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O

Predicting the timing of silver eel migration with environmental factors in a large river system

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One of the most effective strategies to limit silver eel mortality due to turbine passage at hydroelectric projects consists in stopping turbines and providing spill flows during downstream migration peaks. However, migration patterns are badly known and highly variable between sites and years. In that context, management plans have proposed to stop hydroturbines between November and February. A better knowledge of migratory behaviour and timing would help to refine this strategy by predicting the migration peaks in order to suspend turbines during shorter periods. Here, we present an environmental factors-based prediction model of eel migration timing. It is based on the analysis of 4 long-term (20 years) catch time series of professional fishermen of the Loire River and related environmental data. We used Generalized Linear Models to analyse the temporal variations in silver eel catches. The mixture models used enabled us to simultaneously introduce the influence of meteorological (weather type and nighttime luminosity index), hydrological (river flow and turbidity) and temporal factors (number of weeks). All the environmental variables used in the model were standardised to reduce site effects and predictable at least at 24 hours that allows managers to anticipate their turbine suspension. The analysis revealed that about 80% of migration peaks observed are predicted, suggesting that silver eel migration peaks occurred during relatively very predictable environmental windows. This model enables to propose a set of management scenarios optimising the trade-off between silver eel escapement and hydroelectric production objectives. The potential use of this model for hydroelectric project managers and its extrapolation to others river systems is discussed.

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Migratory mega-cyprinids need attention: *Aspiorhynchus laticeps* of the Xinjiang Autonomous Region, China

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The Xinjiang datou fish or big-head schizothorcin (*Aspiorhynchus laticeps*) is a critically endangered large piscivorous cyprinid found in northwest China. This sole species of the genus *Aspiorhynchus* is imperiled by the same threats facing other large river cyprinids in the US, India, and elsewhere. The species range is limited to river basins north of the Tibet Plateau and south of the Tian Shan Mountains where waters drain toward the Taklamakan Desert and evaporate in wetlands along the desert margin. The species spawns in turbulent and rocky large streams in mountain foothills and otherwise occupies warm, sluggish lowland rivers and lakes. Before the 1970s, *Aspiorhynchus laticeps* was an abundant member of a depauperate regional fish fauna supporting a significant annual harvest. It is now absent from all or most lakes and many river systems. Three major threats explain the loss of populations and decline in abundances. First, development of numerous water diversions and dams that block spawning migrations. Second, fishing harvest has changed since the 19070s and is a potential cause of population declines. Finally, the introduction of a many non-native fishes in the region is a probable threat. The reproductive and early life biology of the species is largely unknown and this information is needed to plan recovery efforts such as habitat protection, passage at water diversions, and identification of suitable river systems. Culture techniques need to be developed, and population assessments are needed to determine the security of current wild populations. Regional fish biologists and national Chinese species conservation authorities believe the species may be near extinction.

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EU Life project: The re-introduction of allis shad (*Alosa alosa*) in the River Rhine system

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The overall objective of this new Life project is the conservation and protection of allis shad in Europe. The distribution range of the species has decreased dramatically during the last 100 years. In this European project with financial and practical support of three Rhine bordering countries (Netherlands, Germany, France) the project objective is the re-introduction of allis shad in the Rhine System. 150 years ago several hundred thousand allis shads have been caught annually in the Rhine System and they were an important economic factor for the local population. Only 30 years later the population collapsed. With the stocking of allis shad larvae it shall be achieved that mature allis shad will migrate into the river again and build a healthy population which will not need accompanying stocking activities in the future. The project application was accompanied by extensive preliminary studies including e.g. genetic and habitat analyses and rearing and marking experiments. The first European mass production fish farm opened in 2008 and half a million shad larvae were reared and stocked in the Rhine River in 2008. All the fish were marked with Oxytetracyclin. Stocking was accompanied by monitoring campaigns and applied research on the influence of navigation induced waves.

O

Transfer of existing scientific know-how on species re-introductions can help to improve re-introduction plans of related species

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Historically, the Susquehanna River was a major producer of American shad (*Alosa sapidissima*) on the Atlantic coast of the United States. However, significant environmental problems and dam development led to the virtual extirpation of American shad in the Susquehanna River. Fish re-introduction and project evaluation activities have been undertaken over a three-decade period by numerous state, federal, and utility company partners. The shad population returning to the lowermost dam on the Susquehanna grew from only a few hundred to a maximum of over 200,000 fish in the past years. The re-introduction was accompanied by extensive scientific research on fish culture, marking, stocking and monitoring techniques. In a new European project on the re-introduction of the closely related allis shad (*Alosa alosa*) to the River Rhine the existing scientific work on the re-introduction of the American shad was tested for applicability in a feasibility study. Transferred techniques included artificial reproduction of allis shad with hormone stimulation and mass marking of cultured larvae with oxytetracycline. In both cases the application of existing experimental protocols worked well for the related species. In the case of artificial reproduction even better results could be obtained under certain circumstances. Both techniques are now being implemented in the re-introduction plan for allis shad. In 2008 the first European allis shad fish farm was opened in Bruch, France and 500.000 allis shad were raised, marked and stocked in the Rhine River thereafter.

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Re-establishment of the North-Sea houting in the River Rhine

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From 1916 to 1940 a strong decline in the catches of anadromous North-Sea houting (*Coregonus oxyrinchus*) in the River Rhine was observed, where this species has been considered to be extinct since the 1940s. Descendants of the last known reproducing population of houting from the Danish River Vidå were used for a restocking program in the Rhine system. From 1996 until 2005 roughly 1.9 million juvenile houting had been stocked at two locations of the Lower Rhine. In February 2006, a batch of North Sea houting eggs were stained with Alizarin, from which about 400.000 juveniles (hatching mid of April) were stocked at the Lower Rhine in the mid of May. As a control, one part of the marked juveniles was reared in net cages up to 60 mm total length (L_T), from which all analyzed individuals (n=23) had a clear Alizarin mark in the centre of the otoliths, thus we consider full marking of all North Sea houting stocked in 2006. In total, 55 young-of-the-year North Sea houting from Lake IJsselmeer (21.6.06-25.7.06: 62-120 mm L_T) and four individuals that were caught in the River Rhine near Rees (18.8.06-19.10.06: 97-140 mm L_T) were analyzed. Only two individuals caught in Lake IJsselmeer had a clear Alizarin mark (22.7.06: 113 mm L_T; 24.7.06: 94 mm L_T), thus only 3.6 % of all analyzed North Sea houting. This gives clear evidence that natural reproduction took place in 2006, suggesting the establishment of a self-sustaining population and proving the success of the restocking program of North Sea houting in the Rhine System.

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Floodplain restoration and fish fauna: a 16 year case study from the River Lippe

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Starting in 1997, the state of Northrhine-Westphalia implemented the comprehensive restoration of sections of the Lippe floodplain. The River Lippe is a tributary of the Rhine with a length of 90 km entering the study area, a catchment area of about 2000 km² and a mean discharge (MQ) of 25 m³/s. During the restoration works the riverbed was widened from 13 to 30 - 40 m and raised by up to 2 m. Bank reinforcements were taken out and low levees were removed allowing near natural river dynamics and flood regime. In a long-term study the changes of the river's and the floodplain's fish fauna regarding species composition and population densities are documented by standardized electric fishing that was performed during four years before the first restoration measures and has been carried on so far for 12 years after that. Despite the impact of the restoration measures on the habitat there was no general decline of fish abundance immediately after the transformation. Since then, the abundance of most species in the restored river sections increased significantly compared to that in unrestored reference sections. Several endangered species like Nase *Chondrostoma nasus*, Spined Loach *Cobitis taenia*, and Burbot *Lota lota* benefited considerably. The reproduction of the Burbot depends on the unity of river and floodplain. Restored and newly created ponds in the floodplain are first colonized by pioneer species like Sunbleak *Leucaspius delineatus* and Ten-spined Stickleback *Pungitius pungitius* that immigrate during the floods that now regularly inundate the floodplain. Later the pioneers can be replaced by other species.

O

A simple management tool for planning the restoration of river longitudinal connectivity at watershed level: priority indexes for fish passes

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The fragmentation of the longitudinal connectivity of rivers due to man-made obstacles causes relevant impacts upon fish migrations and therefore the reopening of fish migration routes through the construction of fish passes is a key issue which should be planned at watershed level. The competent watershed Authorities need to prioritize the interventions, addressing the often limited resources to the sites where the construction of a fish pass can have the higher benefit/cost ratio. The present study was therefore aimed at identifying a simple management tool, based on already available or easily collectable data, which could support and address decisional processes in watershed planning. The proposed priority indexes for fish passes, based on obstacle characteristics, length of the potential reopened reach and fish species distribution and migratory capabilities, were tested in 2 Italian watershed (Arno and Magra rivers) over a total river length of more than 400 km. The results (priority lists) coming from the application of such indexes can be considered a preliminary step for the definition of a restoration plan which could help the competent Authorities to address the available resources towards more detailed studies to be carried out at sites classified with the higher priority levels. This is the case of the Regional Natural Park Monte Marcello-Magra, where within a LIFE+ project (P.A.R.C. – “Petromyzon And River Continuity”) recently funded, the first results of the priority indexes application will be analyzed in greater detail and will consequently lead to the design and construction of fish passes with a particular focus on sea lamprey (*Petromyzon marinus*) migration routes restoration.

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Challenges to restoration of salmonids in streams of the Ukrainian part of the Carpathians

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The Carpathian region of Ukraine has more than 31 thousand rivers and streams, many of which were historically inhabited by a complex of salmonid species: Danube salmon (*Hucho hucho*), European grayling (*Thymallus thymallus*), and brown trout (*Salmo trutta morpha fario*). These species were abundant in the beginning of XX century, when their productivity was from 5.5 to 40 kg/ha. Since the middle of XX century, stocks of native salmonids drastically declined due to negative human impact, which disturbed typical biotopes. As a result of this effect, the potential for natural propagation of local salmonid populations was virtually lost. Currently, the number of these fishes in Carpathian rivers is critically low: the Danube salmon and European grayling are listed as endangered in the Red Data Book of Ukraine. Brown trout is not listed yet, but its populations are on very low level with the maximum number of 15 age-3 individuals/km in some trout sections, while in the majority of rivers this species can be found sporadically or is absent. Currently in Ukraine, there is a national program aimed at conserving and restoring native fishes, which provides for stocking of artificially raised salmonid juveniles into Carpathian rivers. However, there is a number of factors, which can hamper successful fish restoration efforts. The first group of them has direct negative effect on fish habitats: barrages; water pollution caused by dumping of industrial wastes (especially those of woodworking plants), sewage waters and household garbage; illegal removal of gravel from river bottoms; use of river beds for trailing timber. The second group of factors is directed at individual fish: over-fishing and fish harvest using illegal fishing gears (especially such as electric devices). The third group of factors has indirect effect on fish and its habitats, such as deforestation, which causes increased sedimentation and heavy floods.

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Effects of hydromorphological restoration measures and near-natural river stretches on the fishfauna of the Eifel-Rur – specific use of "stepping stone effects" for reaching the objectives of the Water Framework Directive

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This contribution presents the results of a robust causality analysis which explores the effects that near-natural restoration measures and near-natural river stretches exert on the fishfauna of stretches far from their natural state. A very good coverage of data for the German "Eifel-Rur" catchment, in particular with respect to the fishfauna, permitted the study. A total number of 219 valid data sets from 2001 until 2008 have been used for multivariate statistical analysis. The study produced meaningful, transparent and reproducible results on "stepping stone effects". Based on the causality analysis a tool for determining the location and the extent of restoration measures required for accomplishing a "good ecological state", as defined by the Water Framework Directive for every water body within the "Eifel-Rur" catchment, was designed. Overall, the study suggests little to moderate demand for restoration measures regarding waters of the low-mountain region, but high demand with respect to waters of the lowlands. Apart from generating new "stepping stones", the focus should be on utilizing existing "stepping stones" for improving ecologically poor stretches. Additionally, it is demonstrated that the developed methodology can be successfully implemented and applied for water management purposes. For the first time, a concept based on "stepping stone effects", which provides an overview of the necessary measures for achieving a "good ecological state", is developed for a catchment of more than 2000 km². Compared to the low-mountain region, data on waters of the lowlands are restricted in the context of this study. Therefore, it is suggested that the methodology is validated and (if needed) modified for lowland waters with catchments of similar size. Furthermore, it is pointed out that, in particular throughout the initial phase of implementing restoration measures, large-scale efficiency controls are carried out. This is to test not only the designed methodology, but also the efficiency of individual measures.

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Restoring migratory salmonid populations in heavily regulated rivers in the northernmost Baltic Sea area, Northern Finland – a review of recent activities

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Three large river systems in Northern Finland, historically renowned major salmon rivers, have been harnessed for hydropower for 40-60 years without provisions for fish passage until recently. Hydropower companies are obliged to compensate for the losses caused by dam construction by annual fish releases, including juveniles of Atlantic salmon and migratory brown trout. Returning fish are harvested in the designated “terminal fishery areas” at river mouths. Recently increased activities, aiming at salmonid stock restoration, have been started in all rivers. First fishways in two rivers have been constructed, and preliminary projects reviewing and surveying the preconditions for restoration, options for overcoming the dams, and studying the performance of the fishways, have been conducted and new projects are underway. In the largest catchment, the River Kemijoki, the first fishway was constructed to the lowermost dam in 1992. Planning is underway for another fishway and transferring adult salmon above five dams into a large, free-flowing tributary. In the River Oulujoki, the first fishway constructed in 2003 opened the route for migratory fish into a 40 km river stretch and two potential tributaries. The successful first years of fishway operation has provoked public pressure towards restoring salmon runs further into the river. Studies on smolt migration through the lowermost dams and impoundments have been undertaken. In the River Iijoki, a large project was recently launched with an aim to start adult salmon transfers above the five dams into the free-flowing large area with excellent salmonid production habitat. Introductions of juvenile salmon and trout in this area have started, and the project also aims at producing feasible options for fish passage overcoming the five dams. The various projects have proved successful in bringing together authorities, power companies, local organizations, and expertise from various institutions for a joint effort to tackle these multifaceted and multidisciplinary problems.

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Development of a national Action Plan for the restoration of the European sturgeon – implementing international commitments on a national scale

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The European sturgeon (*Acipenser sturio*) is one of the most highly endangered fish species worldwide. Being a common part of the fauna of the riverine and coastal habitats of Europe until the end of the 19th century, the drastic decline of its populations led to its extirpation within 50 years throughout most of its historic range. Its longevity and long life cycle, the habitat requirements and the late spawning season have contributed to its sensitivity against anthropogenic impacts which made it a predecessor for other migratory species that subsequently revealed a similar decline. Today only one population is known to exist in the Gironde River, France. To increase the collaborative approach in the safeguarding and restoration of the species' population the Bern Convention has adopted an Action Plan (AP) at the standing committee meeting in November 2007. Based on this document, the member states to the Bern Convention are to develop national APs addressing the critical issues for its conservation. This paper discusses in detail the prerequisites for the development of such a national AP, thus focusing on the increasingly complex structures in the German Federal and Regional governance system, the stakeholder involvement required, as well as the dynamics of a process unprecedented in any fish species under this convention. For the national AP the governmental agencies for nature conservation and for fisheries, the regional and national stakeholders such as fisheries, inland navigation administration, port authorities, river catchment management units, recreational water users and environmental conservation NGO's have to be brought together, overcoming major barriers to allow a constructive dialogue leading towards a common problem analysis scenario. As a result, the national AP is intended to provide the framework for the management plans for those river systems considered suitable for the attempts to remediate populations of the European sturgeon in a joint effort with the French partners.

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The scientific background for preservation of endangered fishes – the Yarqon bleak (*Acanthobrama telavivensis*) as a test case

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The Yarqon bleak (*Acanthobrama telavivensis*), a cyprinid fish endemic to the Mediterranean rivers in Israel, became almost extinct following the drought of 1998-1999. The seven-year saga of its rescue, captive breeding, failure of the first attempt to return the fish to nature, and the final success, prove the need for relevant research for preservation of endangered fish species. The crucial findings for the preservation of the Yarqon bleak were: 1) Preferred spawning conditions regarding substrate type (narrow cracks among stones); water velocity (low) and time (night); 2) Seasonality of reproduction (winter and spring); 3. Growth rate and age of sexual maturity (mature at age of 1 year at ca 50 mm total length); 4) Impact of aging on reproduction (condition factor and fertility begin declining at the age of ca 3.5 years); 5) Cannibalism of eggs and fry (the fish prey upon their eggs and fry); 6) Physiological differences between populations (significant differences were found between the stocks of the Yarqon and Dalya rivers regarding: growth rate and condition factor under various conditions, spawning intensity and impact of temperature, photoperiod and fish density on spawning); and 7) The ability of the Yarqon bleak to climb fish ladders (limited to ca. 5º in a comb type ladder). A controlled field experiment in which the survival of fry and juveniles in an engineered artificial pond was compared to their survival in the "natural" Yarqon River demonstrated the advantage of implementing scientific knowledge in order to achieve mass reproduction and survival of the Yarqon bleak. This accomplishment led to greater success in returning this species to nature.

O

An audit of genetic and breeding practices of French hatcheries involved in salmon and trout restoration

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The breeding practices of 9 French hatcheries involved in Atlantic salmon *Salmo salar* (n = 5; 100 % of the national production for restoration) and brown trout *Salmo trutta* (n = 4) restoration using wild breeders were audited in 2007. A questioner was created by a working group composed of representatives from different organisations: SYSAAF, hatcheries, FNPF, INRA, CNRS, ONEMA, CIPA. This questioner was organised on 5 issues: traceability, technical and Human resources, sanitary, genetics and reproduction. In general, hatcheries have adapted facilities and good level of sanitary and traceability practices. Their genetic and reproduction practices can be improved to limit inbreeding or genetic drift and to provide genetic estimators for the evaluation of public policies. The main difficulties identified were: limited duration of the data storage; compartmentalization between partners for the fishing of the wild parents; inadequacy of authorised number of wild fish to collect; sex-ratio highly skewed in favour of females; lack of differentiation between conservation or production objectives; limited interaction with other hatcheries involved in the same activity; lack of genetic estimator of conservation of the genetic variability; lack of estimation of the genetic efficacy of the restoration. Following technical needs were identified:
Improvement of hatchery genetic practices (management schemes, optimised reproduction protocols, indicators of conservation of the genetic resource, sperm freezing); Use of DNA fingerprint to optimise and evaluate genetic practices; Staff training, scientific and technical survey and setting up of databases; Fine characterisation of the genetic variability of wild and captive populations, National data storage and technical assistance. In conclusion, it was identified a need to develop a collective know-how in reproduction and genetic of the conservation by the hatchery and wild resources managers in close collaboration with research organisations, end users and public authorities.

O

The re-introduction of Atlantic Salmon to the River Rhine – lessons learned from the last 20 years with special regard to river rehabilitation

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Since the late 1950 Atlantic salmon was extinct in the River Rhine due to habitat degradation, water pollution and overfishing. With improving water quality migratory fish species as sea trout were observed in the 1980 again. After disastrous water pollution in Switzerland in 1986, member states of the Rhine basin started a programme for the ecological rehabilitation of the Rhine. In addition a re-introduction programme for Atlantic salmon (*Salmo salar*) was initiated 20 years ago. Since then more than 10 million juveniles (mostly alevins and parrs) have been released into several tributaries where habitat quality was assumed to be suitable for salmon. During last years more than 5.000 adult salmon have been recorded on their migration within the Rhine and successful natural reproduction has been observed in several tributaries. Nevertheless the establishment of a self sustaining viable salmon population is still not reached. Stocking is continuing with several hundreds of thousand juveniles per year and the offspring of natural reproduction is believed to form only a minor proportion of the population. The paper will analyze the actual bottle-necks for the re-introduction of Atlantic salmon and discuss the options for further ecological enhancement. For this purpose the role of salmon as a flagship species for river restoration will be highlighted with regard to the water framework directive and the achievement of a good ecological status in the Rhine basin.

O

Fish release as a mean to restore and enhance populations of Atlantic salmon

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Abstract.- Atlantic salmon populations can be restored and enhanced through planting of green or eyed eggs in rivers, and by releasing fry, parr or smolts or post-smolts. The success of the releases varies with time and site of release, origin, size and age of the fish, and rearing and release techniques applied. However, egg, fry or parr releases cannot be used for augmenting populations above the carrying capacity of the water course. To surpass the carrying capacity, the fish can be released as smolts or post-smolts. Smolts released in rivers during spring migrate to sea for feeding, but return to the river of release for spawning. Salmon released as post-smolt, may return to the release site when adult, but they may stray to any of a number of rivers for spawning. As a result of ecological interactions, released juvenile hatchery fish may partly displace, increase the mortality and decrease the growth rate, adult size, reproductive output, biomass and production of wild conspecifics through density-dependent mechanisms working in fresh water. Hatchery-reared salmon is usually competitively inferior to wild conspecifics both during feeding and spawning in rivers due to environmental impacts and genetic changes which occur during the juvenile rearing. Habitat restoration is preferred when restoring endangered, threatened or weak populations of Atlantic salmon.

O

Restoring Atlantic Salmon and Brown Trout Populations in the Tuloma River System

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The Tuloma River in the Russian Kola Peninsula (catchment area 21 140 km2), with headwater tributaries in Finland, is one of the largest rivers in northern Europe that have lost most of its salmon populations, but having one of the greatest potential for stock re-building. The only currently remaining populations are in tributaries situated below the Upper Tuloma hydro power plant. The salmon stock of the upper parts was lost when the fish pass at the Upper Tuloma hydropower power plant was closed in early 70´s. In order to bring back the salmon stock into the river, two large EU-funded projects (Interreg and Tacis) were carried out in 1998-2000. According to the results of the habitat studies, there are more than 1000 hectares of first class salmonid reproduction and nursery habitat in the river, >80% of it above the impassable upper dam. Different methods of re-introduction of the salmon (stocking, transportation of spawners) were studied and assessed. Turbine passage mortality was studied, and alternative models for fish pass construction were provided. In summary, a stock management plan for Atlantic salmon and brown trout populations with detailed list of recommendations was created. Bilateral planning to initiate the proposed plans is underway between Russia and Finland.

O

Assessment of the Risk of Barriers to Fish Migration in the Nore Catchment, Republic of Ireland.

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The River Nore is a significant angling fishery for Atlantic salmon (*Salmo salar* L.). In addition, it has been designated as a Special Area of Conservation (SAC) under the EU Habitats Directive for salmon, three species of lamprey and Twaite shad (*Alosa fallax Lacepede*). The catchment was recently examined under the Water Framework Directive (WFD) Freshwater Morphology Programme of Measures and Standards (POMS) to determine the risk of impoundments or barriers to fish migration and passage as a morphological pressure. A GIS-based field study compiled a comprehensive inventory of artificial and natural barriers throughout the catchment and classified each barrier with regard to the likely risk of preventing the upstream migration of relevant fish species. This was complemented with datasets on the distribution of juvenile Atlantic salmon and the location of reaches with salmon spawning potential throughout the catchment. A GIS analysis enabled a re-classification of barriers and associated risk based on the presence of juvenile salmon upstream of barriers and the presence of potential spawning areas. A multi-species analysis was then undertaken, examining the risk to upstream passage of eel, sea- and river lamprey and Twaite shad. A combination of barriers identified from a salmon perspective and via the multi-species approach provided a listing of priority artificial barriers requiring attention. Use of the Central Fisheries Board's national salmon rivers wetted area database allowed an assessment of the benefit of removing a particular barrier, in terms of additional wetted area to be gained. The strategy of step-wise removal or modification of artificial barriers in an upstream direction would provide optimal conservation value for the relevant species.

O

Technical challenges for fish restoration in heavily regulated rivers of Northern Finland

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The Rivers Oulujoki and Iijoki in the Baltic Sea basin, northern Finland, once produced considerable numbers of salmon, sea trout, migratory whitefish and lamprey which supported extensive fisheries in the rivers, estuaries and in the nearby coastal areas. Nowadays, several successive hydropower dams block the migration corridor in both rivers. Releases of salmon, trout and whitefish, based on court decisions on compensation for the lost production, are made in the sea area and in the lower parts of the rivers. The survival of hatchery smolts has, however, decreased considerably over the past 15 years, and, consequently, the number of adult salmon returning from the sea to the river mouth areas has declined. This together with implementing the European Water Framework Directive at heavily modified rivers has given support to plans of restoring naturally reproducing populations of migratory fish into these large northern rivers now harnessed for hydropower production. In the River Iijoki, there are some 600-800 hectares of production areas suitable for migratory fish above the dams, both in the main river and in the tributaries. In the River Oulujoki, the respective area is much smaller. In spite of this, there is a strong local wish to get especially salmon back even into the Oulujoki river and the process has already started. In both target rivers, the short term regulation resulting in water level variation in the basins and reduction of the flow during nighttime, are problems with perhaps the most severe effects on uninterrupted fish migration even in case of a migration corridor. The options for restoring fish runs are presented with respect to the hydropower use of these large northern rivers.

O

Status of Pontic shad (*Alosa immaculata* Bennett 1835) in Lower Danube Region

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Pontic shad (*Alosa immaculata*) is an anadromous fish species migrating for spawning from Black Sea to the Danube River with a long tradition for commercially sharing fishery of countries in Lower Danube Region. The population size, according with catch statistics, records large variation with around 10-11 years cycles of maxims/minims, however in spite decreasing trends of catch during last 3 decades is evident no investigations of this species are performed at population areal. Catch of Pontic shad in Bulgaria decreased from 140.8 t in 2002 to 29.1 t in 2008 and due to that it is included in Bulgarian Red Book as vulnerable species. Data in Serbia relating to Pontic shad are lack even from 1993 it is protected in Serbia by Decree of Natural Rarities Protection. Average catch of Pontic shad during the period 2002-2008 in Romania Danube Delta Biosphere Reserve is 322.1±158.7 t with maximum of 549 t in 2008. Average catch in Ukraine Danube Delta Biosphere is 213.5±75.0 during the period from 2002-2005 with maximum of 318 t in 2005. The major conservation measure is protection of a portion of migratory spawning stock from river mouth to upstream spawning sites in period of April-May. In year 2008, the prohibited period for catch in Bulgaria was from 15 April to 15 May while in Romania prohibited period is regulated on Danube River sectors and lasts from 20 April till 27 May. In period 1958-1989, monitoring and regulation of commercial fisheries, especially sturgeons and Pontic shad were under “Convention concerning fishing in the water of Danube”, signed by Romania, Bulgaria, Yugoslavia and Soviet Union, but after socialism collapse, this Convention have no more produce effects. Taken in consideration new environmental and politic realities, common management plan including monitoring, regulation and research is needed for conservation and sustainable use of Pontic shad.

O

Chemical mass-marking success and limitations.

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Stocking programs are widely used in fishery conservation to enhance or even rehabilitate endangered populations mostly in an attempt to sustain commercial and/or recreational fisheries. The evaluation of these programs relies on the ability to discriminate hatchery-reared fish from wild fish. Mass marking is a common method to facilitate this discrimination. Marking can be performed through different techniques. Chemical mass marking has been used for several decades, to mark large numbers of fish simultaneously. Chemicals are taken from the water and incorporated into fish calcified structures. The chemical detection is facilitated through an appropriate excitation of the marking molecule. Since its first use in conservation biology, chemical mass marking has evolved and it is important to address its current challenges. This presentation reviews the success and limitations of chemical mass marking methods. It particularly focuses on 2 points. The first one is mark quality assurance. Although it is required to produce good quality marks, it can be difficult to agree on common standards for what is considered “good”. We will propose a method to objectively quantify mark quality illustrated by results obtained from Allis shad (*Alosa alosa)*. The second objective deals with the importance of choosing the appropriate structure for mark detection. This point will be illustrated in sturgeons (*Acipenser sturio*, *A. baerii*, *A. oxyrinchus*) since there is an ongoing debate on the suitability of pectoral fin rays as a mark detection structure and on the validity of age estimation from this structure. The study targets on the provision of a practical guideline for fishery managers to improve hatchery-reared fish discrimination upon release.

O

Genetic aspects of restoration programs – lessons from sturgeon

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Genetic analyses became an important tool and a major prerequisite for most conservation programs during last decades. In general, we can distinguish between phylogenetic analyses and problems addressing population genetics. Most sturgeon populations became extinct decades ago. Our knowledge about their species composition (phylogeny) of populations is scare. Only a few archaeological remains or archived museum specimens are still available. Today, mitochondrial DNA studies are well established for species identification. But these markers do not allow to identify hybrids or ancient introgession events which are described for several sturgeon species. In sturgeon, the restoration of Iberian sturgeon is an issue under controversial discussion. In the 1990s, a Spanish research team came up with the idea that Adriatic sturgeon (*Acipenser naccarii*) were native in Spanish rivers until its extinction. This point of view is not supported by others who based their research on additional studies of ancient DNA or morphological characters. Much less complicated is the situation for European sturgeon (*A. sturio*) vs. Atlantic sturgeon (*A. oxyrinchus*) and their potential restoration in Western Europe. Although Atlantic sturgeon probably inhabited also rivers outside the Baltic Sea, their most important populations were located in Baltic rivers. Recently, their founder population was genetically characterized. Today it is widely accepted to release as many individuals as possible, but data from Atlantic sturgeon demonstrated that only a few individuals founded a self-sustaining population under natural conditions. Inbreeding, a major risk for bird species or mammals, is less important in fishes because of their large number of offspring. In my opinion, many restoration efforts are to be doomed to fail because less adapted fish are selected for release. Outbreeding depressions are often underestimated but the fine tuned adaptation to local environments is the crucial point that decides between successful and non-successful restoration projects. In the case of Atlantic sturgeon restoration in Europe, fish of large genetic similarity with extinct Baltic sturgeon are used for restorational breeding. We hope, that they will be successfully as they were during the Middle Ages 1, 000 years ago.

O

Do supplemental stockings help restoration of a weak wild salmonid population since monitoring of salmon and sea trout smolts reveal genetic introgression ?

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Downstream migrations of Atlantic salmon (*Salmo salar*) and sea trout (*S. trutta*) smolts were monitored in the Rriver Sävarån in northern Sweden to acquire information for stock conservation plans. A rotary screw trap was installed and operated in the Sävarån from 2005-2008. High recapture rates, 8 to 31%, of tagged smolts guaranteed reliable estimates of the smolt abundance each year. From 2,600 to 3900 salmon and from 500 to 1,500 trout smolts migrated from the river during 2005-2008. The density of salmon and trout 0+ parr (i.e., recruitment success) from electro-fishing was a poor descriptor of the smolt abundance 2-3 years later. Microsatellite DNA variation were used to assess the outcome of stocking salmon and trout. No information on pre-stocking genetic composition of salmon and trout in Sävarån was available. In two year classes (2005-2006) of salmon smolt post-stocking genetic composition differed markedly (Fst = 0.048) from the main donor strain, Byskeälven salmon, and from other Gulf of Bothnia salmon stocks (Fst 0.047- 0.132). The STRUCTURE program failed to detect any sub-structuring within Sävarå salmon. It was concluded that only minor introgression estimated to a proportion of 0.11 (95% CI 0.07 - 0.16) has occurred in salmon. Sea migrating trout showed overall low differentiation among populations with maximum Fst of 0.03 making analysis more cumbersome than in salmon. Still, the Sävarå trout deviated significantly from potential donor populations and structure software supported that majority of trout in Sävarå formed a distinct genetic population. Admixture was more extensive in trout and estimated to 0.17 (95% CI 0.10 - 0.25). Analysis of additional year-classes showed that in 2007 42 % of salmon smolts originated from Sävarån and the remaining from hatchery releases. The rotary screw trap, and genetic analyses employed provided valuable information needed by fishery managers for developing stock conservation plans.

O

Reintroduction of Atlantic salmon (*Salmo salar*) in tributaries of river Rhine in Rhineland-Palatinate and Hesse

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Stocking is conducted in Rhineland-Palatinate since 1994 and in Hesse since 1995. Returning salmon are monitored annually since 1996 and 2002, respectivly. Between 1992 and 2008 a total of 533 returners were recorded, with 52.9% being males and 38.4% females (sex unknown: 8.7%). 2007 and 2008 yielded the highest ratio of Multiple-Sea-Winter (MSW) salmon so far. In 2008 74% of the individuals with known length had spent two or more winter in the sea, thus raising the average length to 80.3 cm. Overall trends show an increase in the total number of recordings and MSW salmon ratio, together with an increase of mean length correlated with the latter. The percentage of female MSW returners increased by 10% to 77% compared to 2007, raising expectations for high levels of natural reproduction in the season 2008/2009. Until 2008 natural reproduction was recorded in 5 river systems (total: 11 streams). In 2008 reproduction was demonstrated in ten tributaries, an increase of two compared to 2007. The density of juvenile 0+ salmon found in immediate vicinity of several spawning sites exceeded 100 individuals per 100 m^2. In 2008 approximately 85% of the suitable and accessible habitat in rivers Nister and Saynbach (Rhineland-Palatinate) were inhabited by wild 0+ salmon, followed by river Wisper (Hesse) with 80%. As a consequence of an increasing shortage of available stocking material a brood-stock program was established in the Atlantic Salmon Centre „Hasper Talsperre“. The program started in 2006 and aims to become independent from further imports by the year 2010. The brood-stock consists (almost) exclusively of the strain Ätran (Sweden). „Wild“ juveniles make up around 30% of the brood-stock. The juveniles were sampled from several spawning areas in seven streams with documented natural reproduction.

O

Status of the diadromous fishes and conditions for their recovery in the Schelde basin

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Until the end of the 19th century, diadromous fishes were an important component of the Schelde ecosystem. The main causes for their decline in the Schelde basin in the course of the 20th century are habitat degradation, migration barriers, overfishing and, in particular, the poor water quality. Our study aimed to investigate the present state of the diadromous fishes in the Schelde basin and to list the preconditions for their recovery. During an extensive monitoring campaign, three catadromous and four anadromous species were recorded. Catadromous species like European eel, flounder and thinlip mullet are quite abundant throughout the estuarine part of the river in summer and they use the estuary as a nursery or growing-up habitat. The riverine reaches above the tidal zone are probably less vital for these species. The occurrence of anadromous species in the estuary is related mainly to their spawning migration during winter and spring. Mature smelts, river lampreys and three-spined sticklebacks migrate upstream to the head of the estuary, where their migration is obstructed by a weir. The distribution of twaite shad on the other hand, is limited to the brackish part of the estuary. The low number of adults and the absence of 0+ individuals indicates that twaite shad does not yet reproduce in the Schelde. Three action items are put forward for the recovery of the diadromous fishes in the Schelde. First, further waste water treatment is necessary to avoid temporal hypoxic conditions in the estuary and the tributaries. Secondly, migration barriers near the head of the estuary should be solved in order to restore the upstream migration of anadromous species that spawn above the tidal limit. Finally, the restoration and protection of estuarine habitats that function as spawning and nursery area are essential for a sustainable recovery of the species.

O

Restoration of Habitat as Essential Factor for Improved Fauna Populations – Long Term Experience on North German Lowland Brooks

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Brooks and small rivers of the North German Lowland, caused by their geochemical background by the glacial ages, within the morane landscape once have been gravel streams. Their groundwater-fed origin and the high habitat variety, accompanying deciduous wood with roots and a high amount of dead wood giving three dimensional structures within the water column characterized these waters as productive summercool salmonid stretches – also important as spawning places for migrators from the rivers, e.g. sea trout, river and sea lamprey. Heavy construction work, hard maintenance over time and increased excessive land use during the last decades turned these once thriving biotopes into sluggish canals with moving sand. Engaged people tried to restore these waters, mostly against heavy pressure of land users and authorities. International knowledge of how to regain the vital functions, however, grew steadily. Now, in the time of the Water Framework Directive, the chance has come to restore habitats in a large scale. Long time experience, often gained in step-by-step activities, helps to take the most effective way, avoiding mistakes. Examples are given for rural and urban waters where the salmonid reaches have been restored. Trout, brook lamprey, stone loach and accompanying characteristic invertebrates reveal the positive results. Adopt-a-brook groups and engaged individuals co-operate with water authorities, land owners and maintenance organisations to further improve the situation. To stabilize the results on catchment level and in the time of climate change develop the necessary adaptations, however, strong efforts have to be taken within the total system. Stream corridors with deciduous trees as buffer to avoid the entrance of erosive materials, pesticides and nutrients as well as re-gaining the characteristics of the summercool stream are the inevitable basis. Altering present day subsidies for agriculture, adaptation of river maintenance to the goals and consequent action of water authorities are needed.

O

Experience of artificial incubation of Atlantic salmon (*Salmo salar*) eggs in rivers of Northwest Russia

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The problem of restoring fish numbers or reestablishing fish stocks in the rivers from which they had been lost can be addressed through several approaches. The aim of the present study was to develop technologies and incubation devices that would yield viable Atlantic salmon parr within rivers. In the climate of Northwest Russia, the ice-covered period on most spawning rivers lasts 7-8 months, wherefore incubation devices that require maintenance – cleaning of drift, removal of dead embryos, cannot be used.
Of the structures we have developed, incubation nests washed by naturally cleaned stream in the river bed proved to be most effective. One was pressed tightly to the gravel bed, and the other one was twisted into the bottom to. Water uptake in both structures was through the bottom; eggs were incubated on the substratum separating them. Larvae left the structure via a short streamwise-oriented tube. Results of studies of natural redds and laboratory hydraulic tests were analysed to make improvements to the structures.
Two variants of the technology were suggested. One is that immediately after being fertilized (October), eggs are placed into the structures to be installed in river rapids. The other one is that eggs are incubated in a hatchery until the eyed egg stage, when they are placed in the nests to be installed on the river bed through ice holes. Either way, viable larvae leave the incubation nests and disperse late in May or early in June, as it happens after natural spawning. The technology and design of the incubation nests were tried out in 2006-2008, in rivers with different hydrological characteristics: Lososinka, Suna (Karelia) and Indera (Kola Peninsula). The proportions of larvae that hatched and successfully left the incubation nests was 75 to 92% in the first variant, and 92 to 97% in the second one.

O

Re-introduction of bullhead in the basin of the river Demer in Flanders

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Bullhead (*Cottus perifretum*) is the only freshwater cottid found in Flanders, the northern part of Belgium. This species generally inhabits natural and unpolluted stony streams where the flow is moderate and the water is cool and well-oxygenated. Formerly bullhead was common in almost all headwaters in Flanders, currently however only very few fragmented populations remain. Habitat degradation and fragmentation are, besides water pollution, the main causes for its decline. Because of its vulnerability, the species is now fully protected by law in Flanders. In addition bullhead is also listed in Annex II of the Habitats Directive. In 2003 a new relict population was discovered in a small headstream in the basin of the river Demer. Until that moment, bullhead was thought to have disappeared from this basin with the last confirmed capture in 1957. A preliminary genetic study revealed that this population is genetically unique (containing private alleles) and that its conservation should be a priority. Since the population is under great pressure, the Research Institute for Nature and Forest (INBO), together with the Agency for Nature and Forests (ANB), launched a conservation project for this unique population by re-introducing its cultured progeny in other suitable headstreams in the same basin. The suitability of the locations was assessed based on the key habitat features bullhead needs, water quality and also on food availability. Meanwhile mature males and females were collected from the discovered source population and transported to the fish farm of INBO where they were cultured in an extensive way. Eventually one headstream was selected for the pilot re-introduction. In October 2008, 1220 cultured bullheads were released over a distance of 1600 metres. A post-release study is ongoing to monitor survival, growth, natural breeding of the released animals, success of natural recruitment and the dispersion of their offspring.

O

The Marble Trout (*Salmo marmoratus*) Conservation Program: main insights from a 15 years' reintroduction experience.

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Trout species or genetically distinct populations at risk of extinction are generally restricted to headwaters preventing hybridization with other introduced salmonids. The Marble Trout (*Salmo marmoratus*) Conservation Program started in 1993 in the upper basin of the Soca river (Slovenia) with two main goals: finding genetically pure population of marble trout and duplicating the existing populations through translocation of marble trout in fishless streams to enhance the long-term viability of the species. New populations have been created by introducing from 200 to 600 marble trout aged 1 in six pristine streams between 1996 and 2004; five of them were previously fishless (Gatsnik, Gorska, Mirna, Zakojska and Zventarska) while in one stream (Martinkov) hybrid trout were previously removed. In order to acquire useful information on the translocation experiment and to study the population dynamics, life-histories and demographic traits of marble trout, the new populations have been systematically monitored since their creation by individually tagging and sampling marble trout. Gorska, Zakojska and Zventarska were wiped away by severe floods in 2004 and 2007 (recurrence interval 50-100 years) while the other populations are still viable. Empirical observations coupled with a population viability analysis (PVA) performed by using a data-driven model of population dynamics suggested that only extreme floods, landslides and severe droughts, are able to trigger local extinction of marble trout populations in these pristine environments. As the absence of fish in the streams was probably a consequence of severe exogenous events, new translocations must be undertaken in streams where fish have been removed in order to avoid the rapid loss of populations. Moreover, the PVA results indicated that less individuals might be necessary to establish a new population, as in a few years density-dependent body growth and first-year survival will regulate population size around stream carrying capacity.

O

Reintroducing an extinct species of fish to the UK: ecological, historical and sociological perspectives

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The last confirmed capture of a burbot (*Lota lota*) in the UK was on the 14th of September 1969, in the Old West River at Aldreth, Cambridgeshire. Despite sporadic reports of subsequent captures, it is generally accepted that the burbot has been extirpated from the British Isles. Nevertheless, the burbot is listed as a UK Biodiversity Action Plan (BAP) species, thus there is a requirement to investigate the status of its population and possible improvement opportunities. Research conducted at the University of Southampton is investigating the reasons for the decline and eventual extinction of the burbot from the UK. The project follows the International Union for the Conservation of Nature and Natural Resources (IUCN) guidelines on species reintroduction designed to ensure that reintroductions achieve their intended conservation benefit. The key aims of the study are to quantify the former distribution and abundance of the burbot in the UK; establish the causes of the burbot's decline and assess whether these factors still prevail; define habitat requirements for the burbot and examine whether these conditions can be met in the UK; assess to which genetic clade former British burbot belong; and consider public perception in relation to a possible future reintroduction. Based on the findings of the project, the feasibility of reintroducing the burbot to UK rivers will be discussed.

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The rehabilitation of potamodromous fish migrations in the Danube catchment with aspecial focus on the Danube Salmon, *Hucho hucho* (L.) and the nase, *Chondrostoma nasus* (L.).

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Freshwater ecosystems, especially rivers, have been substantially altered by humans over the past 100 years of human history. As a consequence both, diadromous and potamodromous fish species have highly suffered from the fragmentation and channelization of rivers. Forced by the EU-Water Framework Directive (WFD), in Europe the re-establishment of connectivity is increasingly seen as a catchment wide task. To guide these rehabilitation efforts, a strategic guideline for restoring connectivity was needed. Based on historical distribution data of typical medium distance migrants like the Danube salmon, *Hucho hucho* (L.), nase, *Chondrostoma nasus* (L.) and on general ecological considerations, a prioritization scheme to guide the restoration of connectivity on a catchment level and a flow chart for selecting the most appropriate type of fish ladder for a specific spatial situation were developed. Results of different monitoring projects highly point out the significant role of river tributaries for the populations of these species, especially when the main river has been severely degraded. Homing seems to play an important role for nase, *Chondrostoma nasus* (L.), but also opportunistic use of newly created habitats was documented. General recommendations for conservation and rehabilitation of these endangered potamodromous fish species are given.