

Potential Impact of the Danube-Black Sea Navigation Route Construction on Fish Stocks and Fisheries

Summary answers to questions by Mr. S. Schmutz of 2 May 2006, provided by the specialists of the Ukrainian Scientific Research Institute of Ecological Problems (USRIEP, Kharkiv) and Odessa Branch of the Southern Scientific Research Institute of Marine Fishery and Oceanography (OB SSRIMFO)

1. List of species recorded in the Ukrainian part of the Danube Basin and the Outer Danube Delta within the Danube Biosphere Reserve (DBR) is provided in Table 1 (Source: The Biodiversity of the Danube Biosphere Reserve: Conservation and Management – Kyiv: Naukova Dumka Publishing House, 1999. – 702 p.).

2. See Tables 1 and 2.

3. See Table 1.

4. The channels of the Danube arms and branches are mainly used by fish as migratory routes; flooded wetland sections and shallows provide spawning habitats; shallow areas and lagoons are main feeding areas for young and adult fishes; deeper stream sections (hollows) provide resting places for migratory fish (sturgeons) and wintering habitats. See also Table 1.

5. In addition to the specified migratory anadromous fish species (Danube herring, sturgeon), the following migratory species have been recorded in the Ukrainian part of the Danube Delta:

- Caspian shad (*A. caspia nordmanni*) – anadromous;
- Brown trout (*Salmo trutta*) – anadromous (no spawning in the Danube Basin);
- Eel (*Anguilla anguilla*) – catadromous.

The list of semi-migratory fish species is provided in Table 1.

6. The migratory fish species use all existing arms of the Danube Delta, though major migration routes lie along the largest arms that have higher flow discharges: the St. George and Sulina Branches in Romania; and the Starostambulske, Bystre, Eastern, Potapovo and Prirva Branches in Ukraine. The significance of the Bystre Branch as the main migration route for herring (the most abundant migratory fish) is illustrated by the fact that prior to the start of construction of the navigation route this area accounted for 25-30% of the total herring catches in the Ukrainian part of the Danube Basin.

The spawning migration period for herring lasts from March through June, reaching its peak in April-May. The downstream migration of young herring occurs from May through September, reaching the peak in June or early July.

The spawning migration of sturgeons upstream occurs throughout a year (winter and spring groups). The migration peaks are relatively weakly pronounced in certain species: great sturgeon (March-April, stellate sturgeon (May-June), sturgeon (August-September). The downstream migration of young sturgeons occurs in summer (July).

7. The most important commercial fish species in the Danube Delta, in addition to herring, are silver carp, common carp, and common bream (Table 2).

Table 1. Summary List of Fish Species Recorded in the Danube Biosphere Reserve

Fish Families and Species		Habitat (Lifecycle)	Mode of Reproduction	Rate of Occurrence	Red Data Book of Ukraine	European Red List
English Name	Latin Name					
Dogfishes	Squalidae					
Atlantic spiny dogfish	<i>Squalus acanthias</i> L.	Marine	Viviparous	Common		
Stingrays	Dasyatidae					
Atlantic stingray	<i>Dasyatis pastinaca</i> (L.)	Marine	Viviparous	Rare		
Sturgeons	Acipenseridae					
Great sturgeon	<i>Huso huso</i> (L.)	Migratory	Lithophile	Common	*	
Spiny sturgeon	<i>Acipenser nudiiventris</i> Lovetzky	Migratory	Lithophile	Single-instance	*	*
Sterlet	<i>Acipenser ruthenus</i> (L.)	Freshwater	Lithophile	Rare	*	
Stellate sturgeon	<i>Acipenser stellatus</i> Pall.	Migratory	Lithophile	Common		
Baltic sturgeon	<i>Acipenser sturio</i> L.	Migratory	Lithophile	Single-instance	*	*
Russian sturgeon	<i>Acipenser guldenstadti colchicus</i> (V. Marti)	Migratory	Lithophile	Common		
Herrings	Clupeidae					
Danube shad	<i>Alosa kessleri pontica</i> (Eichwald)	Migratory	Pelagophile	Numerous		
Black Sea shad	<i>Alosa caspia nordmanni</i> Antipa	Migratory	Pelagophile	Common		
Common kilka	<i>Clupeonella delicatula delicatula</i> (Nordmann)	Various types of waters	Pelagophile	Numerous		
European sprat	<i>Sprattus sprattus phalericus</i> Risso	Marine	Pelagophile	Numerous		
Anchovies	Engraulidae					
European anchovy	<i>Engraulis encrasicolus ponticus</i> Alex	Marine	Pelagophile	Numerous		
Salmons	Salmonidae					
Black Sea salmon	<i>Salmo trutta labrax</i> Pallas	Migratory	Lithophile	Single-instance	*	*
Danube salmon	<i>Hucho hucho</i> (L.)	Freshwater	Lithophile	Single-instance	*	*
Pikes	Esocidae					
Pike	<i>Esox lucius</i> L.	Freshwater	Phytophile	Common		
Mudminnows	Umbridae					
European mudminnow	<i>Umbra krameri</i> Walbaum	Freshwater	Phytophile	Common	*	*
Freshwater eels	Anguillidae					
European eels	<i>Anguilla anguilla</i> (L.)	Migratory catadromous	Pelagophile	Rare		
Carp	Cyprinidae					
Roach	<i>Rutilus rutilus</i> (L.)	Freshwater	Phytophile/lithophile	Numerous		
Black Sea roach	<i>Rutilus frisii</i> (Nordm.)	Semi-migratory	Lithophile	Single-instance	*	
Chub	<i>Leuciscus cephalus</i> (L.)	Freshwater	Lithophile	Rare		
Danube chub	<i>Leuciscus borusthenicus</i> (Kessler.)	Freshwater	Lithophile	Single-instance		
Orfe	<i>Leuciscus idus</i> (L.)	Freshwater	Lithophile	Rare		
Rudd	<i>Scardinius erythrophthalmus</i> (L.)	Freshwater	Phytophile	Common		

Fish Families and Species		Habitat (Lifecycle)	Mode of Reproduction	Rate of Occurrence	Red Data Book of Ukraine	European Red List
English Name	Latin Name					
Grass carp	<i>Ctenopharyngodon idella</i> (Val.)	Freshwater	Pelagophile	Common		
Verkhovka	<i>Leucaspis delineatus</i> (Hechel)	Freshwater	Phytophile	Rare		
Tench	<i>Tinca tinca</i> (L.)	Freshwater	Phytophile	Rare		
Asp	<i>Aspius aspius</i> (L.)	Freshwater	Lithophile	Common		
Undermouth	<i>Chondrostoma pasus</i> (L.)	Freshwater	Lithophile	Rare		
Bream	<i>Abramis brama</i> (L.)	Freshwater Semi-migratory	Phytophile	Numerous		
Blue ballerus	<i>Abramis ballerus</i> (L.)	Freshwater	Phytophile	Rare		
White-eye	<i>Abramis sapa</i> (Pallas)	Freshwater	Phyto-Psammophile	Common		
White bream	<i>Blicca bjoerkna</i> (L.)	Freshwater	Phytophile	Common		
Vimba	<i>Vimba vimba</i> (Pallas)	Semi-migratory	Litho-Phytophile	Common		
Shemaya	<i>Chalcalburnus chalcoides</i> (Guld.)	Freshwater	Psammo-Lithophile	Single-instance	*	
Bleak	<i>Alburnus alburnus</i> (L.)	Freshwater	Phytophile	Common		
Minnow	<i>Phoxinus phoxinus</i> (L.)	Freshwater	Lithophile	Single-instance		
Barbel	<i>Barbus barbus</i> (L.)	Freshwater	Lithophile	Rare		
Stone moroco	<i>Pseudorasbora parva</i> (Schlegel)	Freshwater	Lithophile	Rare		
Gudgeon	<i>Gobio gobio</i> (L.)	Freshwater	Psammophile	Rare	*	
Carp	<i>Cyprinus carpio</i> (L.)	Freshwater	Phytophile	Numerous		
Crucian carp	<i>Carassius carassius</i> (L.)	Freshwater	Phytophile	Single-instance		
Goldfish	<i>Carassius auratus gibelio</i> (Bloch)	Freshwater	Phytophile	Numerous		
Amur bitterling	<i>Rhodeus sericeus</i> (Pallas)	Freshwater	Остакофил	Common		
Sabrefish	<i>Pelecus cultratus</i> (L.)	Freshwater	Pelagophile	Common		
White carp	<i>Hypophthalmichthys molotrix</i> (Val.)	Freshwater	Pelagophile	Common		
Bighead	<i>Aristichthys nobilis</i> (Rich.)	Freshwater	Pelagophile	Common		
Loaches	Cobitidae					
Spiny loach	<i>Cobitis taenia</i> L.	Freshwater	Phytophile	Rare		
Golden spiny loach	<i>Cobitis aurata</i> (Filippi)	Freshwater	Phytophile	Single-instance		
Loach	<i>Misgurnus fossilis</i> (L.)	Freshwater	Phytophile	Common		
Sheatfishes	Siluridae					
Catfish	<i>Silurus glanis</i> L.	Freshwater Semi-migratory	Phytophile	Common		
Needlefishes	Belonidae					
Flat needlefish	<i>Belone belone euxini</i> Gunther	Marine	Phyto-Pelagophile	Single-instance		
Silversides	Atherinidae					
Silverside	<i>Atherina mochon pontica</i> Eichwald	Various types of waters	Phytophile	Numerous		
Cods	Gadidae					
Burbot	<i>Lota lota</i> (L.)	Freshwater	Psammophile	Single-instance		

Fish Families and Species		Habitat (Lifecycle)	Mode of Reproduction	Rate of Occurrence	Red Data Book of Ukraine	European Red List
English Name	Latin Name					
Whiting	<i>Odontogadus merlangus</i> (L.)	Marine	Pelagophile	Numerous		
Sticklebacks	Gasterosteidae					
Southern nine-spined stickleback	<i>Pungitius platygaster</i> (Kessler)	Various types of waters	Phytophile	Common		
Three-spined stickleback	<i>Gasterosteus aculeatus</i> L.	Various types of waters	Phytophile	Common		
Pipefishes	Syngnathidae					
Black-striped pipefish	<i>Syngnathus nigrolineatus</i> Eichwold	Various types of waters	Ovoviviparous	Common		
Mullets	Mugilidae					
Striped mullet	<i>Mugil cephalus</i> L.	Marine	Pelagophile	Common		
Golden mullet	<i>Mugil auratus</i> Risso	Marine	Pelagophile	Common		
Haarder	<i>Mugil so-iuy</i>	Marine	Pelagophile	Rare		
Sunfishes	Centrarchidae					
Common sunfish	<i>Lepomis gibbosus</i> (L.)	Freshwater	Psammophile	Common		
Perches	Percidae					
Perch	<i>Perca fluviatilis</i> L.	Freshwater	Phytophile-Indifferent	Common		
Ruffe	<i>Acerina cernua</i> (L.)	Freshwater	Litho-Psammophile	Rare		
Striped ruffe	<i>Acerina schraetser</i> (L.)	Freshwater	Litho-Psammophile	Rare	*	
Zander, pike perch	<i>Lucioperca lucioperca</i> (L.)	Freshwater Semi-migratory	Phytophile-Indifferent	Common		
Volga zander	<i>Lucioperca volgensis</i> (Gmelin)	Freshwater Semi-migratory	Phytophile-Indifferent	Rare		
Chop	<i>Aspro zingel</i> (L.)	Freshwater	Lithophile	Rare	*	*
Little chop	<i>Aspro streber</i> Sieb.	Freshwater	Lithophile	Single-instance	*	*
Bluefishes	Pomatomidae					
Bluefish	<i>Pomatomus saltatrix</i> (L.)	Marine	Pelagophile	Single-instance		
Jackscads	Carangidae					
Black Sea scad	<i>Trachurus mediterraneus ponticus</i> Aleev.	Marine	Pelagophile	Numerous		
Goatfishes	Mullidae					
Blunt-snouted mullet	<i>Mullus barbatus ponticus</i> Essipov	Marine	Pelagophile	Single-instance		
Gobies	Gobiidae					
Common goby	<i>Pomatoschistus microps leopardinus</i> (Nordm.)	Brackish-water	Malaco-Lithophile	Single-instance		
-	<i>Knipowitschia caucasica</i> Illjin	Various types of waters	Malaco-Lithophile	Single-instance		
-	<i>Knipowitschia longicaudata</i> (Kessler)	Brackish-water	Psammo-	Single-instance		

Fish Families and Species		Habitat (Lifecycle)	Mode of Reproduction	Rate of Occurrence	Red Data Book of Ukraine	European Red List
English Name	Latin Name					
			Malacophile			
Black goby	<i>Gobius niger</i> L.	Marine	Litho-Psammophile	Single-instance		
Round goby	<i>Neogobius melanostomus</i> (Pall.)	Various types of waters	Lithophile	Common		
Mushroom goby	<i>Neogobius cephalarges</i> (Pall.)	Brackish-water	Lithophile	Single-instance	*	
Big-headed goby	<i>Neogobius kessleri</i> (Gunther.)	Brackish-water	Malaco-Lithophile	Rare		
Monkey goby	<i>Neogobius fluviatilis</i> (Pall.)	Various types of waters	Lithophile	Numerous		
Toad goby	<i>Mesogobius batrachocephalus</i> (Pall.)	Various types of waters	Lithophile	Single-instance		
Goad goby	<i>Mesogobius gymnotrachelus</i> (Kessler)	Brackish-water	Malaco-Lithophile	Rare		
Tube-nosed goby	<i>Proterorhinus marmoratus</i> (Pallas)	Various types of waters	Malaco-Lithophile	Common		
Starry goby	<i>Benthophilus stellatus</i> (Sauv)	Brackish-water	Malacophile	Common		
Scombrids	Scombridae					
Atlantic mackerel	<i>Scomber scombrus</i> L.	Marine	Pelagophile	Single-instance		
Scorpion fishes	Scorpaenidae					
Small-scaled scorpion fish	<i>Scorpaena porcus</i> L.	Marine	Lithophile	Single-instance		
Searobins	Triglidae					
Yellow gurnard	<i>Trygla lucerna</i> L.	Marine	Pelagophile	Single-instance	*	
Left-eyed flounders	Scophthalmidae					
Black Sea turbot	<i>Scophthalmus maeoticus</i> (Pall.)	Marine	Pelagophile	Single-instance		
Right-eyed flounders	Pleuronectidae					
Flounder	<i>Platichthys flesus luscus</i> (Pall.)	Brackish-water	Pelagophile	Common		
Soles	Soleidae					
Snouted sole	<i>Solea nasuta</i> (Pall.)	Marine	Pelagophile	Single-instance		

Total: 90 fish species, of that 15 species are included in the Red Data Book of Ukraine and 7 species in the European Red List.

Table 2 Catches in Danube River from 1997 till 2005

Species	1997	1998	1999	2000	2001	2002	2003	2004	2005
Carp	4,0	5,9	5,0	6,0	7,0	14,1	7,03	16,02	14,0
Pike perch	-	0,7	0,9	1,3	1,5	1,8	1,27	4,21	3,216
Common bream	12,2	19,5	11,0	5,1	9,4	9,6	15,75	12,27	7,1
Goldfish	66,2	69,7	66,5	57,3	61,6	76,2	48,51	51,63	43,69
Catfish	1,2	-	-	-	1,6	1,3	1,30	1,67	2,13
Vimba	0,8	-	-	-	5,1	6,7	2,46	2,32	1,52
Pike	0,5	-	-	-	0,4	0,3	0,20	0,73	1,15
Asp	2,0	-	-	-	1,9	2,7	2,86	2,06	1,95
Rudd	2,4	-	-	-	5,3	5,4	2,61	0,62	1,42
Roach	0,3	-	-	-	4,6	11,5	6,04	7,19	3,25
Silver bream	2,0	-	-	-	3,7	6,2	8,80	5,71	3,32
Sabrefish	-	-	-	-	0,3	0,8	1,00	0,13	0,042
Perch	0,6	-	-	-	1,2	2,3	0	0,39	0,25
Silver carp + bighead	7,4	5,6	3,7	0,9	7,5	4,1	2,18	8,00	8,10
Danube shad	274,0	160,8	18,0	78,9	141,3	204,2	143,7	194,6	352,5
Starred sturgeon	0,3	1,0	0,5	0,7	0,02	0,1	0,365	0,272	0,606
Russian sturgeon	1,2				-	0,1	0,011	0,079	0,160
Haarder	-	0,2	0,1	0,5	2,0	2,8	2,05	1,65	2,012
Other fishes	-	13,2	14,4	13,9	-	0,2	0	0,01	1,757
Total	375,3	276,6	120,1	165,6	254,4	350,4	246,6	309,6	448,2

8. Herring is the most important commercial fish species in the Ukrainian part of the Danube Delta, accounting for over 60% of the total fish catch in the recent years. The size of herring shoal entering the river for spawning varies from year to year due to various abiotic and biotic factors (water level and river discharge, temperature regime, wind regime, wintering conditions on the Turkish coast, generation-specific abundance, fishing intensity etc.). It appears that the trend in the spawning population of the Danube herring follows a pattern with cycles of various duration: 3-4, 7 and 11 years. Herring catches vary within a broad range: from 10 tonnes in 1948 to 1,200 tonnes in 1975.

In the recent years, the herring catches have declines by nearly 3 times as compared to catches recorded in the 1960s. Recent annual catches are similar to those recorded in the 1950s, being higher than the catches in the 1940s (Table 3).

Table 3. Average Annual Catches of Herring in the Ukrainian Part of the Danube River

Year	Average Annual Catch, tones
1945–1950	74
1951–1960	207
1961–1970	562
1971–1980	522
1981–1990	408
1991–2000	217
2001–2005	207

Over the past 40 years, the catches of all other fish species have declines by 3-fold.

There has been a significant change in the commercial catch structure. Great sturgeon and sterlet, included into the Red Data Book of Ukraine, are no longer recorded in the commercial catches, nor are tench, ide, barbel etc. The proportion of total catch, accounted for by stellate sturgeon, sturgeon, common carp, vimba, pike, catfish, and asp, has also decreased significantly. The proportion of silver carp in the total catch has considerably increased to replace the crucian carp. The following

new species, established in the Basin, have emerged: white carp, bighead, grass carp (3–10% of total catch).

According to the expert estimates, Ukraine accounts for about 25% of total catch in the Lower Danube Basin, with 75% being accounted for by Romania.

9. In the Ukrainian part of the Danube Basin, herring fishing season lasts from March through June (with fishing intensity being highest in April-May). Fishing intensity is lower during the remaining months, with the number of boats and fishermen involved in fishing operations decreasing by 3–5 times. Only fine-mesh fishing continues.

Fishing efficiency is highest in the most downstream sections of the river branches, immediately in their mouths. Over 80% of the total fish catch come from the most downstream part of the delta.

10. The adverse effect of dredging and hydroengineering construction activities on fish habitats is of local scale and largely limited to the construction period and short annual periods of maintenance dredging during the operational phase. This effect is described in the documentation presented by Ukraine to the Enquiry Commission («**The Assessment of Transboundary Impact of the Navigation Route Reopening in the Ukrainian Part of the Danube Delta**» and Annex 8 (pp. 3; 5.2.2)

The locations of these activities are shown and described in the Ukrainian documentation (Annexes 15(1); 15(2); 23).

Dredging volumes and affected areas are specified in Annexes 2 (Tables 2, 3), 3, 16, 36, 40.

The characterization of bottom sediments is provided in Annexes 20, 21, 22, 24, 33.

11. According to the design, dredging operations are to be conducted in three shifts, taking into account the following hydrological and ecological requirements:

- Suspension of dredging activities during the spawning period – 1 month per year (the start and end date of spawning ban on dredging activities are annually set by the Basin Management Authority “Odessa Fishery and Water Management Authority”);
- No construction works will be carried out in the winter period; all works are to be suspended as soon as mean daily temperature falls below 0°;
- Planned work regime for the sandbar section is 10-12 working days per month (taking into account storm and freezing events), or 160 working days per year;
- Planned work regime for the river section of navigation route is 22 working days per month, or 200 working days per year;

The total operational capacity for dredging, permitted to be operated simultaneously, includes seven multi-bucket dredgers and two suction dredgers, provided that they are distributed along the length of the navigation route (Table 4).

Table 4. Technical Characteristics of Dredgers and their Proposed Distribution in the Dredging Locations

Kilometer Marks along the Navigation Route	Dredger Type	Design Capacity, m³/hour	Monthly Capacity, m³/month
River Section			
112.5 – 115 60.00 – 64.00	Mobile suction dredger	1300	150000
76.00 – 77.00 71.00 – 75.50 68.50 – 71.00 33.00 – 39.00	Suction dredger or multi-bucket dredger	1000 or 600	$\frac{120000}{120000^1}$
64.00 – 68.50	Mobile suction dredger	1300	150000
46.50 – 53.00	Multi-bucket dredger	600	$\frac{80000}{120000^1}$
31.00 – 33.00 26.00 – 31.00 20.50 – 26.00	Suction dredger	1000	120000
1.534 – 20.555	Mobile suction dredger or multi-bucket dredger	1300	130000
Seaward Access Channel	Multi-bucket dredger	1300	180000

Note: ¹ – two-step transfer

12. The navigation route development produced a certain adverse impact on fisheries. During the dredging activities, commercial catches at a distance of 300 m to 1 km from a dredge location were next to none. Noise generated by dredging equipment caused a significant disturbance for fish. Fishing equipment was also affected by increased silting. In more remote areas (both in the river and the coastal sea), the species composition and size distribution of fish catches were close to historical pattern.

Dredging activities, underwater spoils dumping and installation of navigation signs caused the loss of some commercial fishing sites in the Bystre Branch, adjacent coastal waters, and Chilia Branch (near the Maikan island; 35–38 km; 52–53 km etc.). Fishing companies had to relocate their fishing crews and handle related costs.

13-16. Prior to the commencement of construction, and as part of the 2004 integrated environmental monitoring programme for the Danube-Black Sea Navigation Route Project, several fish stock surveys were carried out. They included:

- Ichthyoplankton sampling in the river and coastal waters;
 - Trawl-fishing surveys for accounting the number of young sturgeons moving to the sea from spawning sites;
 - Fish sampling with the use of various fishing techniques in the Danube River and adjacent coastal waters of the Black Sea;
 - Collection of data on commercial fisheries (catch sizes, assets owned by fishing companies etc.).
- No special research for migratory fish species was carried out. Summary information and results of integrated environmental monitoring are provided in Annexes 6; 26; 30.

Further details and additional information are available at USRIEP. Contact e-mail addresses: vasenko@rpmc.com.ua for Olexander Vasenko (Scientific Director of the Programme), and master@rpmc.com.ua for Pavlo Stankevich (Executive Officer of the Programme).

17-18. The proposed programme of compensatory measures includes silt removal and control in the degrading arms of the delta (including the Belhorod Channel restoration project, proposed by the Vylkovo municipality) and overgrowing branches in order to improve the water regime of wetlands, create additional spawning and feeding areas for fish. The clearance and restoration of channels and lagoons would also improve conditions for fishing in these areas. No detailed assessment of environmental and economic benefits of these measures has been carried out. The implementation of fishery-related compensation measures has not started yet, but the compensation fund amounting to about 200,000 USD has been established under the navigation route project.

19. In 2004, the navigation route reopening works in the sandbar section started in late May and their timing partially coincided with the spawning period of Black Sea turbot and goby, during which their special-purpose fishing is banned.

In the river, no construction activity took place during the spawning ban, but their timing coincided with the period of downstream migration of young herring and sturgeon species from their spawning areas.

In 2005, the river-bound construction works commenced on 1 January and suspended by 15 March. These works were resumed after the spawning period, and coincided with the period of intensive downstream migration of young herring in June-July.

In the sandbar area, the construction works partially coincided with the spawning period of Black Sea turbot, goby and Azov/Black Sea mullet.

20. The construction of state-owned sturgeon farm in the Danube Basin is planned under the 2004-2010 National Fishery Sector Development Programme of Ukraine, approved by the Law of Ukraine of 19.02.2004 No. 1516-IV. Planned annual farm capacity is 12 million current-year individuals of sturgeon, great sturgeon and stellate sturgeon (1.5-3 tonnes per year). Estimated construction cost is 40 million UAH (8 million USD), to be financed from the state budget. Main designer is the UkrRybProject (Ukrainian Fishery Research and Design Institute, Kyiv). The project was planned to be completed by 2010.

The expert view of the Odessa Branch of the Southern Scientific Research Institute of Marine Fishery and Oceanography is that the proposed farm capacity is not feasible due to the lack of sufficient reproductive stock. The project was put on hold at the prefeasibility stage due to the lack of funds.

21. There is no provision for artificial reproduction of other fish species.

As an additional compensatory measure, it is planned to prepare the inventory of spawning sites in the Danube Delta and lakes and develop the restoration measures for these sites.