Expression of Interest
for a
Network of Excellence (FP6.2002)

Multidisciplinary Analysis of Diadromous Fish in a Globally Changing Environment (DIADFISH)

This EOI has been prepared by:

French Institute of Agricultural and Environmental Engineering Research (Cemagref), Inland Aquatic Living Resources Unit, Bordeaux, France

Leibniz Institute for Freshwater Ecology and Inland Fisheries (IGB), Berlin, Germany

Research Center in Biodiversity and Genetic Resources (CIBIO), University of Porto, Porto, Portugal

Centre for Ecology and Hydrology (CEH), Pencuik, Scotland UK

Institute of Evolutionary and Ecological Sciences, Section Integrative Zoology, University of Leiden, Leiden, The Netherlands

National Museum of Natural History (MNHN), Paris, France

Swedish University of Agricultural Sciences (SLU), Department of Aquaculture, Umea, Sweden

Netherlands Institute for Fisheries Research (RIVO), Ijmuiden, The Netherlands

Veszprem University, Department of Animal Physiology and Nutrition, Veszprem, Hungary

Norwegian Institute for Nature Research (NINA), Trondheim, Norway

University of Southern Denmark, Institute of Biology, Odense, Denmark

Research Institute of Fisheries, South Branch Federal Centre for Genetics and Selection in Fish Culture, Krasnodar, Russia

Society to Save the Sturgeon (SSS), Rostock, Germany

Université de Liège, laboratoire de démographie des poissons, Liège, Belgium

German Oceanographic Museum, Department of Marine Biology, Stralsund, Germany

Electricité de France EDF, Laboratoire National d'Hydraulique et Environnement (LNHE), Chatou, France

Institute for Inland Water Management and Waste Water Treatment (RIZA), Arhnem, The Netherlands

National Polytechnic Institute (INP), Toulouse, France

Laboratorio di Ecologia Sperimentale e Acquacoltura Università degli Studi "Tor Vergata", Rome, Italy

Institute of Freshwater Research, Swedish National Board of Fisheries, Drottningholm, Sweden

Laboratoire de Biologie et d'Environnement Marin, University of La Rochelle, La Rochelle, France

Freshwater Ecology and Fisheries Conservation Group, Department of Zoology, National University of Ireland (NUI), Galway, Ireland

1 Introduction, need and relevance

The human population is concentrated in the coastal fringe of the continents, often in coastal plains and along rivers. The impacts of anthropogenic influence on ecosystems are maximised with increasing density of settlements. Furthermore, natural resources in rivers, estuaries and coastal areas are prime targets for exploitation. Diadromous fish species have historically been of major importance in this exploitation scheme.

Diadromous fish have ecological, economic and sociological importance. Throughout the last century direct (fisheries) and indirect (habitat modification, pollution, etc.) human impacts on aquatic ecosystems have affected migrating fish stocks to a degree that these stocks today are threatened, or the survival of species is at risk. The main reasons for this development are caused by adverse impacts on the diversity of habitat types these species require. Studying the interactions between these natural systems and human impacts involves aspects of ecosystem management, of nature conservation and of natural resource management.

This proposal aims to bring together experts and users of this resource in a joint approach throughout the range of species in question to improve knowledge and to ensure the sustained management of diadromous fish in Europe. This network will provide a sound basis for future decisions (e.g. water framework directive implementation) and powerful ecological tools for the benefit of European diadromous fish species by identifying and quantifying environmental benchmarks, anthropological impacts, preventive and remedial management options. The aim is also to test methods and procedures for their protection, which may need to be implemented to secure the future of these valuable and threatened species. This proposal is strongly connected to the EU WFD and the FHH guideline.

1.1 Rationale, context

During their life cycle diadromous fish utilise both freshwater and marine habitats from small streams to the open ocean. These species depend on the quality of these different ecosystems (e.g. food webs) and require connectivity between them. They link flows of energy and biological material. Eighteen species of diadromous fish occur in Europe from Finland to Romania. Three of them are catadromous (European eel, thin-lipped mullet, flounder) and fifteen are anadromous (Marine Lamprey, River lamprey, European sturgeon, Adriatic sturgeon, Stellate sturgeon, Russian sturgeon, Beluga, Atlantic salmon, Sea trout, Arctic Charr, Smelt, Houting, Allis shad, Twaite shad, Vimba).

Presently, their distribution areas are decreasing and becoming more isolated, thus limiting gene flow. Most of these species are endangered or vulnerable and are listed in the Natura 2000 network. Some species are even of special concern (e.g. European and Adriatic sturgeons) and could disappear if appropriate measures are not implemented. Historically, these species have shown their capability to survive global changes (e.g. post glaciation repopulation of rivers) due to their marine phase and the tendency of some individuals to stray and colonise new habitats.

The present situation with diadromous fish stocks on the decline, is attributed mainly to human impacts i) directly on these resources (e.g. uncontrolled commercial and recreational fisheries) and ii) indirectly via their habitats (e.g. habitat degradation, barriers to migration, hydraulic modifications) as well as by global climate changes. Their dependence on different modified food webs make diadromous fish extremely vulnerable towards the effects of environmental changes and the consequent alterations in habitat interactions.

As they are symbolic of quality water, Salmonids have been intensively studied (109 projects in EU FP) (e.g. ethology in rivers, osmoregulation physiology) and act as a flagship species, but even in their case there are still wide gaps in knowledge (e.g. interaction with other species, impact of human activities on the populations sustainability). The other diadromous species have been studied much less (e.g. 2 projects concerning shads in EU FP), gaps in knowledge are wider (e.g. ecology, environmental relationships, fisheries), even knowledge of basic features is inadequate(e.g. reproduction, biogeography). Single species approaches have enabled improvement in our knowledge but they also show that there are great difficulties in countering the decreasing trends in species abundance and distribution because of i) large gaps in knowledge (e.g. marine phase, impact of environment on population dynamics, etc.), ii) insufficient involvement of stake-holders in the decision making process (e.g. basin managers, fishermen), iii) recommendations which are too narrow and don't consider the other species, iv) poor connections between scientific and technological tools and management tools.

In order to allow a sound management of the species in question, information gaps have to be closed. There is an extremely urgent need for co-ordinate freshwater and marine research and fisheries management. In this context, we propose that FP6 offers the opportunity for an integrated study of all relevant aspects concerning the welfare and interests of all European diadromous fish species over their whole migration range. This primary aim includes the identification of general patterns in habitat choice, population expansion, limitations of range, overall species adaptations to changing habitats, and interactions between species (especially in lotic and coastal waters). Thus leading on to identifying key habitat characteristics and how they function. Sufficient knowledge on the effects and responses of current environmental and human

impacts on diadromous fish and their habitat must be achieved. Since they share many environmental needs diadromous fish species would benefit from the same improvements (e.g. habitat diversification, fishways, sustainable management of fisheries at an appropriate scale). This broad view requires the establishment of inter-disciplinary studies to build a strong scientific basis dedicated to the conservation biology and management of diadromous species.

1.2 Key scientific issues

As the abundance of diadromous species has been decreasing in Europe, there is a strong need to fully understand species distribution status and behaviour as well as their sensitivities to, and relationship with environmental factors and human activities. Even if human activities are identified as being responsible for this situation, methods and tools are necessary to assess the relative importance and impacts of these activities.

Following past degradation, it is attempted to improve the environmental quality of some European basins (e.g. the Rhine). This raised the demand for ecological tools in order to restore connectivity and habitats of diadromous fish. Several recovery plans are in progress (e.g. salmonids, sturgeons). However in spite of numerous studies (mainly on salmonids) knowledge is still insufficient to maintain populations efficiently and diverse assemblages. We have technological know-how to enable several species to migrate upstream. Further more, downstream migration devices require further developments.

Throughout the recent decades a northern shift in species distribution has been observed (e.g. smelt). Most probably because of climate warming (e.g. eel) but it is necessary to address this topics in co-operation with climatologists. Diadromous fish exhibit strategies in the use of both marine and freshwater environments (interactions and limitations of diadromy, habitat dependance, fidelity to native areas, movements between marine and freshwater) which depend on their density and of the environment variability. Some present hypotheses could be studied in order to establish a general theory for the life history of diadromous species. In other words what are the selective advantages of diadromy ?

The current exploitation of several species (e.g. eel, sturgeons) is no longer sustainable and it is important that sustainable management practices are established in liaison with stakeholders. Modelling could be an efficient tool in this respect. The by-catch of protected species (e.g. sturgeons, salmonids) is significant and potentially very detrimental to their survival.

There is a wide spread scientific community throughout Europe dealing with diadromous fish species but it is fragmented (by species, habitat, basin, research institute). The integration of these scientists and their facilities into a network of excellence will constitute a significant advance in research possibilities. The enthusiasm of the scientists here to join together and build this proposal indicates that such integration is possible.

2 Scientific support

There are at least 200 European scientists in over 50 laboratories that conduct research on diadromous species of fish and could take part in this NEX. At present this community is mainly structured by species (e.g. Atlantic Salmon and European Eel ICES-EIFAC working groups; recent specific symposia for: Shads (F, 2000), Sturgeon (E, 2000; F, 2001, D, 2002), Eel (DK, 2001; F, 2002). Most of the current research projects focus on single species in single environments (i.e. freshwater, brackish water or marine water). While few of these laboratories have diadromous fish as their principal concern, many scientists have expertise on more than one diadromous species. We estimate that 80% of European teams dealing with diadromous fish could take part in this network and will constitute a research community equivalent to those in North America where the scientific community has structures (e.g. shad@yahoogroups.com) to address the issue and problems for diadromous species.

2.1 State of the art

Management of fish resources to date has been run on a local or regional scale only aimed at local objectives, or has followed a *laissez-faire* approach. Research has also focused mainly on local aspects and this has prevented a sound assessment of the broader situation and understanding of the processes involved. Meanwhile, most of the fish resources have shown a steep decline during the past decades and markets have become globalised. Consequently, international management is of the utmost urgency.

Several European projects that deal with diadromous fish have been carried out or are in progress and include laboratories involved in this proposition. One FP5 program focused on eel maturation process (EELREP), another addresses eel colonisation stages and their fisheries (glass eel monitoring). Two FP5 Life programs were conducted on European sturgeon conservation, one on Atlantic salmon (Allier river in France) and one Inco project studied a more sustainable way to produce caviar.

2.2 Partnership

The following laboratories have complementary expertise and knowledge and will constitute the main framework of this NEX.

Table 1. List of institutes, Fields of competency,. N: number of scientists and PhD students involved in the NEX

Country	Institute	Laboratory: Head, species of interest, facilities	Genetics	Ethology	Physiology	Ecology	Environment	Fisheries	Conservation	Technology	Number of scientist + PhD students
F	**Cemagref** *	**Paul Gonthier, Eric Rochard** (sturgeons, shads, eel, smelt, lampreys). One field station dedicated to diadromous fish (hatchery, rearing facilities). Fish ageing lab, one research vessel, sampling and telemetry devices, data bases (Gironde basin)			+	+	+	+	+	+	16 + 3
N	**NINA ***	**Bror Jonsson** (salmonids)	+	+	+	+	+	+	+		15
S	Swedish National Board of Fisheries, Institute of Freshwater Research *	**Torbjörn Järvi** (Salmonids, eel, lamprey, coregonids, sturgeon) Laboratory of stream water ecology including a large stream tank, two fisheries research stations. Fish ageing lab., lab. of fish genetics	+	+		+	+	+	+		11
S	**SLU ***	**Hans Lundqvist, Monika Schmitz** (salmonids, eel) Umeå Marine Sciences Centre, salmon hatchery and databases	+	+	+	+		+	+		5 + 5
IRL	**NUI ***	**Kieran McCarthy** (salmonids, eel, shads, smelt, lamprey, flounder)	+			+	+	+	+		6 + 5
D	**IGB ***	**Frank Kirschbaum** (sturgeons, eel) Aquariums, mesocosms	+	+		+			+		5 + 3
D	**SSS ***	**Joern Gessner** (sturgeons)	+	+	+	+	+	+	+	+	5 + 3
I	Università "Tor Vergata" *	**Stefano Cataudella, Eleonora Ciccotti** (eel, sturgeons) Aquaculture facilities, field station (Tiber)			+	+	+	+			5 + 3
F	**INRA ENSA** Rennes *	**Jean Luc Baglinière** (salmonids, shads, lamprey). Monitoring field stations (Oir, Scorff). Aquaculture hall, mesocosms	+			+	+		+		4 + 2
D	German Oceanographic Museum *	**Ralf Thiel** (salmonids, shads, smelt, flounder, lampreys, coregonids). Aquarium. Field sampling devices. 12-year-database about diadromous species in the Elbe River and estuary.		+		+	+	+	+		3 + 1
D	Fisch und Umwelt MV, Rostock	**Gerd Michael Arndt** (sturgeons, coregonids, salmonids)	+	+	+	+	+	+	+	+	3 + 1
UK	Environment Agency	**Miran Aprahamian** (shads, eel, salmonids)				+	+	+	+		
F	**INP** *	**Michel Larinier, Alain Belaud** (salmonids, shads) One technological hall to test scale model, telemetry devices		+	+	+				+	4
NL	**RIVO ***	**Willem Dekker** (eel, salmonids)				+		+			3
NL	**RIZA ***	**Andre Breukelaar** (salmonids, shads)				+	+		+		3
UK	**CEH ***	**Alex Lyle** (lampreys, salmonids, smelt, shads)				+	+	+	+		1
RO	Danube Delta Institute	**Radu Suciu, Ion Navodariu** (sturgeons, shads)				+	+	+	+		2
P	**CIBIO-ICETA ***	**Paulo Alexandrino** (shads, salmonids)	+			+			+		2 + 1
F	**MNHN ***	**Sylvie Dufour, Martine Fouchereau-Peron** (eel, salmonids, lampreys). One station of Marine Biology (Concarneau)			+	+					5 + 2
PL	Instytut Rybackiwa Srodladowego, River Fisheries Lab, Gdansk	**Ryszard Bartel** (salmonids, lampreys, eel)				+		+			4
E	Consejo Superior de Investigaciones Cientificas, Madrid *	**Javier Lobon-Cervia** (eel, salmonids) One biological station (Ori), 15 year- database (salmonids, eel) in an experimental basin. One National Museum of Natural Sciences				+			+		2 + 1
B	Université de Liège *	**Jean Claude Philippart** (salmonids, shads)				+			+		2
F	**EDF LNHE ***	**François Travade** (salmonids, eel, shads). Hydraulic lab (scale models), fish traps and video counting stations in fishways		+						+	2
NL	University of Leiden *	**Guido Van den Thillart** (eel)			+						4 + 2
DK	University of southern Denmark *	**Cliff Rankin** (lampreys, eel, salmonids)			+						2
HU	Veszprem University *	**Miklos Bercsenyi** (eel, sturgeons) One wet lab and a small hatchery	+						+		1 + 2
F	Université de La Rochelle *	**Eric Feunteun** (eels, mullets) One experimental basin (Fremur)		+	+	+	+	+	+		1 + 1

* indicates laboratories which have expressed their interest in this proposition.

Country	Institute	Laboratory: Head, species of interest, facilities	Genetics	Ethology	Physiology	Ecology	Environment	Fisheries	Conservation	Technology	Number of scientist + PhD students
I	Università di Ferrara	**Remigio Rossi** (sturgeons)				+			+		
UK	**CEFAS**, Lowesoft	**Andy Moore** (salmonids)		+		+		+			
SF	Finnish Fisheries Research Institute	(salmonids)		+		+		+			

One non EU FP country laboratory will also be involved:

RU	Krasnodar Research Institute of Fisheries *	**Mikhail Chebanov** (sturgeons, royal fish, vimba) Artificial spawning sites, experimental fish elevator, ultrasonic techniques, database (Kuban River). One research vessel. Living Gene Bank of 9 sturgeon species	+		+	+			+	+	6 + 4

Several laboratories without a particular focus on diadromous fish but with a high level of expertise in a discipline essential for the network will constitute a second circle of partners.

E	**IMEDEA**, Grupo de Oceanografía Interdisciplinar *	**Beatriz Morales Nin** (Microchemistry of calcified structures: otoliths, scales, etc. ; microstructural analysis related to environmental change)	3
HU	Hungarian Academy of Sciences, Veterinary, Medical Research Institute, Budapest *	**Csaba Székely** (Fish parasitology) wet room	2 + 1
D	**PIK** Institute for Climate impact research, Postdam	**Horst Eisenack** (Assessment of management options in marine fisheries by qualitative modelling techniques)	2 + 2

Some other units will be contacted later to complete the network. Several groups of end users have been informed: management bodies of varying scales, agencies, fishermen, fish traders, energy producers, ports, nature protection associations. We will propose that they participate and contribute financially to this network.

2.3 Readiness

This network will result from the fusion of several communities, which are already partially structured in international groups (e.g. EIFAC-ICES salmon group) and have worked together to build this proposals. Teams from these communities have regular communications since they submit jointly to several EU programs exchange scientists and publish joint papers. They frequently organised symposia or workshops and are also experienced in electronic networking (e.g. two E forums dedicated to eels). Several institutes that support this proposal are already members of existing European networks (e.g. EURAQUA).

3 Joint program of activities

3.1 Common research activities

This network of scientific knowledge and expertise will have the capability to address complex questions.

Stock identification and functional mechanisms that explain the current status and distribution of diadromous fish constitute a present scientific challenge that we will take up. In some well studied areas, extensive data bases already exist. They will be reorganised to enhance study and analysis of diadromous fish: biogeography, ecology, population genetics, ethology, as well as historic analysis of human activities (fisheries, canalisation, damming, etc.) and the effects of global warming. Research will be promoted on the homing and straying capabilities of these species which are mechanisms involved in their possible ability to adapt to global change and to increase their distribution. In order to collect and restructure available knowledge a workshop will be organised serving as a reference point for future work.

The level of human impacts that could lead to the extinction of diadromous populations will be established by comparing the differences in present and historical assemblages using chronicles of human activities to explain temporal changes of status. Links will be established with the evolution of freshwater and marine ecosystems zoogeography. Furthermore, understanding human impacts will also be improved by studying examples of recolonisation of basins by species that had previously become extinct there (e.g. shad, salmon).

Research will focus on several types of drainage basin systems, taking account of their: latitude, fisheries, number and status of diadromous species. This would include basins that correspond to the present limit of distribution for some species and where changes in fish status are more likely due to anticipated climate variations. We will select basin to constitute a network for long term ecological research. Several specific

studies have been conducted in the Danube, Tiber, Ebro, Tagus, Gironde, Loire, Fremur, Rhine, Elbe, Severn and Vindel-Umeälven basins which could constitute interesting locations to focus studies and logistic commitments.

To address isolated stock and metapopulations dynamics a common virtual drainage basins will be used. It will improve understanding of how diadromous species colonise them, the species interactions and how human activities could impact upon them. Modelling would stimulate exchanges between disciplinary fields. Scenarios of simulated climatic change will also be employed to predict impacts on fish status and changes in distribution. Management actions could also be verified by modelling.

Versatile structures will be developed to enable all diadromous fish to cross weirs and to avoid injury in turbines during downstream migration. Telemetry methods will be of particular interest to assess the efficiency of the devices. Engineering techniques to improve essential habitat quality and functionality will be tested (e.g. shad spawning grounds). Stocking experiments of all diadromous species will be consulted in order to produce guidelines for future and present species recovery plans (e.g. shad in the Rhine and Atlantic salmon in France).

Internal calls for proposals will enable young scientists to develop their own expertise in network laboratories (e.g. 3 years of research). We wish to integrate economists (10 scientists) into this NEX to address the problem of fisheries (exploitation and by-catch allowances) and a call for proposals will be made to select teams.

3.2 Integration activities

The network will co-ordinate the research programmes of the participating laboratories. Development of common research strategies will involve either identifying common themes (analytical research, non-applied sciences) or concentrating on common processes (application and integration). A network mobility program will support exchange of scientists, PhD and post doctoral fellows between teams of the NEX.

Sharing experimental facilities will be a vital aspect. Most of the experimental equipment used for studies (e.g. field stations, mesocosms, experimental basin, video counting station, telemetry equipment, etc.) can be used for several species. Sharing of coastal research vessels could be cost-efficient and would probably enable studies otherwise unaffordable. This will be particularly valuable for rare species (e.g. sturgeons) where highly specialised methods are required. Appropriate data-bases could be assimilated to enhance their usefulness and made available through the Internet. A simulation model (virtual drainage basins and virtual diadromous fish) will be build to test ecological hypothesis and management scenarios.

3.3 Transfer activities

To date there have been no symposia to consider diadromous fish species throughout Europe. Such a meeting will be held every two years to address the imminent threats to these fish and to promote action to sustain them and secure their future existence. Proceedings of this symposium will be part of a reference document to be published. A strategy of co-authored publications will be supported.

The network will offer the expertise to contribute to national and international management decisions. A common course for graduate student will be implemented on the network web site.

The network will also help as a medium to exchange information with end users via a multilingual web site. Workshops dedicated to management will be organised in co-operation with stake-holders (management bodies for river basin, board of fisheries, etc.) to present results, guidelines and discuss their consequences for management and river equipment.

3.4 Network management

The scientific leaders of the institutes involved will form the Management Board which will set the priorities, and control the network. A Governing Board representing the heads of the participating institutes as well as financial supporters, will validate the programme of the NEX. It will be assisted by a Scientific Advisory Board including non EU high level scientists and a Technical Advisory Board composed of stake-holders (fishermen's organisations, hydroelectricity producers, harbour association, NGOs, etc.). Prioritisation and methodological approaches could be evaluated by the SAB. The network will be managed by a project deputy, chosen by the management board, and a small management group. E communications (forum, website, electronic information letter, web databases) will be used as the main medium for the management of the network. Special connections will be established with networks dealing with marine and freshwater ecosystems.