



CASE
STUDIES

INT

2012

Flowing Rivers, Full Bellies

The case for freshwater conservation
to achieve food security

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FLOWING RIVERS, FULL BELLIES

The case for freshwater conservation to achieve food security

Conservation organizations and fishermen may not appear to be natural allies; however, when it comes to conserving freshwater biodiversity and ensuring viable fisheries, these groups have key goals in common. Where there is freshwater, there will be inland fisheries meeting basic food needs, generating incomes or simply giving the pleasure of a tasty meal on the table. But with wetlands under ever-increasing pressure from water infrastructure, pollution, changes in climate and over-abstraction, freshwater biodiversity is suffering. For millions of people, fewer fish in the rivers means empty pockets and empty bellies.

As thousands gather to discuss water and food security at World Water Week 2012, WWF calls for action to ensure a sustainable future for freshwater ecosystems, and the species, communities and economies that depend on them. Examples of such action are presented in five cases highlighting various drivers of change and responses. Each example shows that the common ground between conservation and fisheries is far greater than the differences. We should not forget that the status of inland fisheries can be an important indicator of the status of the aquatic environment and the ecosystem services that these wetlands provide.

The world is hungry

Securing a healthy diet is a daily challenge in many parts of the world. It is estimated that in 2010, 925 million people were undernourished – a rise in absolute numbers of hungry people since the mid-1990s¹. As the world's population grows, food prices are likely to rise and natural resources will come under increasing pressure. Food security is now becoming a concern even in developed countries.

Fish is food

Our rivers, marshes, lakes and other wetlands are often overlooked as sources of food. Nevertheless, freshwater fish play an important role in global food security. They are particularly important for many of the world's poor, for whom catches from informal fisheries often form the main source of protein, as well as minerals and vitamins. From small perch to giant catfish, many freshwater fish will have found their way onto a plate somewhere in the world.

Freshwater fisheries are undervalued

Inland capture fisheries can have a high commercial value, which is generally well recognised. They also sustain a large post-harvest industry, crucial in many developing countries where jobs are scarce. In contrast, very little data exists on the value of seasonal and subsistence fisheries, which are not taken into account for various reasons. Many farmers, for example, also engage in fishing or small-scale aquaculture, but these contributions are rarely quantified. It is likely that the actual value of freshwater fisheries far exceeds official estimates.

The systematic undervaluation of freshwater fisheries means that their role in achieving food security is rarely sufficiently recognised. Consequently, when it comes to making decisions on developments that will harm biodiversity and fisheries, there is a real danger that impacts on fisheries are not taken into account.

1. FAO Hunger Statistics. <http://www.fao.org/hunger/hunger-home/en/> 2012.

A key to food security: guiding principles and tools for freshwater conservation and fisheries

1

Keep the rivers flowing

Fragmentation of rivers is a major factor in decline in biodiversity and fisheries. To ensure future diverse and viable fish populations, it is crucial to protect river flows, ensure connections within the river system, and protect important spawning and breeding areas, such as wetlands.

Toolbox: Designation of free flowing rivers, sustainable water allocation agreements, operation of infrastructure to facilitate environmental flow regimes, restore connectivity between rivers and floodplains.

2

Manage fish habitats and fish stocks

The existence of productive habitats forms the basis of any capture fishery, but habitats throughout the world are being destroyed, altered and fragmented. Management of fish stocks through nurseries, restocking or reintroduction also plays a role.

Toolbox: Protected areas, fishing quotas, fishing moratoria, habitat restoration, pollution control, Ramsar Convention, species reintroduction.

3

Build alliances, engage communities

Small-scale fishing communities are often excluded from high-level planning processes, either because they are unorganised, difficult to find, mobile – or because the importance of fisheries to these communities is undervalued by those leading the planning process. Where conservation organizations have a seat at the table, they should request representation of communities that will be affected by the decisions, and that can be allies in influencing the outcomes.

Toolbox: Stakeholder engagement, capacity-building programmes, advocacy, community management systems.

4

Invest in research

Species composition, spawning grounds, as well as hydrological and quality needs are unknown for many of the world's river systems. Large rivers, such as the Mekong and the Amazon, remain unstudied, and the exact number of fish species and their environmental requirements are unknown. Without this information, it is difficult to develop effective economic or conservation policies. More research is also needed to improve dam operations and fish passage facilities.

Immediate research needs: Baseline studies on fish stocks, relationship between freshwater biodiversity and fisheries productivity, social and economic benefits of inland fisheries, management options for water infrastructure.

5

Effective planning, legislation, implementation and enforcement

The principles outlined above all require legislation and enforcement to be effective, and need to be incorporated through all relevant policy fields, including fisheries, water resources management, market regulation and environmental protection. Planning processes need to involve all stakeholders and address the issues at an appropriate scale, taking into account cumulative impacts of drivers of change.

Toolbox: Basin planning tools, strategic environmental assessments, environmental impact assessments, regulation of fishing gear, catch quotas.

WWF VOICE

It is easy to think that where we have water, we will have fish. But that overlooks the fact that many freshwater fish have intricate life cycles that rely on very specific water conditions. The flow velocity of a river, water quality, water temperature, connectivity within rivers and between rivers, lakes and wetlands can all be crucial. Simply protecting some wetlands here and there is not going to be enough – for the sake of both biodiversity and a chance to feed the world, we need to make sure our rivers and wetlands are connected from mountain to sea.

Li Lifeng, WWF International



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Boys in Cambodia take home the day's catch.

CASE 1: MAINSTREAM FISH OR MAINSTREAM DAMS – FOOD SECURITY IN CAMBODIA

Key words:

dams, food
security, poverty
reduction,
livelihoods

The ecosystem

The Cambodian section of the Mekong river basin is home to unique river and floodplain habitats. The Tonle Sap Lake, with its seasonal flood pulse, provides an abundance of fish species. The 56km section of the Mekong between Kratie and Stung Treng is a biodiversity hotspot of international significance, supporting populations of many species that have virtually disappeared from the rest of Southeast Asia. Together with the country's many other large and small rivers and wetlands, these freshwater resources make Cambodia regionally and internationally important for the conservation of aquatic habitats and the wildlife they contain.

The fishery

The Mekong River, its floodplains, rice fields and seasonal pools sustain many fisheries vital to millions of Cambodians. Fish and fish products, together with rice remain the staple foods for the majority of Cambodians. They account for approximately 82 per cent of Cambodia's animal protein consumption and are especially important for the livelihoods of Cambodia's rural poor. The Tonle Sap is home to many communities, often living in 'floating villages', that focus exclusively on fishing. Elsewhere, many farmers supplement their rice crops with aquatic species from rice paddies.

The main groups are fish living in wetlands all year with limited migrations, such as various snakehead fish (sp Channidae), and species that migrate along the rivers, such as various Pangasius species (FAO, 2011).

Problems and challenges

Rural poverty and competition for resources is rapidly increasing pressure on fish stocks. The decline in numbers is most notable in larger species or those with a slow growth rate. Iconic species such as the Mekong giant catfish are on the verge of extinction.

But perhaps the largest threat to Cambodian fisheries is the proliferation of dams in the basin – with some 150 existing and potential hydropower projects in the lower Mekong basin (MRC, 2009). This makes the Mekong the site of one of the most intensive hydropower development schemes in the world (Keskinen *et al.*, 2012). In Laos, preliminary construction work is underway at Xayaburi, causing a storm of controversy in the Mekong region. Ten more mainstream dams are currently under consideration, including at Stung Treng and Sambor in Cambodia.

The supply of fish for consumption in Cambodia is particularly vulnerable to hydropower development on the Mekong River because of the extensive floodplains that are largely dependent on flows from upstream sources for their productivity. Furthermore, many of the species of fish caught in Cambodia must migrate upstream to spawn and complete their lifecycles. The loss of animal protein as a result of the proposed mainstream dams would also have profound effects on land and water use. It is estimated that to replace lost protein as a result of 11 mainstream dams through alternative livestock production, Cambodia would need between 3,751 and 8,317km² of pasture land, and see an increase in its water footprint of 29-64 per cent (Orr *et al.*, 2012).

Action

At the basin scale, WWF has worked closely with the Mekong River Commission and Asian Development Bank to develop a tool to help identify the most sustainable places for hydropower development in the basin. Rather than assessing hydropower projects on a case by case basis, the Rapid Basin-wide Hydropower Sustainability Assessment Tool provides a way to evaluate the cumulative impacts of cascades of dams within a river basin.

In Cambodia, WWF, in partnership with Oxfam and the Danish International Development Agency, is focusing on the direct impacts of hydropower development on food security by providing financial support to the Inland Fisheries Research and Development Institute, the research branch of the Fisheries Administration, to implement the 'Food and Nutrition Security Vulnerability to Mainstream Hydropower Dam Development in Cambodia' project. This study examines national food and nutrition security vulnerability to the year 2030 arising from the potential construction of mainstream Mekong dams at Sambor and Stung Treng in Cambodia.

Food for thought

The Mekong region is undergoing rapid social and economic development and demand for energy is rising. Hydropower offers the potential to meet these needs in a sustainable way, without compromising food security and livelihoods, but only if developed with the greatest care for the environment. Basin-wide planning is crucial to get this right. WWF supports a 10-year delay in the approval of lower Mekong River mainstream dams to ensure a comprehensive understanding of all the impacts of dam construction and operation. Immediate electricity demands can be met by fast-tracking the most sustainable hydropower sites on the lower Mekong's tributaries.

WWF VOICE

Our goal is to provide government leaders in Cambodia with accurate and relevant information about the environmental and social impacts of the proposed hydropower dams on the mainstream Mekong in Cambodia. The impacts will be numerous and complex, but of these, we believe the impacts on fisheries, food security and nutrition are the most important, relevant and compelling to local people and government leaders.

Gordon Congdon, WWF-Cambodia



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Young man with giant barb or giant Siamese carp (*Catlocarpio siamensis*), Tonle Sap River, Cambodia

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CASE 2: A VALLEY OF LIFE – LAKE FISHERIES IN THE MIDDLE AND LOWER YANGTZE RIVER

Key words:

aquaculture,
community-
based fisheries
management,
pollution, poverty
reduction,
livelihoods,
sustainable fishing
methods

The ecosystem

The central Yangtze basin was once described as the “Land of a Thousand Lakes” because of its many floodplain lakes and oxbows, which were particularly rich in biodiversity. But between the 1950s and 1970s, hundreds of lakes were disconnected from the Yangtze to provide more land for cities and farms. Though biodiversity has declined severely in recent decades, the lower and middle Yangtze lakes are still home to some iconic species, such as the Yangtze finless porpoise (*Neophocaena phocaenoides*) and Siberian white crane (*Grus leucogeranus*).

The fishery

The lower Yangtze is still a rich source of fish, sustaining an extensive fishing industry, as well as subsistence and occasional fisheries. However, compared to its peak in the 1950s, fishing output has declined dramatically, dropping from around 427,000 tonnes in 1954 to around 100,000 tonnes now (Yang *et al.*, 2008). Apart from capture fisheries, there is an extensive aquaculture industry exploiting all types of water bodies, including reservoirs, rivers and paddy fields. Economically important fish species include many varieties of carp and bream.

Problems and challenges

The main driver behind the decline in freshwater biodiversity and fisheries is the ever-growing demand for food, energy and safety from floods. The reclamation of lakes and construction of dams, dykes and levees obstructs fish migration and altered fish habitats. Large dam operations changed the flow pattern of the river, seasonality, velocity and temperature, which significantly affects many fish species that take their cues for spawning and other activities from the river's flow. Fish larvae that require submerged aquatic plants to develop are affected by lower water levels.

By disconnecting the lakes from each other and the river main stem, the self-regulating capacity of the lake system was lost, allowing pollutants from industrial and agricultural wastewater, domestic sewage and over-feeding in aquaculture to accumulate in the ecosystem. Overfishing and the use of destructive fishing methods, such as electro-shock fishing, also contributed to the decline.

Action

In 2004, a WWF trial project showed that opening sluice channels and reconnecting the Tian-e-zhou oxbow to the Yangtze improved the lake's water quality and allowed fish to migrate from the river into the lake, replenishing their numbers and genetic stock. Now, over 50 floodplain lakes, totalling 5,535km², have been linked back to the Yangtze, bringing life to floodplain ecosystems and increasing their capacity to absorb floodwater. Pollution issues from aquaculture are being addressed by introducing new eco-fishery practices. Pollution has been drastically reduced by restoring aquatic plants and encouraging fishermen to use natural fish feed. This also helps them breed better quality fish that they can sell at higher prices. WWF is also working with China Three Gorges Project Corporation to review water release schedules from the largest dam on the Yangtze, making sure they are as similar to

natural flows as possible. This benefits most of the Yangtze carp species that rely on a flow pulse and specific temperatures for their spawning in late May and early June.

Food for thought

Results from the eco-fisheries project are encouraging. In some sites, initial estimates show that resources of migratory fish have increased by more than 10 per cent, while the coverage of submerged plants has been restored by 70-80 per cent. The water quality in these lakes has drastically improved, meeting level III and even level II national standards. More than 10,000 people have benefited from the eco-fishery model directly, and in some lakes people have seen their income increase by 5,000-10,000 yuan per year.

Through WWF's work, environmental flow requirements have been successfully incorporated into the Three Gorges Dam operation objectives, in addition to flood control, power and navigation.

WWF VOICE

Healthy ecosystems provide services communities rely on, including safe water, food and protection from natural disasters. By restoring and conserving functioning freshwater ecosystems, people take an important step toward meeting our own needs sustainably.

Lei Gang, WWF-China

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FISH = FOOD

Freshwater fish are served the world over. Here we present some recipes from the rivers in the WWF case studies, as well as from the writers' bases in Scotland and Switzerland.

Happy cooking & eating!



MEKONG FISH AMOK

Fish Amok is a coconut curry steamed gently in banana leaves. This is practically the national dish of Cambodia, and the varieties are endless.

Ingredients (Serves 2-3)

- Kroeung (curry paste)
- 2 dried chilies, soaked
 - 3 cloves garlic
 - 1 shallot
 - 3 stalks of lemongrass, trimmed to the tender middle bit
 - 1 cm slice of galangal
 - 1 lime leaf
 - 1 tsp salt

Amok

- 400 gr of meaty white fish, such as snakehead or catfish, chopped into bite size bits
- 1 tbsp of fish sauce
- 2 bird's eye chilies, finely sliced
- 400 ml coconut milk (1 tin)
- 1 tsp shrimp paste
- 1 egg

To serve

- Coconut cream, 4 shredded kaffir lime leaves, 1 or 2 finely sliced bird's eye chilies to taste.

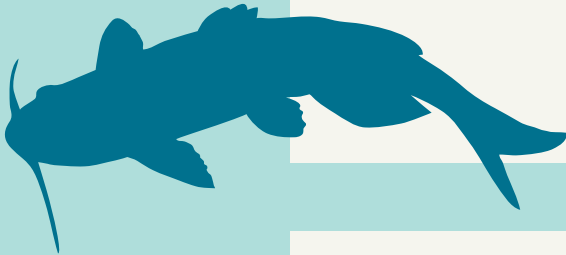
Preparation

First make the Kroeung by pounding all ingredients together to a smooth paste with pestle and mortar or a in a food processor.

Beat the egg and the shrimp paste together, and then mix with the curry paste, coconut milk and fish sauce. Carefully add the pieces of fish and mix in.

Divide the mixture over either bowls made of banana leaves or heatproof ceramic bowls. Steam for 20 minutes or until the fish is tender.

Sprinkle with coconut cream, kaffir lime and chili, and serve with boiled rice.



ROMANIAN FISH SOUP (CIORBA DE PESTE)

This recipe from the Danube is just one way of making this filling fish soup.

Ingredients (Serves 4)

- 500 g sturgeon meat from sustainable farming, or any other firm fish, deboned and cut into 2.5 cm pieces
- Mix of vegetables to taste cut into chunky pieces: 3-4 potatoes, 2 carrots, 1 bell pepper, 2 stalks of celery
- 100 ml of double cream
- 1 egg
- Salt, pepper and fresh dill to taste

Preparation

Bring 1-1.5 litres of water to a boil with salt and pepper.

Add the vegetables and simmer for 5-7 minutes.

Carefully add the fish chunks and let boil for 15 minutes or until the fish is cooked.

Mix the cream, a cup of water and the egg.

When the fish is cooked, take off the heat and whisk in the cream. Take care not to form lumps.

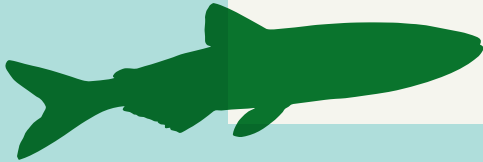
Add the chopped dill and serve with rustic bread.



FRIED CANDLEFISH FROM BRITISH COLUMBIA

The majority of eulachon harvested is rendered for eulachon grease that is then used as a type of condiment to dip seaweed in or spread on toast.

It is a long, elaborate process. Instead, we recommend saving a few fresh eulachon fish from the harvest. Clean them and remove the heads. Lightly coat with flour, salt and pepper, seaweed flakes and onion flakes. Fry them up in a little butter and eat whole.



YANGTZE STEAMED WUCHANG FISH

This steamed fish recipe is made with bream, but many other medium sized fish can be prepared this way. Use chao tian jiao “Facing Heaven” chilies or substitute with another medium hot chili.

Ingredients

- 1 Wuchang fish (or other bream or pomfret, about 600 grams), cleaned and scored on both sides
- 2.5 cm piece ginger, shredded
- 3 gloves garlic, crushed
- 3 dried chilies
- 1 scallion, finely sliced
- 1 tbsp dark soy sauce
- 1 tsp vinegar
- 1 tsp sugar
- 1 star anise
- Salt
- Cooking oil

Preparation

Rub 1 teaspoon of salt over the outside and inside of the fish. Leave for about one hour.

Mix together ginger, garlic, scallions, dark soy sauce, vinegar, sugar, chilies and star anise in a small bowl.

Heat a wok (rub the wok with ginger to prevent the fish sticking). Add 1 tbsp of vegetable oil.

When the oil is hot, add the fish and fry over a low flame until golden (about 2-3 minutes per side).

Transfer the fish to a plate. Pour the soy mixture into the wok and cook for about 2 minutes while stirring.

Return the fish to the wok. Add 2-3 cups of water and simmer the fish until it absorbs most of the liquid.

Add salt to taste and serve with steamed rice.



SCOTTISH BROWN TROUT IN OATMEAL

Brown trout is found in many rivers and lakes throughout Scotland. To remove the fish's earthy taste it helps to soak in a mixture of vinegar and water before cooking.

Ingredients

- 4 large, skinned trout fillets
- 100 gr fine or medium oatmeal
- 75 gram butter
- 1 tbsp vegetable oil
- Little milk

For the parsley butter

- 125 g of butter, softened
- 2 spring onions, finely chopped
- 2 tbsp fresh parsley, finely chopped
- 6 tsp lemon juice
- Crushed black peppercorns

Preparation

Brush the fillets with milk and coat both sides with the oatmeal.

Heat the oil and butter in a frying pan until it starts to bubble.

Place the trout gently in the pan, flesh-side down.

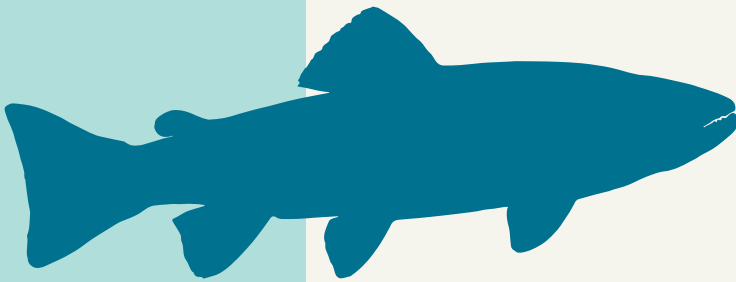
Cook on a high heat for a couple of minutes until oatmeal is starting to brown.

Turn down the heat and continue cooking gently for another few minutes.

Turn the trout over carefully and cook for another 4 minutes until brown on both sides.

Drain on kitchen paper to remove any excess fat.

Serve with parsley butter, which is made by combining all the ingredients, rolling into a log shape and cooling in the fridge for 15 minutes.



LAKE GENEVA PERCH

This small freshwater fish is found in most Swiss lakes and is a popular dish in any restaurant bordering Lake Geneva.

Ingredients *(Serves 4)*

- 800 g perch fillets
- 150 g butter
- 30 g flour
- 1 bunch of parsley
- 0.5 dl white wine
- Salt and pepper
- Pieces of lemon to serve

Preparation

Season the perch fillets with salt and pepper and coat lightly in flour. Heat butter in the pan, taking care not to burn, and fry slowly in small batches.

Drain on kitchen paper.

Garnish with lemon and serve with chips, rice or steamed potatoes and a green salad.





When connected to the river, floodplain lakes in the Yangtze basin can support healthy fish populations. WWF encourages fishing communities to adopt sustainable practices.

CASE 3: STURGEONS – GIANTS OF THE DANUBE

Key words:

dams, fishing
bans, sanctuaries,
protected areas,
navigation,
shipping,
overfishing,
species restocking,
reintroduction

Sturgeon fishing bans have been in place since 2006, when Romania was the first country to impose a 10-year ban on commercial fishing activities.

The ecosystem

The Danube river basin is the most international basin in the world, draining parts of 19 countries on its 2,800km journey from the Black Forest in Germany to the Black Sea. From the largely untamed middle and lower stretches of the river to its spectacular delta, the Danube is home to some of the richest wetland areas in Europe and the world. The Danube is one of Europe's most diverse rivers, with 103 fish species, including seven endemic species and 10 diadromous species, 90 freshwater molluscs and over 30 amphibian species.

The river's flagship species, and a good indicator of its ecological status, is the sturgeon. With a history dating back 200 million years, sturgeons are often referred to as the 'living fossils of the Danube'. These giant migratory fish can grow up to six meters in length through a complex lifecycle that may last up to 60 years. They live primarily in the Black Sea, but migrate upstream to spawn along the gravelly bottoms of the Danube and its tributaries.

The fishery

Sturgeon fishing techniques in the Danube, including specially built weirs, gill nets and lines with sharp hooks, have been documented since the Middle Ages, and the highly valued fish has been known to be traded across long distances. Most sturgeons – the Beluga in particular – are fished for caviar, for which there is a large international market. The international convention on trade in endangered species, CITES, sets quotas for caviar from wild sturgeons. In contrast, sturgeon meat was mostly consumed locally. Today, complete or partial catch bans are in place on commercial sturgeon fishing in most of the lower Danube countries.

Problems and challenges

Of the six sturgeon species native to the basin, one is already extinct in the basin and four, including the Beluga sturgeon, are critically endangered, facing threats of overexploitation, habitat loss and disruption of spawning migration. Despite CITES quotas and national fishing bans, there remains a high rate of illegal catches, driven by the extremely high economic value of caviar, with retail prices of up to €10,000/kg.

The Danube is also heavily modified by dam construction and the Iron Gates dams have effectively limited the remaining sturgeon population to the lower reaches of the Danube. In the past years, the level of new threats has accelerated, including projects to improve navigation, which would destroy many of the sturgeons' spawning grounds, and proposals for eight large dams.

Action

Despite the threats, there is still scope for restoring the Danube sturgeon populations and action is underway at different levels. The WWF Danube Carpathian Programme aims to tackle all major threats in the lower Danube. Effective protection of the sturgeon now could result in a viable fishery in the future, providing important livelihoods in a region with high levels of poverty.

At present, only a handful of spawning and overwintering sites of Danube sturgeons are known, and this gap in knowledge makes it impossible to effectively protect sturgeon habitat. WWF's main goals are to identify and protect key habitats, as well



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Of the six sturgeon species native to the Danube, one is no longer found in the basin, four are critically endangered and one is vulnerable.

as breed and restock with native sturgeons. WWF will also be working with fishing communities, sturgeon breeders, caviar traders, enforcement agencies and decision makers to fight overexploitation.

Through press work and advocacy on national and international levels, WWF lobbies for fish passes at the Iron Gates dams, which cut the sturgeons' vital migration routes and block 1,000km of potential habitat upstream, and against harmful dam construction and navigation projects.

Food for thought

In 2016, sturgeon catch bans will expire in both Romania and Bulgaria. By then, efficient regulation and control mechanisms, based on sound data, need to be in place to allow a recovery of sturgeon stocks in the lower Danube and secure the fishery in the future. To achieve this, all relevant stakeholder groups – especially fishermen – should be involved as much as possible in future regimentation of sturgeon fishing and in conservation measures. If these processes fail, catch moratoria will need to be extended and compensation or access to other sources of income will need to be provided to the Danube's fishing communities.

WWF VOICE

We will not be able to save endangered fish without winning the support of fishermen; official agreements, good legislation and strong law enforcement are important, but not sufficient.

Jutta Jahrl, WWF-Danube Carpathian Programme

Further reading:

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CASE 4: FISHERIES MANAGEMENT SYSTEMS – PIRARUCU IN BRAZIL’S FLOODED FORESTS

Key words:
community-based fisheries management, fishing policy, overfishing, poverty reduction, livelihoods, regulation, licensing

The ecosystem

The landscape of the lower Amazon floodplain, or Várzea as it is called in Brazil, is dominated by large expanses of seasonally inundated grasslands and wide shallow lakes. Each year, the rising waters of the Amazon enrich the soils with nutrients and regenerate lakes, floating meadows and other seasonal habitats. Freshwater fish move into these flooded forests, often feeding on the fruits that drop from the trees. Many communities, including some of the poorest people on Earth, depend on the natural riches of the Várzea.

The fishery

The Várzea fisheries consist of many different species, each with their own techniques and approaches. One of the most iconic species is the pirarucu (*Arapaima gigas*), one of the largest freshwater fish species in the world. It is a highly valued commercial species that is also of great cultural importance. It surfaces regularly to gulp air, is largely sedentary, spawns in floodplain lakes and forms couples to care for offspring. Traditionally caught by harpoon, successful pirarucu fishers are highly respected for their skill.

Action

WWF has years of experience supporting the development of a fisheries co-management system in the Várzea. The objective is to integrate the informal community fishing agreements, which were designed to control access to and pressure on floodplain lake fisheries, into a formal policy and institutional framework for the management of floodplain fisheries and other resources.

The key success has been the development of a consistent set of rules and policies to manage the floodplain resources, even in areas of informal settlement. This approach has several components:

1. Developing community- and settlement-wide institutions for designing, implementing, monitoring and enforcing a management plan.
2. Integration of annual and perennial crop production, small and large animal husbandry, management of floodplain fisheries, conservation of other key aquatic species (caiman and river turtles), and restoration of forest and aquatic macrophyte communities.
3. Environmental education programs in schools to build community awareness and involvement in addressing environmental issues and projects.
4. Strengthening leadership and organizational capacity of settlement institutions.
5. Working with key government agencies to develop and refine policies and institutional arrangements for the joint management of floodplain fisheries and other resources.



© Edward Parker / WWF-Canon

Fishermen use harpoons to catch the fruit-eating pirarucu in the floodplain near Santarém, Brazil.

Food for thought

Small-scale inland fisheries represent a major challenge for fisheries managers and conservationists. However, the project has shown over the last decade and a half that developing the capacity of community organizations and local institutions can provide an effective foundation for the sustainable management of floodplain fisheries and the conservation of aquatic biodiversity.

Today the Várzea project involves 180 communities and around 35,000 people, helping them sustainably manage dozens of lakes in the area. WWF hosts workshops and has trained over 200 fishermen in management and conservation techniques. The best managed lakes have seen fishing catch increases of as much as 60 per cent. The approach for engaging smallholder settlements developed in the Várzea is now being adapted for formal colonist settlements in upland forest areas. The lack of investment in the governance of colonist settlements is a major factor in the high rates of deforestation and forest degradation in Amazon frontier settlements.

WWF VOICE

Development of a co-management system is a continuous process of institutional learning, of constant adjustments to resolve problems created by the different expectations of stakeholders and the legal and institutional constraints on the range of possible options. But the process is worth it: empowered, engaged communities are essential allies in freshwater species and habitat conservation. Indeed, success is nearly impossible without them.

Antonio Oviedo, WWF-Brazil

Further reading:

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CASE 5: PROTECTING CANDLE FISH (EULACHON) – A RAY OF LIGHT

Key words:
climate change,
land-use
impacts, public
awareness,
regulation,
licensing,
science and data
management,
traditional
fisheries

The ecosystem

British Columbia's Great Bear region is the second-largest intact coastal temperate rainforest on Earth. It harbours some of the world's last large wild rivers, including the Skeena and the Nass, which feed the Great Bear Sea. Two decades ago, almost every valley of the Great Bear's temperate rainforest was slated for clear cutting. Yet, since 2006, over 2.1 million hectares of this rainforest have been protected through a historic agreement to ensure eco-friendly logging practices, support sustainable economies and strengthen First Nations'² decisions about their traditional lands. WWF recognized the magnitude of this success with its highest honour in 2007, endowing the architects of the agreement with its "Gift to the Earth" award.

The fishery

The temperate coastal rivers of British Columbia's Pacific coast support an anadromous forage fish known as eulachon or oolichan (*Thaleichthys pacificus*). Eulachon is so rich in oil it can be burnt like a candle when dried – the reason behind its other popular name, candlefish – and has played a key role in BC's culture and history. This small (180mm) fish has been an important source of nutrients for the First Nations in the region. The eulachon are harvested when they return to freshwater to spawn, anytime from early March to May. The fishing methods used vary, but can include beach seined and dip nets, which are operated from the shore, or gill nets.

Problems and challenges

Eulachon stocks have experienced severe declines in over half their range in recent years. The Fraser River alone once produced an estimated annual catch of nearly 400 tonnes. Yet in 2010, a spawning stock biomass survey estimated the total return at less than 4 tonnes. Dredging, pollution, log booming³ and shoreline construction all reduce quality and quantity of the freshwater habitat for eulachon. The eulachon fishery is also at risk due to a massive proposed project to construct a 1,100km oil and oil products pipeline from Alberta's oil sands to British Columbia's north coast for export to Asia.

While traditional harvest continues today, some First Nations' harvests in historic eulachon rivers have been halted. The decline in stocks also affects the wider ecosystem. Its high oil content, combined with the timing of its spawning run makes eulachon a species of vital importance for a variety of predators, including white sturgeon, salmon, seabirds, eagles and marine mammals.

Action

WWF-Canada is working to conserve the eulachon fishery by supporting the efforts of First Nations fisheries managers to identify important eulachon spawning habitat; model potential impacts of climate change in the region that would affect eulachon habitat with First Nations forestry managers; and identify important estuary habitat

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2. First Nations refers to the various indigenous people of Canada (with the exception of Inuit and Métis).
 3. The sorting of floating logs into rafts, or booms, for river transport.



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Every spring, the streams of the Great Bear rainforest run emerald green as the nutrients from the previous fall's salmon spawn fuel a explosion of growth.

with coastal planning teams. Working with government and First Nations, WWF supports research to develop recovery strategies and action plans.

A third area of work concerns advocacy. Efforts to protect eulachon figure in several campaigns, such as opposition to the proposed oil pipeline, the amendment of the BC Water Act and an amendment of Federal Fisheries Act. Finally, a series of blogs on the WWF-Canada website and other activities have helped raise awareness about this fish and its importance to BC.

Food for thought

The main success of the project to date is the adoption of environmental flows as a key habitat need for eulachon by scientists responsible for recovery planning and by our First Nations partners. The reason for this success is a long-term and respectful approach to community engagement, and to working with regulators.

WWF VOICE

“Fisheries and the water they rely on are at the crossroads of community, private sector and government decision making. All three need to make biodiversity in general, and habitat protection in particular, a priority or all three will fail in protecting resources over the long term.”

Linda Nowlan, WWF-Canada



FISHERIES AND THREATS

100%
RECYCLED



37%

The Freshwater Living Planet Index, a global measure of more than 700 vertebrate species, declined by 37% between 1970 and 2008.

60 MILLION

Small-scale fisheries in developing countries sustain 60 million full- and part-time jobs.



\$4.2 BILLION

The Mekong's fishery catch is worth an estimated US\$4.2 billion on the retail market.

37,641

There are 37,641 large dams in the world, fragmenting river basins and changing flows.



Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

panda.org/freshwater