ATTACHMENT

Ivan'kovskoe Reservoir

Ivan'kovskoe reservoir was created in 1938 by closing the Volga river waterway in the area of the town of Dubna.

Major Specifications

Type:	River-like
Water surface area:	3,278.0 km^2
Volume:	1.12 km^3
Length:	133 km
Maximum width:	8.0 km
Average depth:	3.4 m
Maximum depth:	20.0 m
Average annual water intake:	
through Ivan'kovskaya HPP	7.74 km^3
through Moscow Channel	6.82 km^3
Annual water exchange coefficient:	13

The major HPP facilities include the following: locks for navigation, concrete dam with eight openings designed for the maximum flow rate of 7,350 m^3/sec and the hydroelectric station itself. The Ivan'kovskaya HPP is a low head facility, with the headwaters/tailwaters water level difference of 11.0 m and the headwaters depth of 20.0 m.

The HPP power unit is located between the two (300 m from the right shore and 330 m from the left shore) dams. The power unit consists of two Kaplan turbines with the maximum water flow rate of 130 m^3/s. The width of clearance between the runner blades is 10 mm, and the height of this clearance is 0.9 m. The water is taken to the turbine from the gatewell, the upper edge of which is located 9.5 m deep and the lower edge is located 0.5 meters above the bottom.

The most fish species in the reservoir are as follows[1]: carp bream, roach, Northern pike, pikeperch, European perch, bleak, silver bream, ruffe. The following species are rare: asp, burbot, dace, Wels catfish, chub, ziege, crucian carp. carp, nase, blue bream, rudd, ide, tench, European smelt, moderlieschen, European eel, gudgeon, and bullhead.

The species that are caught for commercial needs are as follows: carp bream, Northern pike, roach, and European perch. In 1978 –1988, 200 – 450 t of fish were caught in the

[1] Note of the translator: Here and below please refer to scientific names of fish given in Table 1.2.

reservoir annually. The commercial fish yield of the reservoir is 7 – 14 kg/hectare, but taking into account amateur fishing it is about 15 – 20 kg/hectare (Isaev, Karpova, 1989).

Table 1 Data obtained on the reservoir

Parameter	1979 - 1980	1989 – 1990
Fish downstream migration through the HPP dam		
Number of:		
Daily fish catching stations	36	45
Ichthyological samples	1,442	924
Fish caught	1,596	3,044
Distribution of young fish near the dam		
Number of:		
Icthyological samples	131	81
Fish caught	13,000	403

Table 2 Species specific structure of migrants, %

Species	1979 - 1980	1989 - 1990	Species	1979 - 1980	1989 – 1990
Bleak	30.4	29.3	Pikeperch	9.2	8.5
Carp bream	10.0	24.6	European Smelt	5.7	*
European perch	25.5	22.7	Ruffe	9.0	*
Roach	3.1	10.9	Other	7.1	4.0

* Included in “Other” row.

Table 3 Age of migrants, %

Species	Prolarvae	Early larvae	Late larvae	Fry	Fish age	
					0+	≥ 1+
Bleak	0	12	50	38	36	64
Carp bream	0.2	3.8	1	95	66	34
European perch	0	17	62	21	45	55
Pikeperch	2	37	16	45	93	7
Roach	0	0	4	96	20	80
Other	-	-	-	-	70	30
Average	1	12	25	62	49	51

The fish downstream migration through Ivan'kovskaya HPP was studied in 1979 – 1980 and 1989 – 1990. These studies included year-round observations on the intensity of migration through the HPP turbines and observations on the young fish distribution near the HPP dam from June through August. The scope of the data is given in Table 1.

Over 20 species have been observed as downstream migrants. The information on the major migratory species is given in Table 2. Other migrants were as follows: silver bream, ziege, bullhead, gudgeon, Volga pikeperch, carp, ide, asp, Moderlieschen, burbot, Northern pike, European eel, Wels catfish, European smelt, and ruffe. The following species are the most exposed to downstream migration: bleak, carp bream, European perch, and roach.

Practically all age groups are presented in the reservoir, from prolarvae to adult fishes. On the whole, for small size species, there are more migrants over 1 year old and older (bleak and roach), while for large size fish (pikeperch and carp bream), the situation is just the reverse, i.e., there are more younger migrants (see Table 3). As fry, carp bream and roach migrate the most, while as prolarvae and larvae, bleak, European perch and pikeperch migrate the most.

The average concentration of the migrants in 1979 – 1980 was 5.09 /1,000 m^3, and in 1989 – 1990 – 1.82 /1,000 m^3. The downstream migration is the most intense in summer, with June being the downstream migration peak (Table 4). It is the least intense in winter, especially in January. From summer to winter the concentration of the migrants gradually goes down, while from winter to summer, the concentration of the migrants drastically increases, especially from April to June.

The number of migrants in the reservoir in various years stayed practically the same, and there were always about 4 times more young fish than adult fish (over one year old) there (Table 5).

Table 4 Average Concentration of Fish Migrants (no./1,000 m^3)

Year	Jan	Feb	Mar	Apr	May	Jun
1979	0.15	0.19	0.19	1.49	3.18	20.62
1989	0.02	0.07	0.12	1.17	0.37	13.36
Year	Jul	Aug	Sep	Oct	Nov	Dec
1979	10.37	4.37	4.77	2.91	1.80	0.78
1989	2.24	1.75	1.04	1.05	0.45	0.22

Table 5 Quantity of migrants (thousands of individuals)

Species	1979 - 1980	1989 – 1990		
		Total	0+	≥ 1+
Bleak	5,846	4,800	3,273	1,527
European perch	5,042	3,373	2,641	732
Carp bream	1,636	3,562	2,963	599
Pikeperch	1,328	1,159	1,128	31
European smelt	923	31	21	10
Roach	410	640	310	330
Ziege	0	134	0	134
All species	17,751	15,969	12,625	3,344

Table 6 Fish injuries resulting from HPP downstream migration

Body size, mm	Percentage of injured fish, %	
	All species	*Cyprinidae* sp.
40 – 80	6.0	5.1
81 – 100	6.4	7.1
101 – 150	11.2	15.3
151 – 200	8.6	10.7
201 – 600	11.1	14.3

Fish injuries and losses, resulting from their HPP downstream migration, have been observed during both periods of studies. In 1989 – 1990, 2,414 species over 40 mm long were examined to determine mechanical injuries (without pressure induced injuries) in HPP turbines. The following kinds of injuries were observed: cuts, bruises and crushed wounds; absence of body parts, and damaged fins. Totally, 196 fishes of various species had these kinds of injuries (Table 6), which is 8.1% of the total number of the examined species. A number of injuries varied from species to species. For example, 5.3% of Percidae species were injured, compared to 9.0% of Cyprinidae species.

The conclusion has been made that all these injuries result in the fish loss. On the whole, from July 1989 through July 1990, 271,000 of all fish species over one year old were lost due to mechanical injuries.

Ust'-Khantajskoe Reservoir

Ust'-Khantajskoe reservoir was created in 1970 on the Khantajka river, the Enisey river tributary. The reservoir has two branches located on both sides of the HPP dam: right branch in the Khantajka river and left branch in the Kulumba river.

Major Specifications

Type:	River-like, with two branches
Water surface area:	2,120.0 km^2
Volume:	23.5 km^3
Length	160 km
Maximum width	27.0 km
Average depth	27.0 m
Maximum depth	50.0 m
Average annual water flow through HPP	19.5 km^3
Annual coefficient of water exchange	1.3

The major HPP facilities are as follows: river dam, left shore earthen dam, right shore dam, concrete dam with two openings designed for 3,600 m^3/sec water flow rate, and gatewell. Ust'-Khantajskaya HPP is a high head HPP with 55.5 m difference between the headwater level and tailwater level and a headwater depth in the gatewell area of 31.0 m.

The HPP power unit is installed between the earthen and concrete dams. It consists of seven Kaplan turbines with the maximum water flow rate of 165 m^3/sec each.

The water is taken to the turbine from the gatewell, the upper edge of which is located 15 meters deep and the lower edge is 2 meters above the bottom. There is a special channel that connects the gatewell with the reservoir. This channel is 200 m long, 38 m wide and 23 m deep. In its outflow, the bottom of the channel is 22 meters above the bottom of the reservoir.

There are 18 fish species in the reservoir. The most common species are as follows: sardine cisco, peled, humpback whitefish, roach, European perch, Northern pike and burbot. There are also minnow, taimen, goldfish, dace, broad whitefish, grayling, ide, and ten-spined stickleback. In 1978 – 1988, 290 – 480 tons of fish were caught in the reservoir annually. The commercial fish yield of the reservoir ranges from 1.5 to 2.0 kg/hectare (Isaev, Karpova, 1989).

The studies of fish downstream through the Unst'Khantjaskaya HPP dam were performed in 1991 – 1992. These studies included seasonal monthly observations over the intensity of downstream migration through the HPP turbines. Altogether, there were 16 daily stations where 384 icthyological samples were taken and 980 fish species were caught. In August – September of 1991, the young fish distribution in the reservoir was studied.

Seven species have been observed as migrants (Table 7), The major migrant species are burbot, roach, humpback whitefish,and ide.

Table 7 Species specific structure of the migrants

Species	Percentage in downstream migration, %
European perch	49.4
Sardine cisco	25.9
Peled	23.5
Other	1.2

Table 8 Age of fish migrants, %

Species	Age	
	0+	≥ 1+
European perch	96	4
Sardine cisco	86	14
Peled	94	6
Burbot	0	100
Roach	96	4
other	3	97
Average	62	38

Table 9 Average concentration (no./1,000 m^3) of fish migrants

Year	Apr	May	Jun	Jul	Aug	Sep	Oct
1991 – 1992	0.54	1.83	0.86	0.36	2.46	0.14	0.27

Practically all age groups have been presented by the migrants, from prolarvae to adult species. Almost all species, except burbot, migrate during the first year of life, i.e., as larval fish and fry (Table 8). *Coregonus* species mostly migrate as adult fish, i.e., three years old and older.

The average concentration of the migrants in April – October was 0.92 /1,000 m^3. There are two periods of the highest migration intensity (Table 9). The first period is the downstream migration of *Coregonus* larvae (sardine cisco and peled) in May - June, and the second period is the European perch larvae migration in August. In the fall and in spring, most of the migrants are one year old or older.

To compare the scope of migration with the scope of commercially caught fish in Ust'-Khantajskoe reservoir, the quantity of migrants per year, as well as their mass and percentage of the total quantity of fish in the reservoir, have been calculated for 1989 and 1991. The comparison does not take into account the young fish migration (Table 10). The table shows the correlation between the percentage of the migrated fish and commercially caught fish, specifically 45% of peled, 70% of European perch and over 100% of sardine cisco migrate from the reservoir.

Table 10 Quantity and percentage of fish migrants vs commercially caught fish quantities

Species	Migrated Fish				Fish
	0+, no.	≥ 1+, no.	> 1+, kg	% of the commercially caught fish	Caught per year, kg
European perch	5,240,000	294,000	39,300	70	56,000
Sardine cisco	2,850,000	399,000	24,100	118	20,500
Peled	2,000,000	143,000	13,800	45	30,400
other	320,000	30,000	-	-	-
All species	10,410,000	866,000	-	-	-

Table 11 Fish injuries

Species	Body size, mm	Fish caught, no.	Mechanical injuries, %		
			Total	surface injuries	deep injuries
Coregonus	50 - 150	74	88	83	55
Coregonus	> 150	199	98	81	78
Percidae	50 - 150	89	28	0	22
Percidae	> 150	24	100	0	100

Fish injuries and losses, resulting from their migration through the HPP, were observed during all periods of observations. Most fishes had typical mechanical injuries and pressure induced injuries. Only 10% of migrants have been analyzed. The most common injuries were as follows: absence of body parts, spine fracture, cuts and crush wounds, scale damage, internal bleeding and eye bleeding, as well as swim bladder rupture, resulting from mechanical impact, and pressure induced injuries. No additional injuries were induced by catching the fish because the caught fish and the fish collected in the

surface and from the bottom in the vicinity of the turbine have similar injuries. The injuries data are given in Table 11 where the mechanical injuries are divided into surface injuries (scale and fins damage) and deep injuries (wounds, absence of body parts, internal bleeding, and swim bladder rupture). It should be noted that the percentage of the fish injuries is pretty high and most migrants have been killed.

Sheksninskoe Reservoir

Sheksninskoe reservoir was created in 1963 in the Sheksna river that goes into Rybinksoe reservoir. It has both lake (Beloe Lake) and river portions. The reservoir is connected with the Volga-Baltic channel and has an outlet to the Sheksna River and the Vytegra River. Only the 1982 – 1983 studies provide data on the fish downstream migration through the Sheksninskaya HPP.

Major Specifications

Type:	River-like
Water surface area:	1,665.0 km^2
Volume:	6,521 km^3
Length	262 km
Maximum width	9.0 km
Average depth	3.9 m
Maximum depth	25.0 m
Average annual water flow through HPP	5.07 km^3
Annual coefficient of water exchange	0.733

The major HPP facilities are as follows: river dam, right shore earthen dam, concrete HPP dam, and navigation lock installed between the HPP and the left shore. Sheksninskaya HPP is a low head HPP with the maximum difference of 15 m between the headwaters and tailwaters, and a headwaters depth near the gatewell of 26 m.

The HPP power unit is installed between the earthen dam and the navigation lock. It has four Kaplan turbines with a maximum flow rate of 175 m^3/s each.

The water is taken from four water intake gatewells, the upper edges of which are 13.0 m deep and the lower edges of which are 1.0 m above the bottom.

There are 30 fish species in the reservoir. The most common species are as follows: European smelt, Northern pike, roach, carp bream, blue bream, ziege, pikeperch, Volga pikeperch, and ruffe. European perch, vendace, bleak, and silver bream are also common. The following species are rare: burbot, dace, ide, rudd, and asp. The fewest are sterlet, goldfish, tench, chub, loach, moderlieschen, gudgeon, bullhead, common whitefish, and European eel. The volume of commercially caught fish in 1968 – 1988 was 397 to 1,374 tons per year. The commercial fish yield of the reservoir is 2.4 – 8.3 kg/hectare (Isaeva, Karpova, 1989).

The studies on downstream fish migration through Sheksninskaya HPP were performed in 1982 – 1983. These studies included observations on the intensity of downstream migration performed every 10 days and observations on young fish distribution in the reservoir in July – October of 1982 and June – August of 1983. Thirty eight daily stations were held where 633 icthyological samples were taken and 28,452 fish were caught. Sixty eight daily stations were held for studies of the young fish distribution where 420 icthyological samples were taken and 28,242 fish were caught.

Table 12 Species specific structure of the migrants

Species	Percentage in downstream migration, %
European perch	78.3
Pikeperch	9.4
European smelt	7.9
Volga pikeperch	1.8
Ruffe	1.1
Bleak	0.8
Other	0.7

Table 13 Age of fish migrants, %

Species	Age	
	0+	≥ 1+
European perch	99.99	0.01
Pikeperch	100.0	0.0
Volga pikeperch	100.0	0.0
Ruffe	46.3	53.7
Roach	96.2	3.8
Carp bream	97.7	2.3
Bleak	95.9	4.1
Silver bream	97.2	2.8
European smelt	95.8	4.2
All species	99.7	0.3

Table 14 Average concentration of migrants (no./1,000 m^3)

Year	Jan	Feb	Mar	Apr	May	Jun
1982 - 1983	2.0	0.9	0.7	0.5	0.9	781.2
Year	Jul	Aug	Sep	Oct	Nov	Dec
1982 - 1983	703.0	69.0	79.8	9.1	3.5	32.4

Table 15 Quantity of fish migrants

Species	Quantity of fish migrants, thousands of individuals	
	total	sexually mature fish
European perch	116,000.0	2,100.0
European smelt	33,000.0	1,321.0
Pikeperch	6,940.0	87.7
Volga pikeperch	1,300.0	7.4
Bleak	1,002.0	67.9
Ruffe	577.0	459.0
Roach	200.0	22.0
Carp bream	147.0	25.2
Silver bream	43.7	7.6

Twenty fish species have been registered as downstream migrants (Table 12). The migrants include, but not limited to, the following species: roach, carp bream, vendace, ziege, silver bream, peled, rudd, dace, bullhead, ide, gudgeon, blue bream, and common whitefish. Practically all age groups were represented, from prolarvae to adult fish. All species, except ruffe, migrate during the first year of life, i.e., as larval fish and fry (Table 13).

There are two periods of the most intense migration in the seasonal downstream migration dynamics (Table 14). The first period is June and July and is mostly associated with migration of larval fish, and the second period is in late August and September, and it is mostly associated with downstream migration of fry of pikeperch, European perch and Cyprinidae species.

The Volgogradsky Division of the National Research Institute of Fish Resources data indicate that, as of January 1, 1983, Sheksninskoe reservoir has 2,124,000 carp bream and 1,807,000 pikeperch at the age of 4+ years old. Table 15 shows the correlation between

the total number of migrants and the total number of sexually mature migrants. In 1982, 1.2% of sexually mature carp bream and 4.9% of sexually mature pikeperch migrated through the HPP.

Ozerninskoe Reservoir

Ozerninskoe reservoir was generated in 1967 by closing the Ozerna river waterway. The Ozerna river is a tributary of the Moskva river.

Major Specifications

Type:	River-like
Water surface area:	23 km^2
Volume:	0.14 km^3
Length	30 km
Maximum width	3.0 km
Average depth	6.3 m
Maximum depth	20.5 m
Average annual water flow through HPP	0.24 km^3
Annual coefficient of water exchange	1.66

The major HPP facilities include an earthen dam and hydroelectric plant. The HPP is a low head HPP with the difference between the headwaters and tailwaters of about 5 m, and the headwaters depth of 20.0 m.

The HPP power unit is located in the earthen dam (400 m away from the right shore and 600 m away from the left shore). It consists of one Kaplan turbine with the maximum water flow rate of 20 m^3/s.

Table 16 Species specific structure of the migrants

Species	Percentage in downstream migration, %
European perch	76.6
Pikeperch	10.9
Silver bream	6.6
Carp bream	3.1
European smelt	1.4
Roach	0.6
Bleak	0.5
Ruffe	0.2
Moderlieschen	0.1

Table 17 Age of fish migrants, %

Species	Percentage of fish in the age of 0+
European perch	99
Pikeperch	100
Silver bream	87
Carp bream	100
European smelt	100
Roach	42
Bleak	100
Ruffe	35
Moderlieschen	100

Table 18 Average concentrations (no./1,000 m^3) and quantity of migrants

Date	European perch	Pikeperch	Silver bream	Carp bream	European smelt	Roach	All species
April 28, 1981	0.04	0	0	0	0.04	0	0.12
April 22, 1982	0	0	1.01	0.86	0	0	1,87
June 7, 1982	56.00	6.60	0	0	0	0	62.20
August 4, 1982	0		0.10	0	0	0	0.10
August 16, 1982	0.30	0.80	0	0.30	0	0.20	1.60
August 30, 1982	0	0.24	0	0.24	0	0	0.72
September 10, 1982	0.43	0.31	1.80	0.60	0	0.14	3.42
October 20, 1982	0.02	0	1.12	0.12	0.04	0.04	1.54
October 30, 1982	0	0	0.42	0	0.05	0.03	0.50
November 10, 1982	0	0	0.51	0.16	0.93	0.02	1.62
Migrated per year, thousands of individuals	1,100	140	59	28	20	5	1,356

The water is taken to the turbine from the gatewell, the upper edge of which is installed 16 m deep and the lower edge is 0.5 m above the bottom.

There are the following species in the reservoir: European smelt, Northern pike, European eel, roach, ide, dace, chub, asp, moderlieschen, tench, nase, bleak, carp bream, crucian carp, burbot, pikeperch, Volga pikeperch, European perch, and ruffe. The most

common of them are as follows: European perch, roach, Northern pike, bleak, ruffe, and pikeperch.

No commercial fishing is conducted in the reservoir, there is only amateur fishing.

The studies on Ozerninskaya HPP downstream migration were performed in April 1981 and April – November 1982. These studies included daily seasonal observations on the intensity of migration through the HPP turbine penstock. Totally, 10 daily stations were held, 176 samples were taken and 501 fish specimen were caught.

Nine species have been registered as downstream migrants (Table 16). European perch, pikeperch and silver bream are the most exposed to downstream migration.

The migrants represent practically all age groups from prolarvae to adult fish. Most species usually migrate during the first year of life (Table 17). Only some small fish (roach and ruffe) primarily (over 50%) migrate at an older age (1+ and older).

The maximum concentration of the migrants was observed in June for the downstream migration of early larvae (Table 18). In early September, the second intense period of migration was observed, mostly associated with the migration of silver bream fry.

Over 1 million fish migrate from the reservoir annually, and the major migrant is European perch (81.1%).

Kapchagajskoe Reservoir

Kapchagajskoe reservoir was built in 1970 in the Ili River (a tributary of the Balkhash River) and it is located in a semi-arid area of the Northern type. The reservoir goes from west to east, its left shore has a gently sloping, sandy and shallow bottom and its right shore has a steep, deep and rocky bottom. The littoral zone has a lot of vegetation.

Major Specifications

Type	River-like
Water surface area	1,847 km^2
Volume	2.81 km^3
Length	118 km
Maximum width	220 km
Average depth	40 m
Maximum depth	15 m
Water surface area with up to 2 m depth	25%
Average annual water flow through HPP	5.63 km^3
Annual coefficient of water exchange	2

The HPP major facilities are as follows: concrete dam with the idle water release from the upper layers and four turbine penstocks that take water from 25 – 30 m deep levels. The water flow of each Kaplan turbine is 100 – 120 m^3/s. The HPP head is 35.7 m.

There are 24 – 30 fish species in the reservoir (Erestchenko et al.; Mitrofanov, Dukravets, 1975). Over 19 species have been observed during our studies: fringebarbel sturgeon, dace, *Ctenopharingodon idella*, asp, carp bream, barbel, topmouth minnow, *Schizothorax pseudoksaiensis*, sharpbelly, crucian carp, carp, stream loach, Wels catfish, pikeperch, Balkhash perch and *Rhinogobius brunneus*. Currently, there are 28 fish species in the reservoir (Isaev, Karpova, 1989).

Five species are caught for commercial needs. They are as follows: carp bream, pikeperch, Wels catfish, asp and carp. The fish yield of the reservoir is estimated as 5.3 – 5.5 kg/hectare. During 1980 – 1987, the total volume of the fish caught ranged from 791.5 to 1,352. 5 tons per year (Isaev, karpova, 1989). The most common fish species that are not commercially caught are: sharpbelly, *Rhinogobius brunneus*, and topmouth minnow.

The studies on the fish downstream migration through Kapchagajskaya HPP were performed in 1972 – 1975. In 1973 – 1974, the fish was caught for sampling all year round, about once every 10 days, or even daily, once at night and once in the daytime.

The following input material has been obtained for the studies: 26 complete daily stations, 2,221 fish samples and 17,000 young fish for studies of downstream migration, and 453 fish samples and about 23,000 young fish for studies of the fish distribution.

Eleven species have been observed as migrants: pikeperch, *Rhinogobius brunneus*, balkhash perch, asp, dace, roach, Wels catfish, fringebarbel sturgeon, crucian carp, and carp. The most frequent migrants were as follows: pikeperch – 64%, *Rhinogobius brunneus* – 30%, and, partially, carp bream – 4%. The downstream migration of the following species have not been observed: *Schizothorax pseudoksaiensis*, *Ctenopharingodon idella*, barbel, topmouth minnow, sharpbelly, and stream loach.

In most cases, fish migrated during the first year of life. They are: pikeperch larvae, *Rhinogobius brunneus* fry, roach, fringebarbel sturgeon, dace, and Wels catfish. Carp bream, asp, crucian carp and carp mostly migrated when one year old and older.

Three intense periods of downstream migration have been identified (Table 19). The first was in spring (March), when mostly *Rhinogobius brunneus*, carp bream and pikeperch migrated, the second was in summer (May – August) when pikeperch larvae and *Rhinogobius brunneus* larvae and fry migrated, and the third period was in late November – December when the species over one year old migrated, including sexually mature species. During the third period, the greatest number of various species migrated, and the most common migrating species were pikeperch, *Rhinogobius brunneus* and Cyprinidae species.

Table 19 Average concentration (no./1,000 m^3) of migrants

Year	Jan	Feb	Mar	Apr	May	Jun
1973 – 1974	3.17	0.53	8.00	1.33	56.3	24.4
Year	Jul	Aug	Sep	Oct	Nov	Dec
1973 - 1974	12.8	14.5	4.63	1.07	7.63	16.4

Table 20 Quantity of migrants

Species	Quantity of migrants per year, thousands	Species	Quantity of migrants per year, thousands
Pikeperch	274,240	Carp bream	20,140
Rhinogobius brunneus	68,300	All species	362,680

Table 21 Pikeperch with various kinds of injuries resulting from their passage through Kapchagajskaya HPP Turbines, %

Injured body parts	Body size, mm				
	100 – 200	201 – 300	301 - 400	401 - 500	501 – 600
Skin	6.4	39.3	55.9	37.5	55.8
Fins	6.4	14.3	5.9	7.1	5.7
Eyes	6.4	16.4	54.4	304	11.5
Gills	3.2	32.1	33.8	20.1	11.5
Swim bladder	71.0	63.3	55.6	36.4	58.3
Muscles	0	7.1	11.7	10.3	25.0
Internal organs	9.7	3.6	4.4	2.2	7.1
Mortality, %	51.6	64.3	61.1	63.6	71.4
Quantity, specimen	31	28	68	184	52

The estimated quantity of migrants (Table 20) shows that about 50% of pikeperch larvae migrate from the reservoir. Injuries have been observed in practically all migrants. On visual examination, the following injuries have been observed: bulging eyes (pikeperch, European perch, *Rhinogobius brunneus*), inversion of stomach through mouth and gills

(pikeperch and European perch), scale damage (all species), various body injuries (fringebarbel sturgeon, pikeperch, carp, carp bream and asp), gas bubbles in muscles, gills and blood vessels (pikeperch and carp bream), hemorrhages in eyes, fins, muscles, internal tissues, brain, and kidneys (all species), swim bladder rupture (pikeperch, European perch, and carp bream), irregular breathing (pikeperch, etc.) Apart from the injuries mentioned, the killed fish also had some pigmentation changes, i.e., some of them experienced discoloration (fringebarbel sturgeon), others, on the contrary, had intensified pigmentation (Wels catfish). Table 21 illustrates various injuries received by pikeperch species.

Mostiste Reservoir

Mostiste reservoir is located in the center of Europe in the hilly area of Southern Moravia. It was created by construction of a dam in 1957 – 1961 in the Oslava River (a tributary of the Danube River). The reservoir is mostly used for water supply.

Major specifications

Type	River-like
Water surface area	0.86 km^2
Volume	0.0104 km^3
Length	5.5 km
Maximum width	2.5 km
Average depth	12.1 m
Maximum depth	30 m
Flow rate through the turbine:	
through Jonson's spillway	1.5 m^3/s
through water supply system spillway	16 m^3/s
through flood spillway	115 m^3/s
Average annual water flow through HPP	0.052 km^3
Annual coefficient of water exchange	5

The major hydrofacilities there include a concrete and stone dam with four spillways, i.e. to HPP Kaplan turbine, Jonson's emergency spillway, water purification spillway with three gatewells – 5, 10 and 16 meters deep, as well as the flood water spillway 54 m wide. During our observations, the water was only supplied to the HPP penstock and to the water supply system.

The power unit is located deep underground. The water is supplied to the turbine from the bottom water layers via a special tunnel. The inlet of the tunnel is located in the central part of the small cove near the left shore of the reservoir, approximately 30 m deep.

There are 26 fish species in the reservoir. According to Lusk (1978) and Gaydusek, Lusk (1984), these species are the same that were originally found in the Oslava River. During our observations, we have registered 15 fish species there. They are as follows:

whitefish*, Northen pike, roach, chub, rudd, asp, tench, gudgeon, bleak, carp bream, European eel, pikeperch, European perch, and ruffe.

Table 22 Scope of collected material

Data	Quantity		
	Daily stations	Samples	Fish caught
Fish downstream migration through HPP	15	488	579
Fish downstream migration through water supply system	15	607	460
Fish distribution in the reservoir	-	504	793
Other observations	-	59	3,323

Table 23 Species specific structure of fish migrants through HPP and water supply system, and resident fish of the reservoir, %

Species	HPP	Water Supply System	Reservoir
Roach	0.17	0.35	2.26
Bleak	0.17	-	0.16
Carp bream	0.17	-	0.48
Pikeperch	0.17	6.67	10.34
European perch	82.38	92.85	86.43
Ruffe	8.64	1/05	0.16
European eel	8.29	-	-
All species, number of specimen	579	285	619

Table 24 Ages of fish species migrating through the turbine and water supply spillways, %

Type of spillway	Species	Larvae	Fry and older
HPP	European perch	97.0	3.0
	European eel	-	100.0
	Ruffe		100.0
	Carp bream		100.0
	Other		16.7
Water supply system	European perch		15.3
	Ruff		100.0
	Roach		100.0
	Pikeperch		0.0

There is no commercial fishing, only amateur fishing, primarily with hook tackle.

The fish downstream migration studies were performed in 1982 – 1983. The migrants were caught on a daily and seasonal basis in the HPP and water supply system spillways. The nets were installed in the tailwaters for their entire width, thereby preventing the fish from entering the tailwaters. The scope of collected data is given in Table 22.

Table 25 Average concentration (no./1,000 m^3) of migrants

Year	Jan	Feb	Mar	Apr	May	Jun
1982 – 1983	0.12	0.11	0.04	0.17	4.33	0.06
Year	Jul	Aug	Sep	Oct	Nov	Dec
1973 - 1974	0.17	0	0.46	0.01	0.42	0.20

Table 26 Young European perch injuries, %

Number of fish	Norm	Swim bladder		Buoyancy		Hemorrhages			Inversion of internal organs	Mechanical injuries
		expanded	ruptured	+	-	eyes	fins	internal organs		
20	-	10.00	65.0	10.0	50.0	20.0	35.0	5.0	10.0	15.0
46	6.5	19.6	80.4	45.6	47.8	21.7	52.2	10.9	54.4	0.0

The migrants through the HPP included the following seven species: European perch, ruffe, European eel, pikeperch, roach, bleak, and carp bream (Table 23). The first three were the most frequent migrants (99.3%), others were very few.

The fish migrated as larvae (European perch, pikeperch and carp bream) and as fry, as well as older fish, including sexually mature species (European perch, ruffe, and European eel). Table 24 shows the correlation between two age groups of the fish migrants, i.e., larvae of 4.5 – 17.8 mm long and fish one year old and older. On the whole, larvae prevailed in the migration through both the HPP (94.1%) and the water supply system (81.2%).

The downstream migration was the most intense in May (Table 25) with the larvae migration concentration of 6.41/1,000 m^3. The second peak of migration was in

September (0.46/1,000 m^3) when the older fish migrated. The average annual concentration of the migrants was 0.28/1,000 m^3 at HPP and 0.53 at the water supply system. The estimations on the downstream migration have been performed for the European perch species because it appears to be the most common migrant. Within a year, about 27,000 larvae and about 3,500 older fish migrated from the reservoir.

Fish injuries and losses through their HPP migration were observed throughout the entire period of observations (but the fish were very rarely injured while migrating through the water supply system). Table 26 shows that in November – December 1982, all fish that migrated through the turbine had injuries. Their major injuries were as follows: swim bladder rupture, negative buoyancy, and hemorrhages in the fins and eyes.

Volgogradskoe Reservoir

Volgogradskoe reservoir was created in 1958 – 1960 by blocking the Volga River in the Volgograd area for the purposes building an HPP, providing navigation, irrigation and fishing.

Major Specifications

Type	River-like
Water surface area	3,117 km^2
Volume	31.45 km^3
Length	540 km
Maximum width	4.6 km
Average depth	10.1 m
Maximum depth	40 m
Water surface area with up to 2 m depth	18.1 %
Water surface areas with up to 5m depth	37 %
Average annual water flow through HPP	251 km^3
Annual coefficient of water exchange	8.0

The major HPP facilities include the left shore and right shore earthen dams, HPP building, and concrete dam. The navigation lock is installed between the earthen dam and the concrete dam. Besides, there is a fish transfer station located between the HPP building and the concrete dam. The HPP head is 27 m. The HPP power unit contains 22 Kaplan turbines with the nominal water flow rate of about 680 m^3/s each. The gatewells are located 79 m away from the trash rack. The trash rack is 820 m long and the water flow enters the trash rack at 27.5 m deep.

The most common fish species in the reservoirs are those frequently found in the Volga River. Beyond that, the reservoir, upon its creation, was stocked with carp bream, carp,

and pikeperch. Fifty fish species have been registered in the reservoir. They include but not limited to the following species: Caspian anadromous shad, sprat, Northern pike, burbot, Wels catfish, carp bream, carp, roach, dace, chub, rudd, ide, asp, tench, blue bream, ziege, crucian carp, bleak, silver bream, nase, pikeperch, Volga pikeperch, European perch, and ruffe. Beyond that, Sterry sturgeon, beluga, Russian sturgeon. sterlet, connie, *Caspiomyzon wagneri*, and various Gobiidae species can also be found there, In 1967, the reservoir was stocked with such vegetarian fishes as *Hypophthalmichtys molitrix, Ctenopharingodon idella* and *Mylopharingodon piceus*.

The fishing yield in the reservoir ranges from 3,129 to 4,104 tons per year. The actual fishing yield in the reservoir is 10 – 13 kg/hectare.

The fish downstream migration studies in the reservoir were performed in 1990 – 1991. The fish migrants were caught on a daily and seasonal basis, but not in the tailwaters, as in all other studied reservoirs, but in the headwaters, in front of the gatewell, but 79 m away from it. The filtration velocity in the net ranged from 0.26 to 1.6 m/s, depending on the seasonal and daily modes of HPP operation. The applied methods did not make it possible to estimate precisely the number of the fish migrants older than one year. However, there were no further significant differences between this method and the methods applied in other reservoirs.

During the period of observations, 26 daily stations were sampled, 921 samples were taken, and about 30,000 young fish were caught. This work was performed by the Volgograd Division of Hydroproekt Institute under our supervision.

Over 27 species have been registered as migrants (Table 27). The most frequent young fish migrants were pikeperch (29.1%), sprat (29.0%), and European perch (195%).

The prevailing age of the migrants ranged from early to late larvae, and only Clupeiformes sp. also migrated as fry (30%). It should be noted that no fish older than one year old have been registered as migrants.

Table 27 Species specific structure of migrants

Species	Percentage as migrants, %
Pikeperch	29.1
European perch	19.5
Volga pikeperch	2.6
Ruffe	1.3
TOTAL for Percidae sp.	52.5
Sprat	29.0
Caspian anadromous shad	6.8
TOTAL for Clupeiformes	35.8
Silver bream, bleak, roach, carp bream, each	1.2
Ide	1.0
TOTAL for Cyprinidae sp.	10.2
Gobiidae sp.	1.5
Other species	< 0.1

Table 28 Average concentration (no./1,000 m^3) of the migrants

Month	1st decade of month	2nd decade of month	3d decade of month
Jan	-	0.8	-
Feb	-	0.7	-
Mar	-	0.7	-
Apr	-	0.7	-
May	-	1.0	2,520.0
Jun	1,310.0	2,580.0	2,300.0
Jul	780.0	630.0	70.0
Aug	60.0	33.0	25.0
Sep	22.0	42.0	100.0
Oct	140.0	500.0	180.0
Nov	90.0	10.0	30.0
Dec	30.0	-	-

The downstream migration was the most intense in summer, i.e., in late May and June (Table 28) when mostly early and late larvae migrated. The second downstream migration peak was registered at the end of September and in October when mostly sprat and Caspian anadromous shad fry migrated.

The quantity of the fish migrants younger than 12 months old was 72,867 million fish per year, with pikeperch being the most frequent migrants, i.e., 33,162 million individuals.

Al. Stambolijski Reservoir

Al. Stambolijski reservoir was created in 1954 in the Rositse River (the Danube River basin), and it is located in the vicinity of the Balkan Mountains. The reservoir is of a river type, with steep rocky shores. The upper part of the reservoir has shallow water, with a muddy bottom and a lot of macrophytes.

Major Specifications

Type	River-like
Water surface area	10.86 km^2
Volume	0.222 km^3
Length	19 km
Maximum width	2 km
Average width	0.6 km
Average depth	20.3 m
Maximum depth	46 m

Water surface area with up to 2 m depth	16 %
Average annual water flow	0.35 km^3
Annual coefficient of water exchange	1.6

The major facilities include a concrete dam with the surface spillway and the deep (about 35 m deep) gatewell. After going through the turbine (Kaplan), the water enters the spillway of 5 m wide and up to 3 m deep. Some of the water goes to the Rositse river from the spillway.

Thirteen fish species have been recorded in the reservoir during our observations, specifically: Northern pike, chub, rudd, bleak, *Vimba vimba*, topmouth minnow, bitterling, carp, loach, Wels catfish, pikeperch, ruffe, and pumpkinseed sunfish.

There is no commercial fishing, but there is a lot of amateur fishing with hook tackle.

The fish downstream migration studies were performed from April through October 1984 and from April through June 1985. The fish were collected in the tailwaters spillway for identification of the species and concentration of the migrants, and in the headwaters for the studies of the distribution of young fish. The scope of the data is presented in Table 29.

Only two species have been registered as HPP migrants, i.e., pikeperch (82.1%) and ruffe (17.9%).

Table 29 Scope of collected data

Parameters	1983	1984	1985
Number of:			
Daily fish catching stations	8	24	6
Ichthyological samples	240	650	120
Fish caught	270	650	120
Number of:			
Daily fish catching stations	4	11	12
Ichthyological samples	140	390	300
Fish caught	2,500	12,460	2,900

Table 30 Age of fish migrants, %

Species	Larvae	0+	1+ and older	Total, specimen
Pikeperch	0.1	99.6	0.2	3,278
Ruffe	20.6	30.4	49.0	800
All species	3.8	87.2	9.0	4,478

Table 31 Average concentrations (no./1,000 m^3) of fish migrants in 1984

Species	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pikeperch	0	0.04	1.00	50.0	0.10	0	0.001	0	0
Ruffe	0.15	0.80	0.30	3.00	0.20	0.03	0.30	0.07	0.01

Mostly fry and fish 1+ migrated through the HPP (Table 30). For pikeperch, 30 – 55-mm-long fry predominated (99%). For ruffe, individuals in the first and second year of life predominated (93%), with about 32% of the fry of a length of 25 – 50 mm.

The fish downstream migration was the most intense in June (Table 31). On the average, for the entire period of studies, the concentration of pikeperch migrants was 5.68, and the concentration of ruffe was 0.54/1,000 m^3.

Table 32 Pikeperch and ruffe injuries and frequency of injuries

Types of injuries	Frequency of occurrence, %
Expansion or rupture of the swim bladder	10
Hemorrhages in tissues or internal organs	92
Inversion of internal organs	37
Eye damage	40
Scratches and cuts	13

In 1984, 23.5 million pikeperch and 0.6 million ruffe passed through the HPP turbine.

The fish injuries and losses have been observed continuously. Visual examination has made it possible to observe various mechanical and pressure-induced injuries (Table 32). The mortality of the migrants was 100%.

Nurekskoe Reservoir

Nurekskoe reservoir was created in 1972 on the Vaksh River. It is located in the mountains of Tadjukistan. The reservoir is of a river type, and it has steep rocky shores.

Major Specifications

Type	River-like
Water surface area	98 km^2
Volume	10.5 km^3
Length	70 km
Maximum width	6.5 km
Maximum depth	300 m
Average depth	107.1 m
Average annual water flow	34.2km^3
Annual coefficient of water exchange	3.3

The major HPP facilities include a concrete, 700-m-long dam, idle surface spillway in the dam, and HPP located on the shore. The HPP head is 275 m. The water is supplied to the HPP through the channels from the HPP gatewell that is installed in the littoral zone 50 m deep. The HPP turbine flow rate is 155 m^3/s, and there are six turbines at the HPP.

Twelve fish species have been recorded during the studies. The most common species are as follows: rainbow trout, Amudarya trout, *Hypophthalmichthys molitrix*, carp, snowtrout, and spirlin. Beyond that, Transcaucasian barb and loach have been observed. There is no commercial fishing in the reservoir.

The fish downstream migration studies were performed in July 1986 – June 1987. The data on the downstream migration were collected in the tailwaters. In total, there were 12 daily stations (one station per month), and 144 fish samples taken, but no fish were caught, i.e., there was no downstream migration.

The fish distribution in the reservoir was studied by echo sounding in summer and in winter. The echo sounding has shown that both in summer and in winter, the fish primarily inhabit the surface water levels. No fish were detected in the vicinity of the gatewell (50 m deep). Beyond that, there are more fish closer to the shores, and the greatest fish density in winter has been observed in the bays of the reservoir (Pavlov et al., 1992).

BIBLIOGRAPHY

Alyavdina L.A. Biology and systematics of Acipenseridae sp. during early stages of development// Publications of Saratov Division of Caspian Branch of ВНИРО. 1951, Vol. 1, pp. 33-73.

Ambroz A.I. Fishes of the Dnieper, Southern Bug rivers and Dnepro-Bugsky Valley. Kiev: Published by Academy of Science of Ukraine, 1956, p. 407.

Baburina E.A. Development of eyes in Cyclostomata fishes and ecology. M.: Nauka, 1972, p. 145.

Bakanov A.I. Review of existing approaches to reservoir zoning// // Proceedings of Institute of Biology of Inland Waters. Rybinsk, 1990, No. 62(65), pp. 3 – 16.

Balashkand M.I., Vekilov E.K., Lovlya S.A. et al. New sources for seismic surveys safe for ichthyofauna. M., Nauka, 1980, p. 80.

Batychkov G.A. Downstream migration of sturgeon juvenile species from Volgogradskoe reservoir in 1960 – 1964// Publications of Volgograd Division of ГосНИОРХ (National Research Institute of Fish Resources), 1967, vol. 3, pp. 247 – 258.

Bely N.D. Behavior and distribution of free embryos of *Lucioperca lucioperca* (L.) hatched in deep waters// *Voprosy ikhtiologii* (Icthiology Issues), 1968, vol.8, No. 5 (52), pp. 892-899.

Bely N.D. Biology and culturing of carp bream. Kiev, 1956, p. 76.

Bely N.D. Biology of carp bream in early stages of development in deep waters// *Voprosy ikhtiologii* (Icthiology Issues), 1970, vol. 10, No. 6 (65), pp. 1047-1056.

Biological Encyclopedic Dictionary.M.: Bolshaya Rossijskaya Encyclopedia, 1995, p. 864.

Birznyak O.A., Kuzichkina P.V. Underground explosions and fish// Scientific Information ВНИРО, 1966, No. 6, pp. 9-21.

Bocharnikova A.V. Data on biology of breeding and development of Kuban' pikeperch// Journal on Zoology, 1952, No. 31, pp. 122 – 127.

Bogdanov F.A., Burmakin E.V., Golovkov G.A. Preparation of lakes for stocking with fish with application of explosives// Scientific bulletin ВНИОРХ (All-Russia Research Institute of Fish Resources), 1958, No. 6 –7, pp. 90- 94.

Boldyrev A.M. Some peculiarities of juvenile roach distribution in Ivan'kovskoe and Uglichskoe reservoirs, and in Motka lake in summer// Fish downstream migration. M.: ИЭМЭЖ, USSR Academy of Science, 1985, pp. 109-136.

Boytsov M.P. Vertical distribution of juvenile fish in the area of Konakovskya HPP water intake in Ivan'kovskoe reservoir// Distribution and environmental methods for juvenile fish protection. M.: ИЭМЭЖ, USSR Academy of Science, 1980, pp. 42 – 62.

Bratsenok G.N. Conditions and efficiency of fish breeding in Saratov reservoir// *Izvestiya* ГосНИОРХ (National Research Institute of Fish Resources), 1974, vol. 95, pp. 81-85.

Brett J.R. Environmental factors and growth//Bioenergy and fish growth. M., 1983, pp. 275-346.

Bugrov L.Yu. Juvenile coho salmon (*Oncorhynchus kisutch*) temperature preference in natural temperature stratification of the reservoir// Biology of inland waters, 1985, No. 68, pp. 43-46.

Bugrov L.Yu. Selected temperatures and some behavioral peculiarities of juvenile coho salmon (*Oncorhynchus kisutch*)// Publications of Research Institute on Lake and River Fish Resources, 1982, vol. 191, pp. 27-34.

Calculation coefficients for commercial return of some fish species of the USSR reservoirs used for commercial fishing: Instruction of *Glavrybvoda* # 30-13-3 dated July 12, 1978. M., 1978.

Chikova V.M. Species specific and age structure of fishes in Volzhskaya HPP tailwaters // Trudy (Publications) of Institute of Biology of inland waters of USSR Academy of Science, 1968, No. 16 (19), pp. 135-140.

Chumaevskaya-Svetovidnaya E.V. Biology and development of smelt of Pskov Chudskoj basin // Journal on Zoology, 1945, vol. 24, No. 6, pp. 341-346.

Danilov N.N. Breeding and biological differentiation of carp bream (*Abramis brama*) population in Kujbyshevskoe reservoir // *Voprosy ikhtiologii* (Ichthyology Issues), 1975, vol. 15, No. 2(91), pp. 219-225.

Degtyareva N.G., Zhidovinov V.I., Lupandin A.I. Entrainment of juvenile fish in Volzhskaya HPP water intake //Abstract for All-Russia workshop on fish proteciton, Astrakhan', 1990, pp. 51-53.

Delitsin V.V. Spawning schools and fish breeding in Volgo-Akhtubinskaya floodplain //Publications of Volgograd Division of *ГосНИОРХ* (National Institute of Fish Resources), 1971, vol. 5, pp. 192-209.

Disler N.N. Organs of senses of the sideline and its significance in the fish behavior. M.: Nauka, 1960, p. 228.

Domrachev P.F., Pravdin I.F. Fishes of the Il'men' and the Volkhov rivers and their economic significance // Publication on studies of the Vokhov river and its basin. L., 1926, vol. 10, pp. 5-294.

Dorozhkina T.Ya. Silver bream breeding in Ilmen' lake // Fish studies in internal reservoirs, 1972, No. 7, pp. 26-28.

Dryagin P.A. On age structure of fish population // Journal on Zoology, 1953, vol. 32, No. 1.

Efimov S.F., Tsvetkov V.I., Abrazumov V.A. et al. On decompression for bottom adapted fish // Distribution and migration of fish in internal reservoirs. M.: *ИЭМЭЖ,* USSR Academy of Science, 1986, pp. 174-189.

Eretchenko V.I. Carp in Chardar'insnkoe reservoir and the ways to increase its population // Fish resources in Kazakhstan reservoirs and their applications. Alma-Ata: *КазНИРХ*, 1972, No. 7, pp. 24-37.

Eretchenko V.I. On fish migration from Chardar'inskoe reservoir // Biological foundations for control of fish behavior due to construction of fish protection systems. M.: Nauka, 1971.

Eretchenko V.I., Malinovskaya A.S., Musina N.Kh. et al. Formation of commercial ichthyofauna in Kapchagajskoe reservoir // Ecology of Kazakhstan reservoirs. Alma-Ata, 1973, pp. 58-84.

Fedyaj V.V. Studies on development of Statement of Work for design of fish protection systems for Sevanskaya and Daugavpils HPPs: report # 81088482. Kaliningrad: Kaliningrad University, 1981, p. 84.

Fesenko E.A. Feeding of pikeperch juvenile species during the first year of establishing the regulated Don river flow // *Rybnoe khozyajstvo* (Fish industry), 1953, No. 10,

pp. 39-42.
Gajduk V.V., Malinin L.K., Poddubny A.B. Prevention of sturgeon migration through HPP turbine after spawning // Rybnoe khozyajstvo (Fish industry), 1970, No. 10, pp. 13 –15.
Ginzburg Ya.I. Biology and yield of juvenile fish in Tsymlaynskoe reservoir (1953-1955)// Izvestiya *ВНИОРХ* (All-Russia Research Institute of Fish Resources), 1958, vol. 45, pp. 111-142.
Girsa I.I. Changes in behavior and vertical distribution of some Cyprinidae juvenile fishes, depending on light and the presence of predator // *Voprosy ikhtiologii* (Ichthyology Issues), 1973, vol. 13, No. 3, pp. 535-542.
Girsa I.I. Effect of photoperiod and water temperature on photoreaction of some fishes // *Voprosy ikhtiologii* (Ichthyology Issues), 1972, vol. 12, No. 3(74), pp. 554- 560.
Girsa I.I. Orientation of some juvenile fishes in photo-gradient system // *Voprosy ikhtiologii* (Ichthyology Issues), 1971, vol. 2, No. 2 (67), pp. 361-365.
Girsa I.I. Photoreaction of some fresh water fishes in ontogenesis and in various physiological states // *Voprosy ikhtiologii* (Ichthyology Issues), 1969, vol. 9, No. 1(54), pp. 127-139.
Golovkov G.B., Kozhin N.I. Fishes of the Tuloma river // *Rybnoe khozyajstvo* (Fish industry), 1939, No. 6, pp. 45-54.
Gorin A.N. Distribution of early juvenile fish in Votkinskoe reservoir //Fish downstream migration. М.:ИЭМЭЖ, USSR Academy of Science, 1985, pp. 155-171.
Gorin A.N. Regularities of juvenile *Clupionella cultriventris* distribution in Votkinskoe reservoir // Abstract of Ph.D. thesis for the degree in Biology, M., 1991, p. 21.
Gorodnichij A.E. Data on biological justification of fish protection from entrainment in HPP facilities //Biological foundations on applications of fish protection facilities. M., Nauka, 1978, pp. 58-63.
Gorodnichij A.E. Ecology of pikeperch larvae in Veselovskoe reservoir//*Voprosy ecologii* (Environmental issues), 1962, vol. 5, pp. 39-40.
Grishin M.M. Hydrotechnical facilities. M.: *Gosstroyizdat*, 1962.
Isaev A.I., Karpova E.I. Fish resources in reservoirs. M.: Agropromizdat, 1989, p. 256.
Ivanova M.N. Population changes of fresh water ten-spined stickleback. Rybinsk, 1982, p. 144.
Ivanova M.N., Permitin I.E., Polovkova S.N. Seasonal peculiarities of European smelt (*Osmerus eperlanus*) distribution in Rybinskoe reservoir // *Voprosy ikhtiologii* (Ichthyology issues), 1970a, vol. 10, No. 5 (64), pp. 897-906.
Ivanova M.N., Polovkova S.N. Types of spawning and ecology of spawning of European smelt (*Osmerus eperlanus*) in Rybinskoe reservoir // *Voprosy ikhtiologii* (Ichthyology issues), 1972, vol. 12, No. 4(75), pp. 684-692.
Ivanova M.N., Polovkova S.N., Permitin I.E. Some features of biology of juvenile smelt (*Osmeridae*) in Rybinskoe reservoir // Journal on Zoology, 1970б, vol. 48, No. 6, pp. 881-891,
Ivlev V.S. Experimental ecology of fish feeding. M.: Pischepromizdat, 1955, p. 252.
Iyudina E.F. On biology of juvenile European perch (*Perca fluviatilis*) of Onezhskoe Lake// Publications of Karelo-Finnish Division of *ВНИОРХ* (All-Russia Institute of Fish Resources), Petrozavodsk, 1951, vol. 3, pp. 169-180.
Jeffers J. Introduction to systems analysis: applications in ecology. M.: *Mir*, 1981, p. 256.

Khaladzhiev V.P., V'yuchnov V.S., Krapivina V.I. Studies on mechanisms of seasonal and daily dynamics of fish downstream migration through Volzhskaya HPP. R&D Report. Volgograd. Volgograd Division of Hydroproekt, 1990, p. 44.

Koblitskaya A.F. Juvenile fresh water fish. M.: *Legkaya and pitshevaya prom*, 1981, p. 208.

Koblitskaya A.F. Seasonal migrations of young fish in the Volga river delta before the regulation of the river flow // Publications of Astrakhan' preserve, 1958, No. 4, pp. 209-235.

Konobeeva V.K. Conceptual and mathematical model of evaluation of effect of hydrotechnical facilities on reproduction of fish population // Ecology, 1996, NO. 5, pp. 365-370.

Konobeeva V.K. Critical situation in succession processes in aqueous ecosystems. Abstract for Doctoral thesis for a degree in Biology, M., 1998, p. 37.

Konobeeva V.K. Dynamics of size and mass of juvenile European perch (*Perca fluviatilis*) in various ecological zones of Rybinskoe and Ivan'kovskoe reservoirs // Biology of inland waters, 1983б, No. 61, pp. 40-44.

Konobeeva V.K. Effect of currents on juvenile fish distribution in reservoirs // *Voprosy ikhtiologii* (Ichthyology issues), 1983a, vol. 23, No. 1, pp. 108-114.

Konobeeva V.K. On groups of juvenile fishes in Rybinksoe reservoir // Publications of Institute of biology of inland waters, 1983в, No. 48/51, pp. 193-206.

Konobeeva V.K., Konobeev A.G., Poddubny A.G. On mechanism of generation of juvenile European perch (*Perca fluviatilis*) conglomerations in open parts of lake type reservoirs (Rybinskoe reservoir) // *Voprosy ikhtiologii* (Ichthyology issues), 1980, vol. 20, No. 2, pp. 258-271.

Konobeeva V.K., Poddubny A.G. On prediction of early juvenile fish distribution in reservoirs // *Voprosy ikhtiologii* (Ichthyology issues), 1982, vol. 22, No. 4, pp. 619-625.

Konobeeva V.K., Saltankin V.P., Izyumov Yu.G. Ecological and functional approach to identification of procedures for estimating the effect of hydrotechnical facilities on fish population in reservoirs // *Energeticheskoe stroitel'stvo* (Power engineering construction), 1993, No. 4, pp. 21-29.

Konstantinov A.S., *Martynov V.V.* Effect of salinity changes on juvenile fish // *Voprosy ikhtiologii* (Ichthyology issues), 1992, vol. 32, No. 5

Konstantinov A.S., Zdanovich V.V Effect of temperature oscillations on growth and physiological state of carp juvenile species // USSR Academy of Science presentation, 1985, vol. 282, No. 3, pp. 760-764.

Konstantinov A.S., Zdanovich V.V. Effect of temperature changes on fish growth // *Voprosy ikhtiologii* (Ichthyology issues), 1987, vol. 27, No. 6, pp. 971-977.

Konstantinov A.S., Zdanovich V.V. Some peculiarities of fish growth at various temperatures // *Voprosy ikhtiologii* (Ichthyology issues), 1986, vol. 26, No. 3, pp. 448-456.

Konstantinov A.S., Zdanovich V.V., Sholokhov A.N. Temperature conditions as a factor of optimization of growth, energy and physiological state of young fishes // *Vestnik* (News) of Moscow University, 1991, vol. *16, Biology, No. 2, pp. 38-44.*

Konstantinov K.G. Comparative analysis of morphology and biology of European perch, pikeperch and Volga pikeperch on various stages of development // Publications

of *ИМЖ* USSR Academy of Science, 1957, No. 16, pp. 181-236.

Konstantinov K.G. Data on pikeperch (*Lucioperca lucioperca*) breeding biology // USSR Academy of Science presentation, 1949, vol. 67, No. 1, pp.181-184.

Kostin V.V. Critical velocity of descending flow for bleak larvae // Abstract of presentation for All-Russia workshop on fish protection, Astarakhan', 1990a, pp. 45-46.

Kostin V.V. Development of data minibank of hierarchic structure // Experimental and field studies on fish behavior and distribution. M.: ИЭМЭЖ USSR Academy of Science, 1989, pp. 286-299.

Kostin V.V. Reaction of larval bleak on pressure increase in the experiment // Abstract of presentation for All-Russia workshop on fish protection, Astarakhan', 1990б, pp. 47-49.

Kostin V.V., Lupandin A.I., Pavlov D.S. Dynamics of distribution of juvenile fish in ecological zones of Ivan'kovskoe reservoir // *Voprosy ikhtiologii* (Ichthyology issues), 1997, vol. 37, No. 5, pp. 689-695.

Kostin V.V., Ostrovsky M.P., Verem'ev Yu.E. Comparative characteristics of fish distribution and downstream migration from Sheksninskoe reservoir and Lozsko-Azatskoe lake // Abstract for All-Russia workshop on Fish resources in the reservoirs, M., 1986, pp. 42-43.

Kovalev M.P. Biology of Percidae fishes (pikeperch, European perch and ruffe) in North-Western part of European Russia // North West natural resources and their rational applications and protection. L.: Nauka, 1975, pp. 14-48.

Kovalev M.P. Development of larval pikeperch (*Lucioperca lucioperca*) under natural conditions // // *Voprosy ikhtiologii* (Ichthyology issues), 1976, vol. 16, No. 4(99), pp. 670-681.

Kozhina E.S. Materials on roach biology in Mikeelskoe lake '' Publications of Karelian Division of *ГосНИОРХ* (National Institute of Fish Resources), 1966, vol. 4, No. 2, pp. 47-54.

Kriksunov E.A., Polonsky Yu.S. Do seismic surveys affect fish resources? // *Neftyanoe khozyajstvo* (Petroleum industry), 1991, No. 3.

Kryzhanovsky S.G. Ecological and morphological regularities of development of Cyprinidae, Cobitidae and Siluridae fishes // Publications of ИМЖ USSR Academy of Science, 1949, No. 1.

Kryzhanovsky S.G. Ecological groups of fish and regularities of their development // Izvestiya (News) of ТИНРО, 1948, vol. 27, pp. 5-114.

Kryzhanovsky S.G. Materials on development of Clupeidae fishes // Publications of *ИМЖ* USSR Academy of Science, 1956, No. *17, pp. 1-255.*

Kryzhanovsky S.G., Disler N.N., Smirnova E.I. Ecological and morphological regularities of Percidae fish development // Publications of *ИМЖ* USSR Academy of Science,1953, No. 10, pp. 3-138.

Kurilov S.V. How to increase the sterlet population in the Northern Dvina river basin // *Rybnoe khozyajstvo* (Fish industry), 1951, No. 4.

Kuznetsov V.A. Distribution of young fish in Sviayzhsky bay of Kuybyshevskoe reservoir // Journal on hydrobiology, 1973, vol. 9, No. 5.

Kuznetsov V.A. Dynamics of quantity and survivability of fresh water fishes (in regulated river flow). Kazan': Kazan' University, 1975, p. 72.

Kuznetsov V.A. Fish reproduction in regulated river flow. Kazan': Kazan' University, 1978, p. 160.

Kuznetsov V.A. Spawning places, larvae distribution and efficiency of Percidae breeding in Kuybyshevskoe reservoir // *Voprosy ikhtiologii* (Ichthyology issues), 1970, vol. 10, No. 6(65), pp. 1018-1025.

Kuznetsova V.M. Regularities of commercial fish distribution in the area of water intake facilities in Chardar'inskoe reservoir // Distribution and environmental methods for protection of young fishes. M.: *ИЭМЭЖ* USSR Academy of Science, 1980, pp. 77-89.

Lakin G.F. Biometry. M.: Vyshaya Shkola, 1990, p. 352.

Lange N.O. Stages of roach development under various ecological conditions // Publications of ИМЖ USSR Academy of Science, 1960, No. 28, pp. 5-40.

Lapin Yu.E. European smelt of Rybinskoe reservoir // Ph.D. Thesis for degree in Biology. M., 1955, p. 189.

Lapkin V.V., Svirsky A.M. Temperature changes associated with season and age of the fishes of Rybinskoe reservoir // Biology of inland waters, 1977, No. 76, pp. 45-49.

Lapkin V.V., Svirsky A.M., Sopov Yu.N. Selected temperature and acclimation temperatures for fishes // Journal on Zoology, 1979, vol. 58, No. 2, 1659-1669.

Lebedev A.P., Shipilov A.Ya. Direct accounting of fish downstream migration through Sergeevskoe reservoir dam in spring of 1985 // Biological foundations of fish industry in Middle Asia and Kazakhstan. Abstract for presentation at the workshop on October 9 –11, 1986, pp. 246-248.

Legky B.P. Changes in photoreaction of European perch in early stages of ontogenesis //Experimental and field studies on fish photoreaction and distribution. M.: *ИЭМЭЖ* USSR Academy of Science, 1989, pp. 113-124.

Legky B.P., Pavlov D.S. Individual changes of roach larvae photoreaction due to their downstream migration. Ecology, 1987, No. 5, pp. 53-58.

Lesnikova T.V., Kharitonova E.D. Juvenile fish distribution and growth in Gor'kovsoe reservoir // Publications of Research Institute of lake and river fish resources, 1979, No. 143, pp. 144-150.

Malevanchik B.S., Nikonorov I.V. Fish protection systems. M.: Legkaya I Piitchevaya prom., 1984, p. 256.

Mantejfel' B.P. Adaptative significance of periodical migrations of underwater organisms // *Voprosy ikhtiologii* (Ichthyology issues), 1959, No. 13, pp. 3-15.

Mel'nikov G.B. On fish downstream migration under ice in the Dnieper river and Lenin lake // Academy of Science of Ukraine, 1957, No. 3.

Mikheev V.N. Connection between fish feeding and distribution and downstream migration in the reservoir // Fish downstream migration. M.:*ИЭМЭЖ* USSR Academy of Science, 1985, pp. 87-108.

Mitrofanov I.P., Nezdoly V.K. Effect of regulated river flow on fish migration // Proceedings of Conference of faculty of Kazan' University, Kazan', 1974, pp. 89-190.

Mitrofanov V.P., Dukravets G.M. Ichthyofauna of the Il' river and its distribution in the reservoirs // Biologicheskie nauki (Biological science). Alma-Ata: Minsitry of Higher Education Publications, Kazakhastan, 1975, No. 9, pp. 12-19.

Mokryak T.S. Observations over fish passage in Tsymlyanskoe reservoir // Scientific and technical bulletin of *ВНИОРХ* (National Institute of Fish Resources), 1958, No. 4.

Mosiyash S.S. Resources of ruffe and bleak in Ivan'kovskoe and Uglichskoe reservoirs // Publications of *ВНИОРХ* (National Institute of Fish Resources), 1980, No. 145, pp. 67-73.

Muravenko T.A., Trofimov V.V. Studies on survivability of young fishes in the jet pump // Publications of *Yuzhgyprovodkhoza* (Southern Research Institute on Hydrosystems). Novocherkassk, 1981, pp. 126-134.

Nezdoly V.K. Fish downstream migration in the Il' river upstream from Kapchagajskoe reservoir // Biological science. Alma-Ata, Kazan' University, 1974, No. 7.

Nezdoly V.K., Kirillov P.I. Young Cyprinidae downstream migration and distribution in the Derha river and Soosha river // Issues of morphology and ecology of animals. Tver', University of Tver', 1997, pp.12-34.

Nezdoly V.K., Resin A.L. Juvenile fish downstream migration from Otkaznenskoe and Novoselitskoe reservoirs. M., 1988, p. 127.

Nezdoly V.K., Sazonov Yu.G. Effect of drastic hydrostatic pressure changes on some juvenile species // Proceedings of Conference of faculty of Kazan' University, Kazan', 1974

Nezdoly V.K., Sazonov Yu.G., Dubrovsky A.S. Negative effect of Kapchagajskaya HPP on fish resources of the Il' river // *Rybnoe khozyajstvo* (Fish industry), 1975, No. 11, pp. 78-86.

Nikol'sky G.V. Fish ecology. M.: Vyshaya shkola, 1974, 3d edition, p. 366.

Nusenbaum L.M. On experimental methods for studies of fish behavior at hydrotechnical facilities // Biological foundations of applications of fish protection systems. M.:Nauka, 1971, pp. 191-208.

Nusenbaum L.M. On fish behavior in near dam areas due to construction of fish protection facilities. M.: USSR Academy of Science, 1961, No. 10

Odum Yu. Basics of ecology. M.:Mir, 1975, p. 740.

Orlov A.V. Distribution of early juvenile commercial fish species in the littoral zone of Kapchagajskoe reservoir // Distribution and environmental methods for protection of young fishes. M.: *ИЭМЭЖ* USSR Academy of Science, 1980, pp. 62-76.

Ozinovskaya S.P. Larval fish distribution in Kremenchugskoe reservoir // *Rybnoe khozyajstvo* (Fish industry), 1973, No. 16, pp. 53-58.

Pakhorukov A.M. High-speed trawling for quantitative estimation of juvenile fish // Fish behavior and migration. M.: *ИЭМЭЖ* USSR Academy of Science, 1982, pp. 4-15.

Pakhorukov A.M. Studies on juvenile fish distribution in reservoirs and lakes. M.: Nauka, 1980, p. 64.

Pavlov D.S. Biological foundations of fish behavior control in the water flow. M.: Nauka, 1979, p. 319.

Pavlov D.S. Experiments on burbot (*Lota lota*) feeding at various light conditions // *Nauchnye doklady vyshej shkoly* (University scientific papers). Biological science. 1959, No. 4, pp. 42-45.

Pavlov D.S. Fish opto-motor reaction and orientation in the water flow. M.: Nauka, 1979, p. 148.

Pavlov D.S., Barekyan A.Sh., Ripinsky I.I. et al. Ecological method of fish protection in an open flow with turning jets. M.: Nauka, 1982, p. 112.

Pavlov D.S., Gorin A.N., Presnyakov V.V. Studies on efficiency of nets for catching juvenile fish species // *Voprosy ikhtiologii* (Ichthyology issues), 1993, vol. 33, No. 5, pp. 684-690.

Pavlov D.S., Kogan A.V., Nezdoly V.K. Fish downstream migration from Verkhne-Volzhsky reservoir // Distribution and ecological methods of juvenile fish protection. M.: *ВАСХНИЛ*, 1980, pp. 5-29.

Pavlov D.S., Kostin V.V., Nezdoly V.K. et al. Fish downstream migration from Ivan'kovskoe reservoir // Behavior and distribution of fish from reservoirs with a slow water exchange. M.: *ИЭМЭЖ* USSR Academy of Science, 1985a, p. 136.

Pavlov D.S., Kostin V.V., Ostrovsky M.P. Effect of the water intake zone location on fish downstream migration (in Sheksninskoe reservoir and Lozsko-Azatskoe lake). M.: *ИЭМЭЖ* USSR Academy of Science, 1991a, p. 142.

Pavlov D.S., Lupandin A.I. Effect of light on roach (*Rutilus rutilus*) attitude towards flows with various turbulence // Papers of Russian Academy of Science, 1995, vol. 341, No. 6, pp. 842-846.

Pavlov D.S., Lupandin A.I., Degtyareva N.G. et al. Role of Turbulence in formation of juvenile fish distribution (early larvae) in wide and narrow areas of the water flow // Papers of Russian Academy of Science, 1995, vol. 341, No. 6, pp. 842-846.

Pavlov D.S., Lupandin A.I., Kostin V.V. Environmental requirements to the HPPs to minimize the fish and plankton loses: Final scientific and technical report on the program: Environmental Safety of Russia. M., 1994б, p. 25.

Pavlov D.S., Lupandin A.I., Kostin V.V. et al. Temporary stability of fish downstream migration characteristics // *Sbornik nauchnykh trudov* (Collection of scientific papers) of *Hydroproekt*, 1991б, No. 147, pp. 43-51.

Pavlov D.S., Lupandin A.I., Kostin V.V. Fish downstream migration from Ust'-Khantajskoe reservoir // *Voprosy ikhtiologii* (Ichthyology issues), 1994a, vol. 34, No. 3, pp. 359-365.

Pavlov D.S., Lupandin A.I., Taradina D.G. Connection between fish vertical movements at downstream migration with their buoyancy and flow turbulence //// *Voprosy ikhtiologii* (Ichthyology issues), 1997a, vol. 37, No. 4, pp. 532-538.

Pavlov D.S., Lupandin A.I., Taradina D.G. et al. Daily dynamics of buoyancy of Cyprinidae and Percidae juvenile specie due to their downstream migration in the Volga river delta // *Voprosy ikhtiologii* (Ichthyology issues), 1996, vol. 36, No. 6, pp. 847-850.

Pavlov D.S., Mikheev V.N., Vasil'yev M.V. et al. Feeding, distribution and migration of juvenile fish species from Alexander Stambolijski reservoir (Bulgaria), M.: Nauka, 1988, p. 120.

Pavlov D.S., Nechaev I.V., Kostin V.V. et al. Hormonal mechanisms of roach (*Rutilus rutilus*) larvae downstream migration // *Voprosy ikhtiologii* (Ichthyology issues),, 1998, vol. 38, No. 2, pp. 257-266.

Pavlov D.S., Nezdoly V.K. On juvenile fish injuries at their downstream migration through low head dams // Information bulletin of the Institute of biology of inland waters, 1981, No. 50, pp. 29-32.

Pavlov D.S., Nezdoly V.K., Khodorevskaya R.P. et al. Juvenile fish downstream

migration in the Volga and Il' rivers. M.: Nauka, 1981, p. 320.
Pavlov D.S., Ol'khovsky G.I., Mosievsky A.A. et al. Juvenile fish distribution in upstream dam area and their migration through Uglichskaya HPP // Fish downstream migration. M.: *ИЭМЭЖ* USSR Academy of Science, 1985б, pp. 60-86.
Pavlov D.S., P'yanov A.I., Ostrovsky M.P. Fish distribution in Nurekskoe reservoir as obtained from echo sounding data // *Voprosy ikhtiologii* (Ichthyology issues), 1992, vol. 32, No. 4, pp. 37-43.
Pavlov D.S., Pakhorukov A.M. Biological foundations of fish protection from HPP entrainment. M., Pitchevaya prom., 1973, p. 208.
Pavlov D.S., Pakhorukov A.M. Biological foundations of fish protection from HPP entrainment. M., Pitchevaya prom., 1983, 2d edition, p. 264.
Pavlov D.S., Popova I.K., Legky B.P. Various sizes of juvenile roach from littoral and pelagic zones of the river during their downstream migration // *Voprosy ikhtiologii* (Ichthyology issues),1990. Vol. 30, pp. 255-263.
Pavlov D.S., Sablin-Yavorsky A.D. On a possibility to use the fish reaction on low-frequency hydrodynamic oscillations to prevent the fish entrainment in HPP facilities // Proceedings of All-Russia Conference on Fish Behavior, M., 1991, pp. 329-229.
Pavlov D.S., Sadkovsky R.V., Kostin V.V., Lupandin A.I. Effect of light, pressure and temperature on the juvenile Cyprinidae behavior and vertical movements // *Voprosy ikhtiologii* (Ichthyology issues), 1997б, vol. 37, No. 1, pp. 72-77.
Pavlov D.S., Sbikin Yu.N., Vathcinnikov A.E. et al. Effect of light and water temperature on the curent critical velocities for fishes // *Voprosy ikhtiologii* (Ichthyology issues), 1972, vol. 12, No. 4, pp. 769-778.
Pavlov D.S., Shtaff L.G. Juvenile fish distribution in the rheogradient flow // Paper of USSR Academy of Science, 1981, NO. 2, pp. 509-512.
Pavlov D.S., Turukov S.N. Hydrodynamic mechanism of fish orientation in water flow // *Rybovodstvo* (Pisciculture), 1986, No. 1, pp. 32-33.
Pavlov D.S., Turukov S.N. Role of hydrodynamic stimuli in fish behavior and orientation in the vicinity of the barriers // *Voprosy ikhtiologii* (Ichthyology issues), 1988, vol. 28, No. 3, pp. 303-314.
Perevoznikov M.A., Golubkova O.G. Fish reaction on oxygen modes // *Sbornik nauchnykh trudov* (Collection of scientific papers) of Research Institute of Lake and River resources, 1987, No. 271, pp. 154-162.
Permitin I.E., Ivanova M.N., Polovkova S.N. On some biological features of smelt of Beloye lake // Publications of Institute of biology of inland waters, 1971, No. 22 (25), pp. 182-190.
Petkevich A.N. Biology and reproduction of sturgeon in the Ob' river due to HPP construction. Tomsk, 1951, *Trudy* (Publications) of Tomsk University.
Petrashkevich V.V. Fish protection facilities in the water intake areas. M.: Sovintervod, 1992, p. 149.
Petrov V.V. Smelt of Pskov-Hudskoj basin // Izvestiya (News) of ГосНИОРХ (State Institute of Fish Resources), 1974, vol. 83, pp. 111-130.
Poddubny A.G. Breeding of ziege in Rybinskoe reservoir // Journal on Zoology, 1958, vol. 37, No. 11, pp. 1701-1709.
Poddubny A.G. Ecological topography of fish populations in the reservoirs. L.: Nauka,

1971, p. 311.
Poddubny A.G. Practical applications of results of ecological zoning of the reservoirs // Ecological zoning of fresh water reservoirs. Rybinsk, 1990, pp. 145-163, *Trudy* (Publications) of Institute of biology of inland waters, No. 62.
Poddubny A.G., Golovanov V.K., Lapkin V.V. Seasonal dynamics of preferred temperatures for fishes // Biology of inland waters, 1970, No. 6, pp. 55-59.
Poddubny A.G., Malinin L.K. Fish migrations in inland reservoirs. M.: Agropromizdat, 1988, p. 225.
Polovkova S.N., Permitin I.E. On fish zooplankton feeding // *Trudy* (Publications) of Institute of biology of inland waters, 1970, No. 6, pp. 55-59.
Polyaninova A.A., Khodorevskaya R.P. Behavior, distribution and feeding of sturgeon juvenile fish in the Volga river // Abstract for *ЦНИОРХ* session, Gur'ev, 1976, pp. 65-67.
Ponedelko B.I. Distribution of roe, larvae and fry of commercial fishes in Il'men' lake // Bulletin of Institute of biology of reservoirs, 1958б, No. 2, pp. 33-37.
Ponedelko B.I. On behavior of some fresh water fishes in various stages of ontogenesis// Bulletin of Institute of biology of reservoirs, 1958a, No. 1.
Popova M.S. Migration of juvenile and adult fishes from Sengileev reservoir // *Trudy* (Publications) of Stavropol University of Agriculture, 1962, vol. 33, No. 3, pp. 89-93.
Popova O.A. Ecology of Northern pike and European perch in the Volga river // Feeding of carnivorous fishes and their relationship with other organisms. M., 1965, pp. 91-172. Manual on design of fish protection facilities. M.: Hydroproekt, 1988, p. 124.
Postoev V.S. Plankton losses in HPP turbines and methods for its preservation: Report on performed studies. St. Petersburg, Center of HPP Environmental Safety at Nevsky Company, 1994, p. 51.
Potekhina E.V. Application of the Don downstream reservoirs for reproduction of anadromous fishes // *Rybnoe khozyajstvo* (Fish industry), 1956, No. 11.
Protasov V.R. Fish behavior. Mechanisms of fish orientation and their applications in fishing. M.: Pitshevaya prom., 1978, p. 296.
Pushkina N.P. Regularities of juvenile fish distribution in reservoirs of the Kamsk cascade // Distribution and environmental methods of fish protection. M.: *ИЭМЭЖ* USSR Academy of Science, 1980, pp. 62-76.
Pyatkova Z.A. On biology of ruffe of Naroch lake // Fish industry in Belorussia, Minsk, 1962, pp. 177-183.
Rezanov D.P. On ecology of major commercial fishes of Kajrak-Kumsky reservoir // Hydrobiology and ichthyology, Dushanbe: Donish, 1969.
Ripinsky I.I. Fish protection systems for HPP facilities. M.: PO Sovintervod, 1991, p. 206.
Rudakovsky L.G., Solodilov D.N., Protasov V.R. et al. Explosions and fish // *Voprosy ikhtiologii* (Ichthyology issues), 1970, vol. 10, No. 4, p. 745-746.
Rybinskoe reservoir and its life. L.: Nauka, 1972, p. 364.
Schetinina L.A. Observations at Veselovsky canal // Mechanical barriers for juvenile fishes. M.: 1959, pp. 4-12.
Sharonov A.V. Migration of northern and southern fishes into Kujbyshevskoe reservoir //

Trudy (Publications) of Tartar Division of ВНИОРХ (All-Russia Institute of Fish Resources), 1972, No. 12, pp. 178-179.

Shilov V.L. Breeding of Acipenseridae species in Volgogradskaya HPP headwaters // *Voprosy ikhtiologii* (Ichthyology issues), 1966, vol. 6, No. 4, pp. 663-671.

Shmidt P.Yu. Fish migrations. M: USSR Academy of Science Publications, 1947, p. 361.

Skorobogatov M.A., Lupandin A.I., Pavlov D.S. et al. Reaction of moderlieschen (*Leucaspius delineatus*) juvenile species on hydrostatic pressure changes in flows with various temperatures // *Voprosy ikhtiologii* (Ichthyology issues), 1997, vol. 37, No. 1, pp. 133-137.

Skorobogatov M.A., Pavlov D.S. Studies on orientation of juvenile roach (*Rutilus rutilus*) species relative to the current velocity // *Voprosy ikhtiologii* (Ichthyology issues),1991, vol. 31, No. 3, pp. 516-520.

Skorobogatov M.A., Pavlov D.S., Barekyan A.Sh. Studies on connections between roach (*Rutilus rutilus*) buoyancy and pressure, as well as the flow angle // *Voprosy ikhtiologii* (Ichthyology issues), 1987, vol. 27, No. 2, pp. 313-319.

Skorobogatov M.A., Pavlov D.S., Lupandin A.I. Effect of current velocity and turbulence intensity on roach (*Rutilus rutilus*) distribution in the water flow // *Voprosy ikhtiologii* (Ichthyology issues), 1996, vol. 36, No. 5, pp. 687-692.

Skorobogatov M.A., Pavlov D.S., Lupandin A.I. et al. Reactions of juvenile moderlieschen (*Leucaspius delineatus*) and bleak (*Alburnus alburnus*) on hydrostatic pressure changes in the aqueous flow // *Voprosy ikhtiologii* (Ichthyology issues), 1995, vol. 35, No. 4.

Skorobogatov M.A., Pavlov D.S., Shtaff L.G. roach threshold rheotaxiss in the aqueous flow of variuous turbulence // Papers of USSR Academy of Science, 1983, vol. 268, No. 2, pp. 510-512.

Soin S.G. On biology of catfish breeding // Papers of USSR Academy of Science, 1947, vol. 57, No. 6.

Summarized catalog of fishes of the Russian inland waters. Moscow: Nauka, 1998, p. 220.

Svirsky A.M., Golovanov V.K. Acclimation temperature effect on temperature regulation behavior of carp bream (*Abramis brama*) juvenile species in various seasons // *Voprosy ikhtiologii* (Ichthyology issues), 1991, vol. 31, No. 6, pp. 974-980.

Svirsky A.M., Golovanov V.K. Role of feeding factor in temperature regulation behavior of carp bream // Abstract for presentation at the 8th Scientific Conference on ecology, physiology and biochemistry of fishes. Petrozavodsk, Karelian Scientific Center of Russian Academy of Science, 1992, vol. 2.

Syrovatsky I.Ya. Materials on ecology of breeding of carp bream and pikeperch of the Don river // Publications of Don and Kuban' fishery, 1940, No. 6, pp. 49-83.

Syrovatsky I.Ya. On biological role and economic significance of pikeperch in the reservoirs // Journal on Zoology, 1963, vol 32, No. 3, pp. 480-483.

Syrovatsky I.Ya. On causes of juvenile pikeperch losses in Tsymlyanskoe reservoir and a necessity to stock the reservoir with amphidromous fishes // Abstract for the 3d Conference on Ecology, Kiev, Kiev University, 1957, Part 2.

Taradina D.G., Pavlov D.S., Lupandin A.I. Connection between the vertical movements of fish juvenile species at their downstream migration and their buoyancy and flow turbulence // *Voprosy ikhtiologii* (Ichthyology issues), 1997, vol. 37, No. 4,

pp. 532-537.

Tavrizov V.M. On minimization of underwater explosions hazards // *Rybnoe khozyajstvo* (Fish industry), 1959, No. 10, pp. 17-20.

Temporary procedure for estimation of fish losses, resulting from construction and other activities in the reservoirs. M.: *Minrybkhoz* (USSR Ministry of Fish Resources), 1990, p. 37.

Tikhij M.V., Viktorov P.V. Fish resources and HPP construction. M.: Pithsepromizdat, 1940, p. 200.

Timm V.Ya., Timm T.E. On terminology of lake benthal zone // Hydrobiological journal, 1986, vol. 22, No. 6, pp. 40-45.

Tryapitsyna L.N. Ecology of rudd and silver bream in the Volga river delta in the regulated river flow. M.: Nauka, 1975, p. 180.

Tsvetkov V.I. Environmental aspects of hydrostatics of closed swim bladder fishes // Ph.D. Thesis for Degree on Biology. M.: Moscow University, 1975, p. 164.

Tsvetkov V.I. Fish reaction on pressure changes and some peculiarities of their hydrostatics // Basic characteristics of fish behavior and orientation. M.: Nauka, 1974, pp. 188-222.

Tsvetkov V.I. Hydrostatic and atmospheric pressure as environmental factors for lower aqueous vertebrates // Itogi nauki. (Scientific reviews). Zoology. M.: *ВИНИТИ*, 1969, pp. 15-31.

Tsvetkov V.I., Danilov A.N. Reaction of roach (*Rutilus rutilus*), minnow (*Phoxinus phoxinus*) and moderlieschen (*Leucaspius delineatus*) on buoyancy changes // *Voprosy ikhtiologii* (Ichthyology issues), 1979, vol. 19, No. 2, pp. 347-353.

Tsvetkov V.I., Pavlov D.S., Nezdoly V.K. Lethal pressure changes for some juvenile fresh water fishes // *Voprosy ikhtiologii* (Ichthyology issues), 1972, vol. 12, No. 2, pp. 344-356.

Tyurin V.P. Degtyareva N.G. Nets for catching juvenile fish in rivers and their efficiency depending on the fish behavior in the flow // Fish behavior. M.: ВАСХНИЛ, 1981a, pp. 152-168.

Tyurin V.P., Degtyareva N.G. Juvenile fish behavior in the ichthyoplankton nets // Fish behavior. M.: *ВАСХНИЛ*, 1981б, pp. 168-181.

Valid Kh.I. Effect of regulated Dnieper river flow on biology and distribution of rudd//Publications of ВНИРО, 1975 vol. 107, pp. 119-127.

Vasilev M.V. Observations over downstream migration of fish from Al. Stambolijski reservoir (Bulgaria) // Distribution and migration of fish in internal reservoirs. M.: ИЭМЭЖ USSR Academy of Science, 1986, pp. 5-16.

Vasnetsov V.V. Spawning migrations of anadromous fishes// Essays on general issues of ichthyology. M; L.; USSR Academy of Science, 1953, pp. 227-241.

Vasnetsov V.V., Eremeeva E.F., Lange N.O. Stages of development of commercial anadromous fish of the Volga and Don rivers, carp bream, carp, Caspian roach, and pikeperch // Publications of *ИЭМЭЖ* USSR Academy of Science, 1957, vol. 16, pp. 8-76.

Vekilov E.Kh. Effect of electrical fields on ichthyofauna due to intensification of geological and marine geophysical activities // Abstract of Ph.D. thesis for the degree in Geology and Mineralogy. M., 1973, p. 23.

Vekilov E.Kh., Kriksunov E.A., Polonsky Yu.S. Effect of seismic waves for marine geo-

physical surveys. M.: Russian Federation Committee on fishing, *ЦУРЕН*, Moscow State University, 1996, p. 64.

Verzin Yu.N. Juvenile fish migration in Generalovskaya irrigation system from Tsymlyanskoe reservoir // Biological foundations of applications of fish protection structures. M., 1978, pp. 89-93.

Viktorov P.V. Effect of HPP turbines on migratory fish // Bulletin of technical information, 1938, No. 1.

Vladimirov V.I., Sukhovajn P.S., Kugaj K.S. Fish breeding in regulated river flow. Kiev: Ukraine Academy of Science, 1963, p. 395.

Volodin V.M. Fish migration through Rybinskaya HPP dam // Bulletin of Institute of Biology of Reservoirs, 1968, No. 17(20), pp. 230-241.

Vyskrebentsev B.V., Pinus G.N., Soloditov L.N. Effect of explosions on fish // Rybnoe khozyajstvo (Fish industry), 1968, No.1.

Zakharova L.K. On biology of fish breeding in Rybinskkoe reservoir // Publications of Borok biological station. M.; L.; vo. 2, pp. 200-265.

Zdanova N.N. On young pikeperch migration in the Don river // *Rybnoe khozyajstvo* (Fish industry), No. 6, pp. 34-39.

Zernov S.A. General hydrobiology. M.: USSR Academy of Science, 1949.

5cr. N 54. Publ. Ont. Fish Res. lab. 1947. N 68. 62 p.

Alexander R.M. Physical aspects of swimbladder function // Biol. Rev. 1966. Vol. 41, N I. P. 141-176.

Alexander R.M. The densities of Cyprinidae // J. J. Exp.. Biol. 1959. Vol.36, N 2. P. 123-134. Amer. S. Fish. Manag. 1983. Vol.3. P. 86-90.

Andrew F.J.. Geen G.H. Sockeye and pink salmon investigation in Seton Creek hydroelectric installation // Intern. Pacif. salmon Fish. Comm., Prog. Report. 1958. N 4. 73p.

ARL (Alden Research Laboratory, Inc.). Development of a more fish tolerant turbine runner. Techn. memorandum N 2. Development of biological design criteria. Draft. Holden (Mass.), 1996. 32 p.

Arnold G.P. Methods of tracking, deflecting and counting fish in North America // Fisheries research Techn. Rep. Lowestoft: MAFF Direct. Fish. Res. 1978. N 44.

Arnold G.P. Rheotropism in fishes // Biol. Rev. 1974. N 49. P. 515-576.

Barton B.A., Shreck C.G., Sigismondi L.A. Multiple acute disturbances evoke cumulative physiological stress responses in juvenile chinook salmon // Trans. Amer. Fish. Soc. 1986. Vol. 115. P. 245-251.

Bates D.W., Vinsonhaler R. The use of louvers as a means of guiding fish at the Tracy California, pumping plant // Mimeo Rept. Region. I.U.S. Fish and Wildlife Serv., 1954. 21 p.

Beck A.P., Poje G.V., Walter W.T. A laboratory study on the effects of the exposure of some entrainable Hudson River biota to hydrostatic pressure regimes calculated for the proposed Cornwall pumped storage plant // Fisheries and energy production: A symp. / Ed. S.B. Saila. Lexington (Mass.): Heath, 1975. P.167-204.

Bell M.C. Revised compendium on the success of passage of small fish through turbines. U.S. Army Corps of Engineers. North Pacific Div. Portland (Ore.), 1990. 83 p.

Bell C.E. Immediate mortality of American shad (*Alosa sapidissima*) resulting from passage through a Kaplan turbine at Holyoke Dam, Massachusetts. // Unpubl. Master's thesis. Univ. of Massachusetts, Amherst (Ma.), 1982.

Bell C.E., Kynard B. Mortality of adult American shad passing through a 17-megawatt Kaplan turbine at a lowhead hydroelectric dam // N. Amer. J. Fish Manag. 1985. Vol.5. P. 33-38.

Bell M.C. Fisheries handbook of engineering requirements and biological criteria. Fish passage development and evaluation program. U.S. Army Corps of Engineers. North Pacific Div. Portland (Ore.). 1991. 307 p.

Bell M.C. Updated compendium on the success of passage of small fish through turbines. U.S. Army Corps of Engineers, North Pacific Div. Portland (Ore.). 1981. 294 p.

Bell M.C., Bruya K.J. Updated compendium on the success of passage of small fish through turbines // Foster Dam mortality studies, U.S. Army Corps, of Engineers. North Pacific Div. Portland (Ore.). 1981.

Benson M.H. Coexistence of fish and dams. by Howard A. Preston. Louis E. Rydell: Discussion // J. Power Div. Proc. Amer. Soc. Civil Eng. 1954. Vol. 84, N 2.

Bentley W.W.. Raymond H.L. Passage of juvenile fish through orifices in gatewells of turbine intakes at McNary dam // Trans. Amer. Fish. Soc. 1969. Vol.98. P.723-727.

Berg R. Fish passage through Kaplan turbines at a power plant on the River Neckar and subsequent eel injuries // Vie Milieu 1986. Vol.36. P.307-310.

Bishai H.M. The effect of gas content of water on larval and young fish // Ztschr. wiss. Zool. 1960. Bd. 163. S. 37-64.

Bishai H.M. The effect of pressure on the survival and distribution of larval and young fish // J. Cons. perm. intern. Explor. mer. 1961. Vol.26, N 3. P. 292-311.

Blaxter J.H.S. The effect of hydrostatic pressure on fishes // Environmental physiology of fishes / Ed. M.A. Ali. N.Y.: Plenum press, 1980. P. 369-386.

Bohl E. Duel pattern of pelagic distribution and feeding in planktivorous fish // Oecologia. 1980. T. 44. P. 368-375.

Brawn W.M. Physical properties and hydrostatic function of the swimbladder of herring // J. Fish. Res. Board Canad. 1962. Vol.19. N 4. P.636.

Brett J.R., Hollands M., Alderdice D.F. The effect of temperature on the cruising speed of young sockeye and coho salmon // Ibid. 1958. Vol.15, N 4. P.587-605.

Brown F.A. Responses of the swimbladder of the guppy. *Lebistes reticulatus*, to sudden pressure decreases // Biol. Bull. 1939. Vol. 76, N 1. P.48-58.

Cada G.F. A review of studies relating to the effects of propeller-type turbine passage on fish early life stages // N. Amer. J. Fish. Manag. 1990. Vol. 10. P. 418-426.

Cada G.F. Suffern J.S.. Kumar K.D. et al. Investigations of entrainment mortality among larval and juvenile fishes using a power plant simulator // Issues associated with impact assessment: Proc. of the Fifth National workshop on entrainment and impingement / Ed. L.D. Jensen. Sparks (Md.), 1980. P.111-122.

Cada G.F., Coutant C.C., Whitney R.R. Development of biological criteria for the design of advanced hydropower turbines / U.S. Dept. of Energy Idaho Operations Office. Idaho Falls (Idaho), 1997. 85 p.

Calderwood W.L. Passage of smolts through turbines: effect of high pressures // Ibid. 1945. N 115. P. 214-221.

Calderwood W.L. Passage of smolts through turbines: Experiments at a power house // salmon and Trout Mag. 1935. N 96. P.123-167.

Campeau S., Guderley H., Fitz G.G. Salinity tolerances and preferences of fry of two species of sympatric sticklebacks: possible mechanisms of habitat segregation // Canad. J. Zool. 1984. Vol. 62. N 6. P.1048-1051.

Canada Dept. of Fisheries. The fisheries problems associated with the power development of the Puntledge River, Vancouver Island, B.C. Canad. Dep. Fish. 1958.

Clay C.H. Design of fishways and other fish facilities / Dep. of Fish. Ottawa, 1961.

Clay C.H. Design of fishways and other fish facilities. 2nd ed. Boca Raton (Florida): Lewis, 1995. 248 p.

Coles T.P. The distribution of perch (*Perca fluviatilis* (L.)) through their first year of life in Lyon Tegid, North Wales // J. Fish Biol. 1981. Vol. 18, N 1. P. 15-30.

Colins N.J. Potential fish mortality associated with large hydroelectric turbines // Canad.Techn. Rep. Fish. Aquat. Sci. 1984. N 1256. P.551-563.

Colins N.J., Ruggles C.P. Fish Mortality in Francis Turbines. Montreal Engineering Co. Ltd., Halifax, N.S. 1982. Sep.

Cramer F.K., Oligher R.C. Fish passage through turbines, tests at Cushman N 2 hydroelectric plant: U.S. Army Corps of Engineers Progress Report N 2. Walla Walla (Wash.), 1960.

Cramer F.K., Oligher R.C. Passing fish through hydraulic turbines // Trans. Amer. Fish.

Soc. 1964. Vol.93. P. 243-259.
Dadswell M.J., Rulifson R.A. Macrotidal estuaries: A region of collision between migratory marine animals and tidal power development // Biol. J. Linnean Soc. 1994. Vol. 51, N 1/2. P. 93-113.
Dadswell M.J., Rulifson R.A., Daborn G.R. Potential impact of large-scale tidal power developments in the Upper Bay of Fundy on fisheries resources of the Northwest Atlantic // Fisheries. 1986. Vol.11, N 4. P. 26-35.
Daily J. Lessons from a career in hydraulics // J. Hydraulic Eng. 1986. Vol.2, N 9.
Davies J.K. A review of information relating to fish passage through turbines: implications to tidal power schemes // J. Fish Biol. 1988. Vol.33. P.111-126.
Dijkgraaf S. The functioning and significance of the lateral line organs // Biol. Rev. Cambridge Philoc. Soc. 1962. Vol.38, N 1. P.51-105.
Dijkgraaf S. Uber die Bedeutung der Weberschen Knochel fur die Wahrnehmung von Schrankungen des hydrostatischen Druckes // Ibid. 1941. Bd. 28. S. 389-401
Dijkgraaf S. Untersuchungen uber die Funktion der Seitenorgane an Fischen // Ztschr. vergl. Physiol. 1933. Bd. 20. H. 1/2. S. 162-214.
Durkin J.T., Park D.L., Raleigh R.F. Distribution and movement of juvenile salmon in Brownlee reservoir, 1962-1965 // Fish. Bull. 1970. Vol.68, N 2. P.219-243.
Ebel W.J. Review of effects of environmental degradation on the freshwater stages of anadromous fish // Habitat modification and freshwater fisheries: Proc. of a symp. of EIFAC / Ed. J.S. Alutaster L.: Butterworths, 1975. P.67-79
Elder H.Y. Biological effects of water utilization by hydroelectric schemes in relation to fisheries, with special reference to Scotland // Proc. Roy. Soc. Edinburgh B. 1965. Vol.69, N 3/4. P. 246-271.
Eloranta P., Eloranta A. Vertical distribution of fishes in one deep lake (Lake Kunsvesi, Central Finland) // Verh. Intern. verein. Theor und angew. Limnol. 1980. Vol.20, N 3. P.2092-2097.
Evans H.M., Damant G.C.C. Observations on the physiology of the swim bladder in cyprinoid fishes // British J. Exp. Biol. 1929. Vol.5. P.42-55.
Fahlen G. Morphological aspects on the hydrostatic function of the bladder of *Clupea harengus* // Acta Univ. Lund. Sect. 2.1967. N 1. P.49.
Fange R. Observations on the air-bladder of *Ctenolabrus* // Kgh. fisiogr. Sallsk Lund. Forhandl. 1945. Vol.15. P.224.
Fange R. The mechanisms of gas transport in the euphysoclist swimbladder // Acta physiol. scand. 1953. Vol.30, suppl. 110. P. 1-113.
Feathers M.G., Knable A.E. Effects of depressurization upon largemouth bass // N.
Ferguson J.W. Analyzing turbine bypass systems at hydro facilities // Hydro Rev. 1992. Vol. 11,N3. P. 46-56.
Foye R.E., Scott Al. Effects of pressure on survival of six species of fish // Trans. Amer. Fish. Soc. 1965. Vol. 94. P. 88-91.
Franz Z. Ober den Reflex des Oasspuckens bei Fischen und die Function des Weberschen Apparates If ztschr. Vergl. Physiol. 1937. Bd. 25.S. 193-238.
Fry F.E.J. Effect of the environment on animal activity // Univ. Toronto Studies, Biol. Scr. N54. Publ. Ont. Fish Res. Lab. 1947. N 63 62p.
Fry F.E.J., Hart J.S. Cruising speed of gold-fish in relation to water temperature // J. Fish. Res. Board Canad. 1948. Vol.7. P. 169-175.

Gajdusek J., Lusk S. Ichtyofauna udolni nadne Mostiste na rece Oslave [Ichtyofauna of Mostiste Reservoir in the Oslava River]/ Venebnt. Zpravy. 1984. S. 95-106.

Gayenot E. Les fonctions de Ia vessie natatoire des poissons teleosteens II Bull. sci. fr. BeIg. 1909. Vol.43. P.203.

Ginn T.C.. Poje G.V., O'Connor J.A. Survival of planktonic organisms following passage through a simulated power plant condenser tube // Fourth national workshop on entrainment and impingement: Ecological analysts communications. N.Y.: Melville, 1978. P.91-101.

Gloss S.P., Wahl J.R., Dubois R.B. Potential effects of Ossberger turbines on Atlantic salmon smolts, striped bass and American shad. // Ed. Knapp W.E.. Kynard B. Potential Effects of Kaplan, Ossberger and Bulb Turbines on Anadromous Fishes of the Northeastern United States. Newton Corner (Ma); U.S. Fish and Wildlife Serv. 1982.

Gordon MS. Hydrostatic pressure // Fish physiology. 1970. Vol.4. P.445-446.

Gray J. Pseudorheotropism in fishes // S. Exp. Biol. 1937. Vol.14. P. 95-l03.

Groves A.B. Effects of hydraulic shearing actions on juvenile salmon: (Summary report) // Northwest Fish. Center, National Marine Fish. Service Seattle (Wash.), 1972.

Gunsolus R.T., Eicher G.J. Evaluation of fish passage facilities at the North Fork project on the Clackamas River in Oregon // Oregon Fish Comm., Oregon Game Comm., U.S. Bureau of Commercial Fish., U.S. Bureau of Sport Fish. Wildlife, Portland Electric Company. Portland (Ore.), 1970.

Hadderingh R.H. Fish intake mortality at power stations the problem and remedy //

Hadderingh R.H. Mortality of young fish in the cooling water system Bergum power station // Verb. Intern. verein. Theor. und angew. Limnol. 1978. Bd. 20. N 3.

Hadley C.G., Rust M.B., Van Eenennaam J.P., Doroshov S.I. Factors influencing initial swim bladder inflation by striped bass // Amer. Fish. Soc. Sym p. 1987. Vol.2.

Hamilton J.A, Andrew FJ. An investigation of the effect of Baker Dam on downstream - migrant salmon // Intern. Pacif. Salmon Fish. Bull. 1954. N 6. P.73.

Hamilton J.A. An investigation of the effect of Baker Dam on down stream migrant salmon. Ph.D. diss. Univ. Wash. // Diss. abstr. 1955. Vol.15, N 10. P.1934.

Hamilton W.S. Preventing cavitation damage to hydraulic structures. // Water Power and Dam Construction. 1983a. Nov. P. 40-43.

Hamilton W.S. Preventing cavitation damage to hydraulic structures. 2 // Ibid. 1983b. Dec. P.48-53.

Hamilton W.S. Preventing cavitation damage to hydraulic structures. 3 // Ibid. 1984. Jan.

Harvey H.H. Pressure in the early life history of sockeye salmon: Ph.D. Thesis / Univ. of British Columbia, Vancouver (B.C.), 1963. 267 p.

Henly F. The influence of the gas content of sea water on fish and fish larvae // Rapp. Cons. explon mer. 1952. Vol.131, N 3. P. 24-27

Hogan J. The effects of high vacuum on fish // Trans. Amer Fish. Soc. 1941. Vol.70.

Holand H.C., Holand B. The reaction of blinded goldfish to rotation in centrifuge // J. Exp. Biol. 1962. Vol.39. P.491-502.

Holmes H., Morton P. Bonnevilles first year // Par. Fish. 1939. Vol.4.

Hubbs C.L.. Rechnitzer A.B. Report on experiment designed to determine effects of underwater explosions on fish life // Calif. Fish and Game. 1952. Vol.38.

Hydrobiol. Bull. 1979. T. 13, N 2/3. P. 83-93.

Jacobs W. Untersuchungen zur Physiologie der Schwimmblase. 3. Luftschlucken und Gassekretion bei Physostome // ztschr. vergl. Physiol. 1934. Bd. 20. S. 674.

Jones F.R.H. An apparent reaction of fish to linear accelerations // Nature. L. 1956. Vol.178. P. 642-643.

Jones F.R.H. Fish migrations. L.: Arnold, 1968.325 p.

Jones F.R.H. Rotation experiments with blind goldfish U S. Exp. Biol. 1957. Vol.34.

Jones F.R.H. The swimbladder and the vertical movement of teleostean fishes. I Physical factors // Ibid. 1951. Vol.28, N 4. P. 111-120.

Jones F.R.H. The swimbladder and the vertical movements of teleostean fishes. 2. The restriction to rapid and slow movements // Ibid. 1952. Vol.29. N 2. P. 94-l09.

Karisson L.. Ekbohm G., Steinholts G. Comments on a study of the thermal behavior of the American eel (*Anguilla rostrata*) and some statistical suggestions for the temperature preference studies // Hydrobiol. 1984. Vol.109, N 1. P. 75-78.

Kearus R., Boyd F. Effect of a marine seismic exploration of fish population in British Columbia coastal waters // Canad. Fish Cult. 1965. Iss. 34. P. 3-25.

Kedl R.J., Coutant C.C. Survival of juvenile fishes receiving thermal and mechanical stress in a simulated power-plant condenser // Thermal ecology II: National Technical Information Service, CONP-750425. Springfield Va). 1976.

Knight A.E.. Kuzmeskus A. Potential effects of Bulb turbines on Atlantic salmon smolts // Potential Effects of Kaplan, Ossberger and Bulb Turbines on Anadromous Fishes of the Northeast United States / Ed. W.F. Knapp, B. Kynard. Newton Comer (Ma): U.S. Fish and Wildlife Serv., 1982.

Kokas E.V. Ober die physiologische Bedeutung des Weberschen Apparates bei einigen Cyprinoiden // Zool. Jahrb. Physiol. 1932. Bd. 52. S.179-l90.

Kynard B., Taylor R., Bell C., Stier D. Potential effects of Kaplan turbines on Atlantic salmon smolts, American shad and blueback herring. // Potential Effects of Kaplan. Ossberger and Bulb Turbines on Anadromous Fishes of the Northeast United States / Eds. W.F. Knapp, B. Kynard. Newton Corner (Ma): U.S. Fish and Wildlife Serv.. 1982.

Lampert W. Experiments on the resistance of fish to rapid increase in hydrostatic pressure // J. Fish Biol. 1976. Vol. 8. P.381-383.

Liscom K.L. Orifice placement in gatewells of turbine intakes for bypassing juvenile fish around dams // Trans. Amer. Fish. Soc. 1971. Vol.100. P. 319-324.

Liston C.R. Estimates of salmonid fish mortalities occurring at the Ludington pumped storage power facility during 1975-1976, and related studies: Annual Report (1978), Ludington Project, 1(2). East Lansing. MI: Dept. of Fish. Wildlife, Michigan State Univ., 1979. 45 p.

Long C.W. Duel movement and vertical distribution of juvenile anadromous fish in turbine intakes // Fish. Bull. 1968. Vol.66. P. 599-609.

Long C.W., Krema R.F., Ossiander FJ. Research on fingerling mortality in Kaplan turbines: Progress Report. Bureau of Commercial Fish., Seattle (Wash), 1968.7 p.

Lucas K.S. The mortality of fish passing through hydraulic turbines as related to cavitation and performance characteristics, pressure change, negative pressure, and other factors // Cavitation and hydraulic machinery: Proc. of IAHR (International Association for Hydraulic Research) symp. I Ed. F. Numachi. Sendai, 1962. P.307-335.

Lusk S. The ichthyofauna of the Oslava River // Folia zool. 1978. Vol.27, N 2. P.165-176.
Lynwood B. Bends in fish // Comp. Biochem. and Physiol. 1974. Vol. 49A. N 2. P.311-321.
Lyon E.P. On rheotropism. I. Rheotropism in fishes // Amer. J. Physiol. 1904. Vol.12, N 2. P. 149-161.
Lyon E.P. Rheotropism in fishes // Biol. Bull. 1905. Vol.8.
Marsh V.C., Corham F.P. The gas disease in fishes // Rep. US. Fish. Commun. for 1904.1905. P. 343-376.
Marshall N.R. The life of fishes. L.: Weidenfeld and Nicolson, 1965.402 p.
Massey J.B. Summary report on juvenile downstream migrant fish passage and protection studies at Willamette Falls. Oregon: Final Rep. Columbia River Fish. Dev. Program, Project 912.4-SCR-1, Control No l4-l7-0001-456. Portland (Ore): Oregon Game Comm., 1967. 234p.
Mathur G. Heisey D.P.. Euston E.T. et al. Turbine passage survival estimation for chinook salmon smolts (*Oncorhynchus tshawytscha*) at a large dam on the Columbia River // Canad. J. Fish. Aquatic Sci. 1996. Vol.53. P.542-549.
McCutcheon F.R. Pressure sensitivity, reflexes and behaviour in the pinfish *Lagodon rhomboides* L. // Ibid. 1966a. Vol.52, N 2/3. P. 245-251
McCutcheon F.R. Pressure sensitivity, reflexes and buoyancy responses in teleosts // Anim. behav. l966b. Vol.14, N 2-3, P. 204-217.
McCutcheon F.R. Swimbladder volume control in the pinfish *Lagodon rhomboides* // J. Cell. Comp. Physiol. 1962. Vol. 59. P. 203-214.
Meek A. The migration of fishes. L., 1916.427 p.
Mesa M.G. Effects of multiple acute stressors on the predator avoidance ability and physiology of juvenile chinook salmon // Trans. Amer. Fish. Soc. 1994. Vol. 123. P. 786-793.
Monten J.F. Fish and turbines: Fish injuries during passage through power station turbines. Stockholm: Vattenfall, 1985.111 p.
Morgan R.P. II, Ulanowicz R.E., Rasin V.J. et al. Effects of shear on eggs and larvae of striped bass, *Morone saxatilis*, and white perch, *M. americana* // Trans. Amer. Fish. Soc. 1976. Vol.105, N 1. P. 149-l54.
Muir J.F. Passage of young fish through turbines // J. Power Div. Proc. Amer. Soc. Civil Eng. 1959. Vol.85, N 1.
Munro W.R. Effects of passage through hydro-electric turbines on salmonids // Intern. Council for the Exploration of the sea. Salmon and Trout Committee. 1965. N 57.
Munro W.R. Passage of smolts through turbines. Tests with trout at Cashlie Power Station, Glen Lyon. North Scotland Hydroelectric Board, Dep. Ag. Fish. Scotland, Salmon Res. Committee 27. FW. 66/SRC. l28, 1966.
Munro W.R. Progress report on the passage of smolts through turbines. North Scotland Hydroelectric Board, Dep. Ag. Fish. Scotland 34. FW.64/SRC. 1964.
Munro W.R. Turbine tests at the Awe barrage: North Scotland Hydroelectric Board, Rep. 19.FW.68, 1968.
Munro W.R., Campbell RN. Passage of smolts through turbines-tailrace netting at Clunie Power Station: North Scotland Hydroelectric Board, Dep. Ag. Fish. Scotland 68.FW.61/SRC(SC)1, 1961.
Newton M.S., Kennedy G.C. An experimental study of the PVTS relations of seawater //

1. Mar. Res. 1965. Vol.23. P. 88-l03.
Nishiyama T. A preliminary note on the effect of hydrostatic pressure on the behaviour of some fish // Bull. Fac. Fish. Hokkaido Univ. 1965. Vol. 15. P. 2l3-2l4.
Northcote T.G. Migratory strategies and production in freshwater fishes // Ecol. Freshwater Fish Prod. Oxford e.a., 1978. P. 326-359.
O'Connor J.M., Poje G.V. Power plant entrainment simulation utilizing a condenser tube simulator (U.S. Nucl. Regulatory Commission; NUREG/CR-0894). Wash. (D.C.), 1979
Oligher R.C., Donaldson L.J. Fingerling Mortality Versus Turbine Efficiency at Big Cliff Dam // U.S. Army Corps of Engineers. Walla Walla (Wash.), 1965. Oct.
Olson F.W. Kaczynski V.W. Survival of downstream migrant coho salmon and steelhead trout through Bulb turbines // Rep. for Public Utility District Chelan County. 1980. N 1.
Paterson C-, Turner W. The effect of underwater explosion of the fish of Wentzel Lake, Alberta // Canad. Field-Natur. 1968. Vol.82, N 3. P. 219-220.
Pavlov D.S. Structures assisting the migrations of non-salmonid fish // USSR, Fac Fisheries Technical Paper. 1989. Vol. 308. P.1-97.
Pavlov D.S. The downstream migration of young fishes in river (mechanisms and distribution) // Folia zool. 1994. Vol.43, N3. P. 193-208.
Pavlov D.S., Kostin V.V., Lupandin A.L. Development of downstream migration in roach larvae (*Rutilus rutilus* L.): The role of locomotor activity // Russ.. Aquatic Ecol. 1997. Vol.7, N I. P.75-82.
Pavlov D.S.. Barus V., Nezdolq V.K. et al. Downstream fish migration from Mostiste and Vestonice reservoirs. Praha: Academia, 1987.63 p.
Pavlov D.S.. Turuov S.N. Reactions of dace to linear accelerations // J. Fish Biol. 1995 Vol.46. P.768-774.
Quasim S.Z., Rice A.L.. Knight-Jones E.W. Sensitivity to pressure changes in teleosts lacking swim bladders // J. Mar. Biol. Asso:. India. 1963. Vol.5. P. 289-292.
Qutob Z. The swimbladder of fishes as a pressure receptor // Arch. neerl. zool. 1962. Vol. 15, N 1/2. P. 1-67.
Rowley W.E., Jr. Hydrostatic pressure tests on rainbow trout // Calif. Fish and Game. 1955. Vol.41. P. 243-244.
Ruggles C.P., Collins N.H. Fish mortality as a function of the hydraulic propenies of turbines: Rep. for Canad. Electrical Association by the Montreal Engineering Co. Montreal, 1981.
Ruthener F. Grundrisder Limnologie. B., 1962.
Scheuring L. Die Wandenung der Fische. 211 Ibid. 1930. Bd. S. 4-304.
Scheuring L. Die Wanderung der Fische. I // Ergebn. Biol. 1928. Rd. 3.S. 405-691.
Schoeneman D.E.. Junge C.O.. Jr. Investigation of mortalities to downstream migrant salmon at two dams on the Elhwa River. // Wash. Dept. Fish. Res. Bull. 1954. N 3. 51 p.
Scholander P.F. Secretion of gases against high pressures in the swimbladder of deep sea fishes: The rete mirabile // Biol. Bull. 1954. Vol.107, N 2.
Shoeneman D.E., Pressey R.T., Junge C.O., Jr. Mortalities of downstream migrant salmon at McNary dam // Trans. Amer. Fish. Soc. 1961. Vol.90. P.58-72.
Smith J.R., Farr W.E. Bypass and collection system for protection of juvenile salmon and

trout at Little Goose dam // Marine Fish Rev. 1975. Vol.37, N 2. P.31-35.

Spoor W.A. Distribution of fingerling brook trout, *Salvenius fontinalis* (Mitchill), in dissolved oxygen concentration gradients // J. Fish Biol. 1990. Vol.36, N 3. P. 363-378.

Stier D.J. Immediate mortality of Atlantic salmon (*Salmo salar*) smolts resulting from passage through Kaplan turbine at Holyoke Dam, Massachuetts // Unpub. M.S. thesis. Univ. of Massachusetts. 1983.

Stier D.J., Kynard B. Use of radiotelemetry to determine the mortality of Atlantic salmon smolts passed through a 17MW Kaplan turbine at a low head hydroelectric dam // Trans. Amer. Fish. Soc. 1986. Vol.115. P.771-775.

Strotkoerter E. Rezeption hydrostatischer Druke bei Fischen und ihre Mitwirkung an der Orientirung im Raum // Natuwissenschaften. 1960. Bd. 47, N 24. S. 68-75.

Thorpe J.E. Downstream movements of juvenile salmonids: a forward speculative view // Mechanisms of Migration in Fishes. N.Y. and London: Plenum Press. 1982. P.387-395.

Thorpe J.E., Ross L.O., Struthers O. et. al. Tracing Atlantic salmon smolts *Salmo salar* L. through Loch Voil, Scotland // J. Fish. Biol. 1981. Vol.19. P.519-537.

Travade F., Dartiguelongue J., Larinier M. Devalaison et franchissement des turbines et ouvrages energetiques: lexperience EDF // Hoyille Blanche. 1987. N 1/2. P.125-134.

Trefethen P. Man's impact on the Columbia River // River ecology and man. Inc. N.Y.; L.: Acad. press, 1972. P.77-98.

Turnpenny A.W.H., Davis M.H., Fleming J.M., Davies J.K. Experimental studies relating to the passage of fish and shrimps though tidal power turbines / Marine and Freshwater Biol. Unit, National Power. Southhampton: Fawley, 1992.

Vibert R. General report on the Working Party on the application of electricity to inland fishery biology and management // Fish Electricity. L.: Fish. News, 1967. P. 3-51.

von Raben K. Turbines and their destructive effect on fishes // Ztschr. Fisch. Hilfsweissen. Sonderdruck. 1957. Rd. 6 H. 1/7. P. 171-182.

Vostradovsky I., Leontovyc I., Vostradoysia M. Ichtyofauna prazske Vltavy v letech l970-1972 // Bull. VUR Vodnany. 1973 Vol.9, N 2. P. 19-26.

Wagner H., Ingram P. Evaluation of fish facilities and passage at Foster and Green Peter dams on the South Santium River drainage in Oregon // Fish Comm. of Oregon. Portland (Ore.), 1973.

WAPORA, Inc. Fish passage studies at the Racine and New Martinsville hydroelectric projects: 4 vol. Cincinnati (Ohio), 1987.

Weitkamp D.E.. Mckenzie D.H., Schadt T.H Survival of Steelhead Smolts During Passage Through Wells Dam Turbines and Spillway. Bellevue (Wash.): Parametrix, Inc.. 1985.

Williams H.E., Brauer R. W. Thermoregulatory behavior and temperature gradient perception in a juvenile fish (*Poecilia reticulata*) // Canad. S. Physiol. and Pharmacol. 1987. Vol.65, N 6. P. 1389-l394.

Wunderlich R.C. A preliminary assessment of juvenile salmon mortality through the Elhwa River dams. Olympia (Wash.): U.S. Fish and Wildlife Sen.. 1983.

Wunderlich R.C., Dilley S.J. An assessment of juvenile coho passage mortality at Elhwa River dams. Olympia (Wash.): U.S. Fish and Wildlife Serv., 1985.