean basin) where it appeared approximately in 1994—1995.

Acclimatization of rotan in water bodies of Middle Asia in Lake Baikal basin may be regarded as a transition to new areas situated in the same latitudinal zone as the natural distribution range of the species. Unlike this, introduction of rotan in water bodies of the European part of the former Soviet Union, its shift to the north (approximately by 10 degrees latitude) to the geographic zone, new for the species. Successful naturalization in water bodies of this territory is the evidence of wide ecological plasticity and potential of the species (Kudersky, 1982).

On the basis of genetic research it is assumed (Ilyin, 1987) that rotan was brought only once to the regions of Leningrad and Moscow.

Kozlov (1993) proposed conventional calculations of rate of expansion of rotan distribution range. Under conditions of branched river network rotan needed 25 years to move from Moscow by 300 km and reach Volga (12 km per year). Volga is a powerful current and its population extended its distribution range to Samara, i.e.5 times more rapidly (67 km per year), than before. With this rate of dispersal rotan will appear in Astrakhan by 2010. Single individuals will be found earlier. Approximately the same pattern of dispersal of rotan may be expected in the Don River. In the west dispersal of rotan is restricted because of the absence of connection between the Volga River basin and Zapadnaya Dvina. This does not concern the north-western direction – Baltic basin where owing to the mild climate it will disperse probably at a rate of 10—12 km per year.

HABITAT

Noteworthy is hardiness of rotan. According to the data of many authors (Yakovlev, 1925; Kirpichnikov, 1945; Sinelnikov, 1976; Kudersky, 1980, and others). It inhabits water bodies of different types endures well low oxygen content and water chemical composition. Rotan occurs mostly in water bodies that either have weak current or are stagnant with well developed higher water vegetation, in river flood plains with well developed vegetation, in littoral of lakes in swampy water bodies and even in swamps. It is particularly abundant in small water bodies with ground feeding, where in most cases rotan is the only representatives of their ichthyofauna.

Its single specimens usually after high water occur also in rivers. Adult individuals prefer deeper areas and juveniles stay in overgrown shallow water areas.

Rotan definitely belongs to eurytherm fishes (Kirpichnikov, 1945; Konstantinov et al., 1987; and many others). It demonstrates normal vital activity within a very wide temperature range from 1—2 to 20 and even 37 degrees C.

Its ability to freeze into ice and then to “melt” is well known (Yakovlev, 1925; Zaloznykh, 1982, and others). According to the information of sportfishermen from Belogorsk city of Amur Region (Sokolov, 2001) cavities in the ice where rotan winter have the appearance of a hemisphere of different diameter (from 20—30 cm to 1.5—2 m) the upper point of it is situated 30—60 cm of ice surface. It is filled with air mixed with water and pieces of ice, i.e. air ice wet mass.

Such hemisphere is very frequently situated above a hillock or a bunch of aquatic vegetation. Temperature in the place of wintering of rotans. Temperature in the locality of wintering of rotan is close to 0, they are in state of torpor and when taken out of ices slightly move. When they are put in a container with water their torpor passes quickly and fishes begin swimming actively (Reshetnikov, 2001). In the opinion of Bolonev and others (2002) by autumn salts accumulate in cavity liquids of rotan and they become a kind of a natural “antifreeze”. As a result, no internal freezing occurs and ice crystals do not destroy tissues of fishes. According to the information from the book by Bolonev and others (2002) O.N. Yunchis, an expert in fish diseases from St. Petersburg demonstrates in his lectures a piece of ice with rotan. By the end of the lecture when the ice is melted the students can see a live rotan.

Such freezing into ice is described for rotan in introduced range (Vechkanov, 2000; Naumenko, 2002).

Sometimes rotan winter in a different way, like Carassius species they are buried in silt (mud) and stay immobile for several months. According to the data of Kirpichnikov 1945) rotan was found in small water bodies in the flood plain of the Sintuhe River in the Lake Khanka basin frozen to the bottom. In one such water body with an area of less than 2 square km more than 150 specimens of rotan were obtained at the age of 1—4 years immersed in a thick layer of silt constituting the bottom of the water body. No signs of suppression of vital activity of fishes were observed, moreover, evidence of cannibalism was found.

Better than other species of Amur fauna rotan survives also warming and drying of water bodies. According to the evidence of Kirpichnikov (1945) (Khanka Lake basin) rotan was discovered in the drying pond. As the water bodies dry the amount of bicarbonates increases considerably, and growth of total water hardness and carbonate hardness and also shift of environment response toward alkaline reaction, increase of chlorine concentration and decline of the amount of dissolved oxygen (to 14.2%) were observed. A day before complete drying, 224 specimens of rotan were found, none being sick or dead. There is evidence that in the summer when the sun dries out some overgrown small water bodies to such an extent that hard silt crust is formed on their bottom, rotan are covered by mucus and in a dense capsule fall in dormancy (summer “hibernation”?), like frogs (Bolonev et al., 2002).

The physiological study (Pilipenko, Tishchenko, 1986) shows a certain physiological specificity of rotan. Structural characteristics of hypotalamo-hypophisial neural system, low values of G6PhDH activity and at the same time rapid growth rate in all probability are related to the highly eurybiont state and ecololgical plasticity of this species. High abundance of rotan population in water bodies of the European part of Russia is probably determined not only by ecological factors, but also by some physiological characteristics of functioning of several systems of its organism. An abrupt acceleration of growth of juveniles in alternating temperature regime may be regarded as an index of extreme adaptation of this fish to abrupt temperature fluctuations in natural habitats (Pilipenko, Tishchenko, 1986; Konstantinov, et al., 1987).

Many authors (Seleznev, 1973; Lysenko, Vorobyova, 1975; Zaloznykh, 1982) emphasize that within the limits of the natural distribution range and in new areas rotan attains high abundance in small water bodies with poor ichthyofauna. In large water bodies with multicomponent ichthyocenoses density of rotan population is low. Probably in complex ecosystems increase of abundance of rotan is restricted by the pressure of predatory fish species.

AGE AND GROWTH

Maximum body length of rotan in different water bodies of the native distribution range fluctuated from 14 to 25 cm (Soldatov and Lindberg, 1930; Kirpichnikov, 1945; Berg, 1949; Nikolsky, 1956). Its growth rate in native water bodies is relatively low and quite variable. In the native distribuiton range individuals older than 4+ occur extremely seldom (Kirpichnikov, 1945; Nikolsky, 1956).

According to the evidence obtained by Yakovlev (1925) for rotan from a small lake in the basin of Lake Khanka by the end of the first year fry had hardly reached weight of 1 g (on the average 0.8 g) and length of 3.5 cm. Two year individuals have body length of approximately 5.5 cm on the average and weight of approximately 4 g. Three year old individuals have body length 7.7 cm and body weight 11.6 g, seven year old rotan had body length 13.6 cm and weight 53.5 g. The author assigns this to high density of population of the particular water body up to 3-4 adult individuals per square meter.

In non-native range for Lake Glubokoye in Moscow region Reshetnikov (2001) indicates total length of 250 mm and mass of 250 g at the age of approximately 10 years.

According to the data of Kudersky (1982), in a pond in Sestroretsk in St. Petersburg Region in October 1981 individuals of three age classes were represented: 1+, 3+, and 4+.

Unlike natural water bodies in aquariums (Spanovskaya et al., 1964) rotan in the first year of life may attain a length of 5—6 cm in length. Thus its potential growth abilities are high.

In natural water bodies in Moscow region considerable of fluctuations of rotan body in the same water body are noted, which the authors attribute to uneven growth. Increase of irregularity of linear and weigh growth of the population of rotan is related to deterioration of life conditions in the studied pond. In the first years of existence in that pond rotan was scanty and feeding conditions (and therefore growth conditions) were favourable.

Its growth rate was much higher than in the Suifun River and in the lower Amur River. The range of variation of length and weight of different age groups was approximately the same. In the subsequent years as numbers of rotan in the pond increased fish weight declined and variation of growth rate rose. Growth rate of the major part of the population (data for 1961—1962) slowed down and approached growth rate in the basin of the Siufun River.

At the same time there appeared individuals growing very rapidly, much more rapidly than in 1955-1956. The increasing unevenness of growth was displayed not only in the division into rapidly and slowly growing fishes, but also in the increasingly varied character of linear weight growth and accumulation of depot nutritive substances in the liver, fat on the internal organs within each age group of rapidly and slowly growing fishes, particularly three and four year old fishes, i.e. in fishes forming the basis of the population.

In Mordovia (Volga River basin) rotan at the age of 4-5 years attains a length of 8-10 cm. Limiting length is 25 cm, body mass 350 g. In Lake Trostnoye (Sura River flood plain) a specimen with mass of 350 g at the age 8 years was caught (Vechkanov, 2000).

Linear and weight growth in non-native range can vary notably depending on food supply. Thus, indices of linear and weight growth of rotan in Lake Gusinoye, Moscow Region were high. Maximum weight of rotan attained 260—270 g (Bolonev and others, 2002), whereas in maternal water body (Amur River) and in Ivlevsky fish farm of Gorkovskaya Region maximum weight of fishes of older age at the age of 7 years did not exceed 60—70 g (Kudersky, 1980). This indicates that rotan found very good conditions with rich food supply in shallow water areas of Lake Gusinoye.

GROWTH CHARACTERISTICS AND FORMATION OF ECO-MORPHOLOGICAL FORMS

As has been noted above, Spanovskaya and co-authors (1964) noted in rotan from the European part of the USSR differentiation in growth rate and assigned it to the consequences of acclimitaiztion. Krysanov and Elovenko (1981) also paid attention to the growing variation of these fishes at long isolation of the water body. However the authors came across the same differentiation in a study of rotan from natural Far Eastern water bodies. Unlike populations from flood plain lakes of rivers Amur, Ussuri, Mo, Razdolnaya in water bodies having no relations with river for many years, as for instance clay pits in Khabarovsk, isolated lakes of the European part of Russia and Eastern Kazakhstan, distinct ecological dimorphism is observed. Two forms that the authors conventionally denoted as light and dark ones differ significantly by 12 of 45 examined plastic characters.

Rotan of the light rapidly growing form feeds mostly on fish. It has a more elongated body shape, strong head, terminal mouth, anal and second dorsal fin are better developed and shifted backwards. Rotan of the dark form feeds on all groups of aquatic invertebrates. Differentiation becomes noticeable by the end of the first year of life when stage III of gonad maturity (start of yolk development) is attained. Ratio of abundance of these forms in the population changes with growth. Fishes of the light form in the age group 50—100 mm are also rare, as well as dark individuals among individuals longer than 200 mm.

DIET AND FEEDING BEHAVIOR

In water bodies of the Far East rotan feeds on insect larvae of Chironomidae, Aedes, Chaoborus, Odonata; in a smaller amount, mostly in the young, on crustaceans Cladocera and Copepoda and larger individuals on small fishes (Berg, 1912, 1949; Yakovlev, 1925; Kirpichnikov, 1945; Nikolsky, 1956).

Diet of rotan in the natural distribution range was studied in greater detail by Sinelnikov (1976) in flood plain water bodies of the basin of the

Razdolnaya River (Suifun). It is shown that feeding range of rotan is exceptionally wide. 76 components were noted in the diet. Cladocera are represented by 18 species, among which Chydorus sphaericus, Eurycercus lamellatus, Simocephalus elizabethae are predominant. Of Copepoda, 8 species were noted (juvenile stage are predominant in numbers).

Thus, of higher crustaceans rotan prefers juveniles of river crayfish and freshwater shrimp. Larvae of different aquatic insects Odonata, Ephemeroptera, Trichoptera, Coleoptera, Diptera (Chirinomidae, Heleidae, Tabanidae), have a significant role in the diet, larvae of chironomids are the major group, both in numbers and biomass. Juveniles of rotan are seldom predators, adults feed mostly on fish; young of rotan, bitterlings, minnows.

Since the character of feeding of rotan changes essentially with age the above author (Sinelnikov, 1976) distinguished 7 size groups: 5 mm, 8-11, 12-25, 26-40, 41-60, 61-100, 101-217 mm.

In larva 5 mm in length (with yolk sack) food has not been found. Fishes 8-11 mm in size actively feed. Their diet includes lower Crustaceans and chironomid larvae. Cladocera, particularly Chydorus sphaericus, are predominant in the number of individuals and in weight. Of Copepoda, mostly immature forms occur. Chironomid larvae are represented by very small individuals, therefore in spite of their abundance (58%) their weight does not exceed 22.5%. Single larvae of May flies are noted, algae and detritus.

In the young 12-25 mm in size food is more varied. Cladocera occur in larger numbers, however, by weight (48.4%) a predominant group are chironomid larvae. In fishes of this size group remains of fish food have been found in stomachs for the first time. A case is noted when 18 mm rotan swallowed a fish of the same species that was 7 mm in length. This facts suggests not only cannibalism, but also predation on early stages. Nevertheless predation for rotan of this size group is an exception rather than a rule, because all the recorded findings were single occurrences, and as a rule only mature individuals (more than 50 mm) feed on fish.

Juveniles 26-40 mm in length feed mostly on larvae of different aquatic insects among which chironomid larvae are predominant. Adult insects are frequently noted. The role of the lower crustaceans declines considerably: they constitute approximately 30% in weight.

Fishes 41-60 mm in length among which mature individuals occur nearly never feed on lower crustaceans and pass over to larger objects – larvae and adults of insects. Their diet begins to include freshwater shrimps, remains of fish also occur.

Rotan 61-100 mm in size feeds mostly on larvae of aquatic insects. It uses chironomids to a lesser extent (34.1 %). Fishes play an important role in its diet (11.1 %).

On the basis of data obtained three periods may be defined in rotan's feeding: planktonophagous (8-11 mm), benthophagous (12-100 mm) and predatory (more than 100 mm).

In the introduced range spectrum of feeding of rotan is also very wide – from cyclops and daphnia to fishes, only slightly inferior to it in sizes. Diet of rotan from the Upper Volga Basin was found to include 100 components (Shlyapkin, Tikhonov, 2001). When food is insufficient in water bodies large individuals of rotan eat smaller ones as in the natural water body (Bandura, 1979; Bolonev, et al., 2002; and many others. This is a factor allowing its populations to exist in any biocenoses and maintain abundance on a permanent level. Feeding on fry and juveniles of valuable fish species rotan replace them from a body of water and become the only species.

According to the data of Spanovskaya et al. (1964), feeding of rotan in a pond in the suburbs of Moscow in the first years after introduction in its qualitative composition was little different from food in Far Eastern water bodies. Juveniles 40 mm in length were feeding mostly on crustaceans (Cladocera, Copepoda), and larger ones apart from Cladocera (mostly Daphnia cucullata), consumed insect larvae of Chironomidae, Ephemeroptera, Odonata, Coleoptera, Chaoborus, Heleidae, Trichoptera, Hemiptera

In 1961-1962 quantitative composition of food of rotan in comparison to 1955—1956 changed drastically. Percentage of Cladocera in fishes with sizes of 40-60 mm remained relatively high, but Chydoridae (Chydorus, Camptocercus) crayfish inhabiting algae, Daphnia and Bosmina inhabiting water column occurred in larger individuals of this group and in fishes 60—105 mm in length.

Larvae of Odonata, Coleoptera, Hemiptera nearly disappeared from the diet, the role of larvae of Chironomidae declined notably and their species composition changed. In 1955-1956 larvae of Tanytarsus, Polypedilum, Einfeldia gr. carbonaria, Limnochironomus gr. Nervosus were predominant, whereas in 1961-1962 larvae of Orthocladiinae (Cricotopus gr. silvestris, Psectrocladius gr. psilopterus) and Corynoneurinae, associate with fouling communities were more common. It was not until 1961 that rotan in that pond began consuming its own juvenile. Cannibalism was noted in individuals that had attained a length of 45 mm. In fishes more than 60 mm in length more than a half of food consumed were its juveniles. Moreover, rotan ate tadpoles that are seldom consumed by fishes.

The change for feeding on its juveniles and tadpoles is assigned (Spanovskaya et al., 1964) to an abrupt impoverishment of the fauna of large invertebrate (beetles, their larvae, larvae of dragonflies) differing from planktonic forms by a low rate of reproduction and complete elimination of crucian carp on the stage of eggs, larvae and juveniles.

Feeding on larvae and adults of amphibians was described for rotan from suburbs of Moscow (Manteifel, Reshetnikov, 1997, 2001; Reshetnikov, 2001; Reshetnikov, Manteifel, 1997) from the Transcarpathian region (Litvinchuk, Borkin, 2002). Fragments of larvae of *Bufo bufo* were found in intestines in 6 specimens (3 females and 3 males) of 31, having absolute length from 100 to 161 mm. On the average stomachs of rotan that had consumed larvae of toads contained 4 ± 1.41 *B. bufo* (1 to 10.). Rotan consumes larvae of two species of tritons Triturus cristatus and T. vulgaris, and adults of the former (Reshetnikov, 2001; Reshetnikov, Manteifel, 1997), and also larvae and adult individuals *T. dobrogicus* (Litvinchuk, Borkin, 2002).

For water bodies of Mordovia (Volga River basin) it also shown (Vechkanov, 2000) that the many generation population of rotan uses nearly the entire food supply of the water body. For instance in flood plain lakes of the Sura River this fish consumed up to 70 different representatives of invertebrates, including molluscs and its own juveniles on larval statge. For several years the extremely dense population of the species of the could devastated the whole fauna of the water body. For instance, in Lake Pyzhovka (Surskaya flood plain) where a powerful population of rotan was formed only 12 forms of invertebrates were found instead of 40-60 representatives usual in such lakes

On the whole diet of rotan in different water bodies of Baikal Region was recorded to contain approximately 100 species of food organisms belonging to 57 genera and 30 families with a maximum diversity of larvae and pupae of chironomids (28 species) and caddis flies (Pronin et al., 1988). In all water bodies rotan feeds on animal food and is characterized as an euryphage. The young of rotan consumes in large amounts small animals inhabiting in the water. At the age from one year to four years rotan is mainly a benthophage (consuming organisms living on the bottom of the water body) and partially a predator. Older age groups (on the fifth or sixth year of life) consume in large amounts the young of fishes, particularly carps.

In fish culture ponds according to the data of Elovenko and Klimova (1983) and Elovenko (1984) juveniles of rotan in the first week of life feed on phytoplankton, than changes for Cladocera and Copepoda crustaceans. When fishes attain a length of 12-15 mm chironomid larvae become a predominant group, they dominate in stomachs of rotan up to 110 mm in length. Species composition of chironomid larvae as a rule is represented by swimming forms.

Fishes up to 40 mm in length consume molluscs, larvae, May flies, beetles other Diptera, dragon flies (during moulting), caddis flies. The portion of crustaceans in food clots is disappearing. In individuals 20 mm in length, fish eggs and larvae (including those of its species) appear in stomachs; the portion of fish food increases with growth and in individuals of more than 110 mm in length it is of primary importance. Chironomid larvae have lower mass than fish food. Among fishes in fish culture ponds rotan prefers to consume those unamoured: minnows, bleaks, gudgeons, common bitterling, pike, crucian carp, its own juveniles as compared to ruffe, perch, loach and wild carp. According to the data of Zaloznykh (1982) for rotan from ponds of Ili fish farm, food of individuals of older age classes comprised up to 97% of fish objects, at the end of summer and in the autumn its own juveniles comprised up to 82 %.

Consumption of food objects very different in size and behaviour is possible because rotan possesses a number of morphological features characterizing it as an active catcher and a potential predator.

Rotan has a large mouth (hence its name in Russian); teeth are present on the dentary and premaxilla, on the lower and upper elements of the hyoid arch, on the upper elements of two last gill arches. Gill rakers (9—10) are knob-shaped covered with setae assembled in bunches, assist in keeping the prey in the mouth. Relative size of head increases with growth jaws become longer, which facilitates capturing large prey.

Makhlin (1960) indicates that rotan in aquarium readily capture guppy, juveniles of crucian carp. Results of aquarium observations in the selectivity of rotan to different foods show that when sufficient amount of different large invertebrates (for example, larvae of dragon flies) rotan with a size of approximately 60 mm much more readily feed on them than on fish. Larger individuals feed on fish, but they retain a high degree of selectivity in relation to large invertebrates.

In the opinion of Spanovskaya and others (1964) and Elovenko (1984) rotan does not feed on juveniles of its own species if other food is sufficient. Feeding on invertebrates, is apparently more characteristic of this species; the change for feeding on juveniles of its species, tadpoles is attributed to the unfavourable feeding conditions in connection with the deterioration of the state of food supply.

Yakovlev (1925) describes "hunting" of rotan in an aquarium. It notices the prey rapidly at a distance, but never attacks it immediately, it begins approaching it gradually, with stops, along a straight line, moving only its pectoral fins, not moving its caudal fin and permanently looking at the prey; only after it approaches the prey it seizes the prey by a swift sharp movement.

SEXUAL DIMORPHISM

In the breeding period males have pronounce external morphological differences from females. They are of intensive black colour with a large "inflation" of skin on the upper part of the head (Tsepkin, 1977; our observations). On the sides of the body there are distinct irregularly arranged bright bluish-green spots. Spots of the same colour, but arranged in even horizontal rows are present on dorsal and anal fins. Strong "inflation" on the head is reminiscent of "fatty pad" of males of some species of the family Cichlidae. It began beneath the skin from the interorbital space and stretching over to the back terminates near the first dorsal fin. When the male stops guarding the egg clutch its colour fades, and the inflation on the head disappears, its head gradually acquires its normal shape, and the body greenish grey colour (somewhat darker than in females).

SPAWNING BEHAVIOR

During spawning and guarding the clutch the male does not feed. It displays aggressive behaviour. It attacks adult individuals of its species placed in aquarium (both males and females), hitting them with its head and trying to make them leave its territory. Spawning lasts for several days (Bolonev et al., 2002).

Eggs are laid on the lower surface of floating objects (boards, etc.) and plants (Zaloznykh, 1984; Kozlovsky, 2001) and also on stones and other objects lying on the bottom up to tins (Bolonev et al., 2002). At the time of incubation the clutch is protected by a male. In case of death of a male eggs on the second day are consumed by other fishes (Zaloznykh, 1982, 1984). The male fans the clutch with pectoral fins, therefore the eggs are bathed well and embryos do not suffer defficiency of oxygen. Moreover the male defends the clutch and may even attach man's hand. However rotan may eat its juveniles after hatching (Bolonev et al. 2002).

SPAWNING

Spawning of rotan in the basin of the Amur River takes place at the end of May through June at a temperature of 15—20° at the age of 2+ — 3+ (i.e. on the third to fourth year) when body length is 5—6 cm (Kirpichnikov, 1945; Nikolsky, 1956). In aquarian conditions rotan can mature earlier at the second year of life (1+) (Makhlin, 1957) at the same sizes. In the European part of the acquired distribution range the majority of rotans mature at body length of 45—70 cm at the age of 2+, but there occur specimens having acquired maturity in the second year (1+) (Spanovskaya et al., 1964; Pronin, Litvinov, 1994). According to the data of Zaloznykh (1982, 1984) for Gorky Region females mature at body length of 4—5 cm and weight of 1.9—3.7 g, males become mature at a length of 3.4 cm and weight 0.95 g.

Analyzing literature data we can conclude that at more favourable temperature conditions in the acquired distribution range (a longer period of comparatively high water temperatures) duration of spawning period of the population increases and the number of portions laid by each separate female grows.

For the natural distribution range Kirpichnikov (1945) assumed one time spawning. The author emphasized that in relation to conditions of spawning rotan is hardy. He observed spawning in a water body with a depth of 30 cm, an area of 150 square m, which served as a reservoir of watering vegetable gardens, but was also polluted by cattle, was used for laundry and had hard water rich in chlorine and bicarbonate.

Reproduction of rotan in the acquired distribution range was studied in detail.

From the data of Spanovskaya and others (1964) for ponds of Moscow suburbs the spawning occurred in portions and was protracted as was shown by the observation (catch of larvae 6—7 mm in length in June and discovery of clutches of eggs, larvae, yearlings 6—30 mm in length on 8 July 1962) and the state of gonads.

In June fishes with both low and high gonado-somatic index (=coefficient of maturity in Russian literature) occurred. The high coefficient of maturity was observed in fishes ready for the first spawning; in newly spawned individuals it was low (up to 2%). Coefficients 2—4; 6—8%, larger than in the previous group were noted in fishes that had spawned earlier. The next portion of eggs was maturing. In a female 6.3 cm in length and 6.7 g in weight caught on 14th July 1962 on sections of gonads there were many unresorbed empty follicles that indicated recent spawning and also a relatively large number of oocytes constituting the next second portion of eggs that were to be released in the same year. The second portion included 380 eggs. In July percentage of fishes with low maturity coefficient (less than 2%) increased because the major mass of fishes had completed its spawning in the same year. Few individuals having maturity gonado-somatic index of 8-10% were to spawn in July. The prolonged spawning is determined not only by release of eggs in portions, but also by irregular maturation of gonads within the limits of spawning period of individuals spawning for the first time or repeatedly; it also shows the different quality of growth in connection with unfavourable conditions of feeding of the population.

Smaller (younger) individuals seem to spawn only once (Manteifel, Bastakov, 1986).

Zaloznykh (1984) emphasizes that prolonged spawning in rotan defines the wide size composition of yearlings, and the varied quality of the young allows the species to use the water body more completely and, therefore, to increase its abundance.

According to the data of Pronin and Litvinov (1994) in rotan from Lake Gusinoye (Lake Baikal basin) the interval between the first and the second egg release is 14—18 days.

According to the data for ponds of Gorky Region (Zaloznykh, 1982, 1984) (we have not found such data for the native range) the number of fish eggs in clutches is 1155 to 13650, on the average 3700. As a rule several females lay eggs in the nest in turns. Quite frequently clutches of eggs on different developmental stages occur. Maximum difference in time of hatching of larvae from mixed clutches is equal to 4 days. Probably this period determines the time during which the male allows females to approach the clutch for spawning. An average number of eggs per portion ready for release fluctuates from 330 for females 4—5 cm long to 11,493 for females 13—14 cm long. Maximum number of eggs per portion, i.e. 17,874 is noted in a female 13.4 cm long.

Histological studies of gonads of rotan in a native range (Kurdyayeva, 1976) and in an introduced range (Travkina, 1997) have shown highly asynchronous development of oocytes and spermia, which provides a wide range of the number of laid portions.

Eggs are laid in even rows and are firmly fastened to the substratum by a thin filament. One day larvae have body length of 5.6 mm and height of 1.2 mm. From the first minutes of life the larvae swim freely and are spread among coastal vegetation. Larvae are weakly mobile (Zaloznykh, 1982; Vechkanov, 2000; Bolonev et al., 2002; et al.,).

COMPETITION AND PREDATORS

Predators to a large extent control rotan abundance. In the Amur River more than 10 species, including bagrids and snakehead, feed on rotan. It is assumed that rotan abundance is controlled mostly by snakehead (Bolonev et al., 2002).

Elovenko and Klimova (1983) studied food relations between rotan and hydrobionts in fish culture ponds of Khankaisky fish factory, Khabarovsk fish-farm (native distribution range) and fish factory “Nara” of Moscow Region. In ponds, catfishes, pike, bagrids, snakehead, common perch and ruffle feed on rotan.

Among these, snakehead and perch feed on rotan most intensively. Eggs and juveniles of rotan are destroyed by bugs Notonecta glauca, Nepa cinerea, Naucoris cimicoides, Ranatra linearis, Sigara hellensii, S. falleni, Micronecta griseola, etc., beetles Dytiscus marginalis, Hibius ater, larvae of dragon flies Lestes sponea and L. nympha. Among the predatory invertebrates maximum damage to rotan progeny is caused by bugs, which in small amounts are consumed by adult specimens of rotans. In growth ponds juveniles of rotan are competitors for food to many species of gobies, ruffe, perch, minnows, loaches; to common bitterling and other fish species for chironomid larvae and crustaceans and among reared fishes to yearlings of carp, crucian carp, Amur wild carp and Amur pike.

In the Baikal system, density of rotan ranged from 41 to more than 4,000 per hectare. Densities were highest in oxbow lakes where there was no current and lowest in the river channels where the current was swift (Litvinov, O'Gorman, 1996). Feeding relationships of rotan with local species of fish are relatively tense. This is clearly seen in water bodies of the delta of the Selenga River where in similarity of food the maximum antagonism is with ide (up to 90%), crucian carp (81.2%) and roach (67.3%), to a lesser extent with dace (49.4%) (Pronin et al., 1998).

Shlyapkin & Tikhonov (2001) in the Yaroslavl Region inspected 17 reservoirs populated by rotan. In two reservoirs all kinds of fish were absent before the rotan introduction. Native fish communities of other reservoirs included 1-8 species of fishes, such as verkhovka *Leucaspius delineatus* (Heckel), roach *Rutilus rutilus* (L.), crucian carp *Carassius carassius* (L.), tench *Tinca tinca* (L.), perch *Perca fluviatilis* L. and pike *Esox lucius* L. As a result of rotan introduction in two reservoirs with one-species fish communities amur sleeper completely has superseded "verkhovka", which previously was a mass species. Multispecific fish communities with predatory fishes such as perch and pike are steadiest against the occurrence of the new species (Elovenko, 1980; Kudersky, 1980; Vechkanov, 2000).

According to the data of Zaloznykh (1982) for Gorky Region (Volga River basin) in bays of the Sarma River and in small water bodies periodically connected with river rotan occurs very seldom, even though a large number of juveniles enter this river from growth ponds of Ilevsky fish farm. Also accidental are occurrences of rotan in old river beds and flood plain lakes of Oka River, regularly inundated where predators perch and pike are common components of their ichthyofauna.

At the same time in small water bodies isolated from rivers, where deficit of oxygen often arises and inchtyocenoses consist mostly of roach and crucian carps, rotan is sometimes predominant. Obviously, such is the case with P. glenii in the biocenosis of Lake Glubokoe. In 1981, P. glenii was found in considerable numbers in the littoral, mainly in areas overgrown with water thyme; a catch made in shallow water showed a predominance of individuals up to 7 cm long, whereas individuals more than 10 cm long were rare. One individual 16 cm long and weighing 80 g was caught. In subsequent years the numbers and size of this fish in Lake Glubokoe have not changed considerably (Manteifel, Bastakov, 1986).

IMPACT

Results of research (Reshetnikov, 2001) show that the presence of rotans in small water bodies results in an essential decline of diversity of species and abundance of larvae of amphibians and invertebrates feeding on these larvae. However different species of amphibians are to a varied extent susceptible to the action of *P. glenii.* In water bodies colonized by rotan tritons *Triturus cristatus, T. vulgaris,* frogs *Rana temporaria, R. arvalis* and *R. lessonae* as a rule cannot reproduce successfully. Rotans can disturb normal development of spawning behaviour of tritons of both species, consume adult *T. vulgaris* and larvae of both species. Frogs of three species do not avoid spawning in water bodies colonized by rotan, but their larvae are actively eaten by rotans and in the majority of cases are eliminated by them completely before the beginning of metamorphosis. Toads *B. bufo* reproduce successfully in water bodies inhabited by rotan. Larvae of this species of amphibian are relatively not fit for *P. glenii* and in their mass reach the stage of metamorphosis in such water bodies. Possibly conditions of development of larvae of *B. bufo* even improve after colonization of water bodies by rotans (Reshetnikov, 2001). In small water bodies inhabited by rotan the author noted 0 to 2 species of amphibian, whereas in water bodies without rotans this index varied from 0 to 5. Significant negative correlation has been revealed between presence of rotans and diversity of species ($N=22$; $r = -0.4619$; $p = 0.03$) and also abundance.($N=22$; $r = -0.4455$; $p=0.038$) of amphibians in 1997.

Similar results were obtained during analysis of relationship between abundance of rotans and diversity ($r = -0.4969$) and abundance of ($r = -0.4792$) amphibians.

In a number of water bodies rotan may completely eliminate larvae of tritons (Reshetnikov, Manteifel, 1997).

According to the observations of other authors for the basin of the Danube *T. dobrogicus* no longer occurs in some water bodies in the vicinity of Chop, Batevo and Mukachevo after appearance of this species of fish in them. In 1996 rotan had not appeared yet, in 2000 it was already numerous (Litvinchuk, Borkin, 2000).

Negative correlation was revealed between the presence or rotans in water bodies and diversity of species of invertebrates ($r = -0.5528$; $N= 18$; p - 0.017) (Reshetnikov, 2001). In water bodies inhabited by rotan adult beetles of the fam. Dytiscidae and their larvae, beetles *Hydrous* sp., larvae of dragon flies *Aeschna cyanea, Somatochlora aenea* and *Erythromma viridulum,* spiders *Dolomedes* sp., and leeches *Haemopis sanguisuga* did not occur or were rare. These species were noted in some other water bodies that are not inhabited by rotan. However клопы-гладыши *Notonecta glauca* are abundant in a water body with с *P. glenii.* Of molluscs in a water body inhabited by rotan large прудовики *Lymnea stagnalis* are numerous. Pronin (1982) thinks that invasion of rotan, [элодеи канадской, рипуса, пеляди] in Baikal and ichthyoparasites brought with acclimatized species should be regarded as biological pollution of the lake. Biological pollution of large water bodies is nearly not restricted in time. The intentionally of unintentionally acclimatized species will evolve with the ecosystem.

In another publication dealing with rotan in Baikal Litvinov и O'Gorman, 1996 analyzed relations between rotan and other fishes. Siberian roach and Siberian dace are commercially important in many areas of Lake Baikal and together they accounted for about 50% (by weight) of the commercial harvest in the Barguzin commercial area during 1980-1989 (records of the Ust-Barguzinsky Inspector and Protector of fish). But these two valuable fishes must now share food resources with the rotan. Thus, the establishment of the rotan may eventually lead to reductions in the populations of Siberian roach and Siberian dace through competition for food. Consumption of fish eggs and young fish by rotan, however, is perhaps a more serious threat to the native fish community. Most species of native fishes spawn in deltas, in rivers, or in the few shallow, marshy areas around the lake. Establishment of dense populations of rotan in these areas could diminish recruitment of many fishes and eventually lead to large-scale population declines. In the Great Lakes, the exotic alewife appears to have contributed to the collapse of endemic fish populations by eating young fish (Eck and Wells 1987).

POSSIBLE POPULATION CONTROL

The r-strategy of reproduction of rotan at the first stages of development of new reservoirs in the Yaroslavl area (Volga system) was observed. It becomes mature on the first-second year of life and it’s fecundity here is higher, than in natural area. It promotes fast augmentation of number and suppression of indigenous species. The population number is regulated mainly via food resources, cannibalism and predators (Shlyapkin, Tikhonov, 2001).

In the basin of Lake Baikal pike may be the regulator of rotan numbers. It acts as such regulator in water bodies of the delta of the Selenga River, however its numbers are low. Alternatively, larger populations of rotan may well have developed more rapidly in the delta of the Selenga River in the absence of predation. Clearly, the focus of the two main shallow-water piscivores on rotan has reduced predation on endemic fishes although it seems unlikely that this will offset the losses of the juvenile endemic fishes to predation by the rotan. Maintaining vigorous populations of Eurasian perch and northern pike may well be an effective strategy for limiting the size of rotan populations. It is possible to increase its numbers and temporary fish rearing stations and already existing fish rearing stations. The natural reproduction of pike was affected to a large extent by dynamics of water level in Lake Baikal in the period of spawning (April – May). The natural fluctuations of the level of Lake Baikal influenced by its regulation by dam of the power station (1958). Before that minimum water level in its annual dynamics falls on April. After regulation and raising of the level by one meter seasonal minimum shifted to May. However the annual physiological cycle of pike, genetically determined, remained invariable. Decline of water level in May leads to a considerable decline of spawning areas. Therefore regime of Irkutsk Power Station function should provide minimum level of water in April as before the regulation (Litvinov, O’Gorman, 1996; Bolonev et al., 2002).

Litvinov and O’Gorman (1996) suppose that elimination of rotan from Lake Baikal is clearly not possible since attempts to eliminate exotic fishes after they have established reproducing populations are rarely successful.

The experiments (Zaloznykh, 1984) have shown that of all species of weed fishes rotan is the most resistant one to lime chloride and ammonia water. 100% death of rotans occurs when concentration of lime chloride is

0.3 g per 1 l of water at exposure of not less than 6 hours. In actual practice this may be done in only small pools. In processing of [бочагов] and catchment canals ammonia water works well. At water temperature of 7—8 degrees and pH 9.0 100% death of rotans occurred in 1 hour 5 minutes after 1 ml of ammonia water was diluted in one pool.