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A DEEP DIVE INTO FRESHWATER

LIVING PLANET REPORT 2020

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Cover photograph: © Jaime Rojo / WWF-US
Elizete Garcia da Costa is an "isqueira" (a fisher that specializes in capturing crabs and small fish that will be used as bate for larger fish) in the Paraguay River, Brazil.

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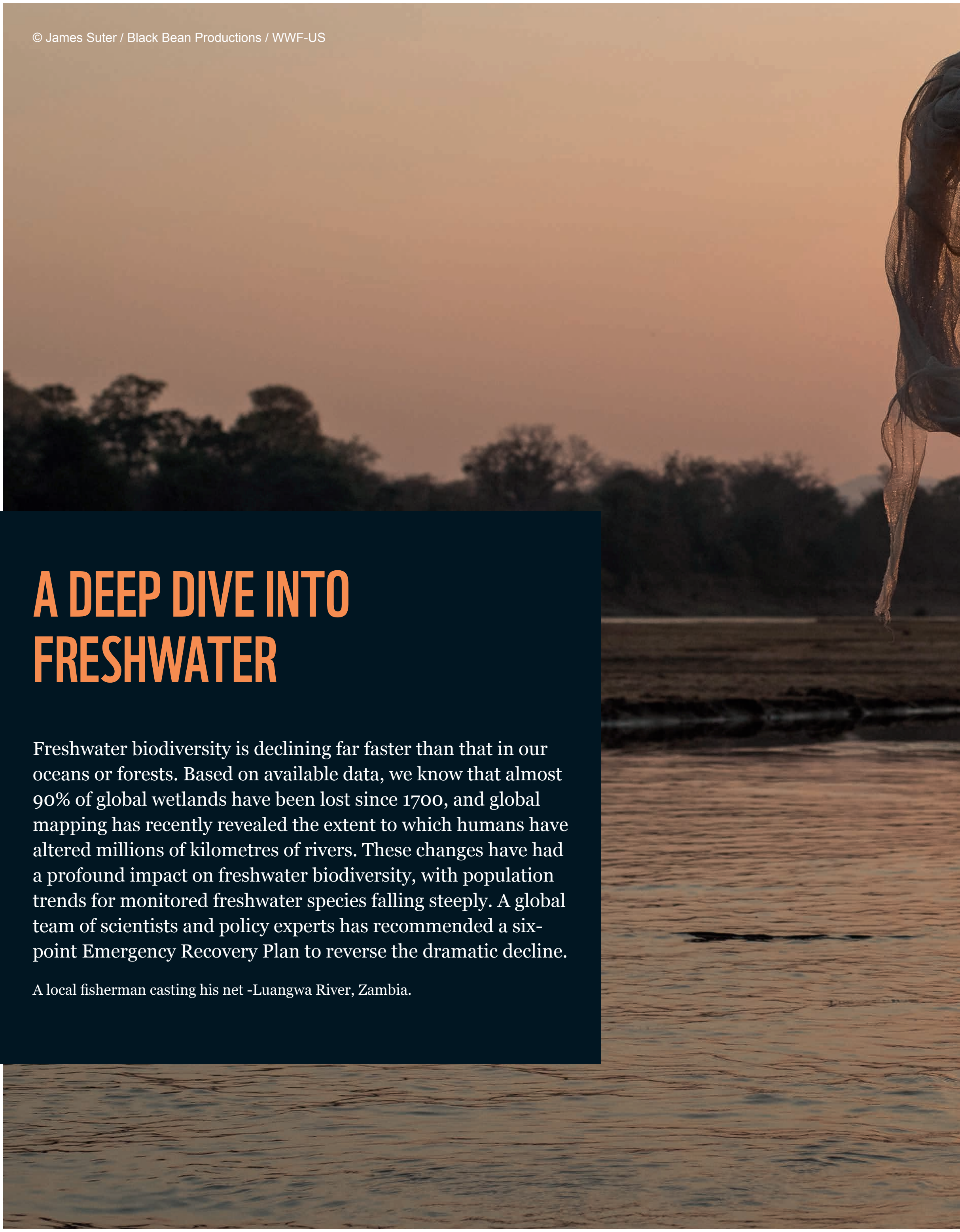

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A DEEP DIVE INTO FRESHWATER

Freshwater biodiversity is declining far faster than that in our oceans or forests. Based on available data, we know that almost 90% of global wetlands have been lost since 1700, and global mapping has recently revealed the extent to which humans have altered millions of kilometres of rivers. These changes have had a profound impact on freshwater biodiversity, with population trends for monitored freshwater species falling steeply. A global team of scientists and policy experts has recommended a six-point Emergency Recovery Plan to reverse the dramatic decline.

A local fisherman casting his net -Luangwa River, Zambia.

SUSTAINING WATER FOR LIFE

Jamie Pittock,
The Australian National University

The well-being of humanity depends upon sustaining freshwater ecosystems – however, this chapter is replete with grim news on our stewardship of the freshwater biome, and a number of key trends emerge from the following pages. People's consumption of freshwater is increasing by 1% per year in line with a growing population and the increasing demand for thirsty products that comes with rising wealth. There is an associated decline in the Living Planet Index for freshwater species of 4% per year, meaning that freshwater biodiversity is more imperilled than the terrestrial biome. A changing climate shifts the distribution of water, threatening freshwater biodiversity directly, and as a result of people's adaptations to climatic variability and change[1].

Yet we can be hopeful. Humanity lives around freshwater ecosystems and there are increasing ways in which the power of citizens can be harnessed to protect these wetlands[2, 3]. Growing recognition of the links between the health of our wetlands and people is a driver for conservation. Solutions are presented in the following pages, including the protection of the remaining free-flowing rivers and the restoration of more. The recovery plan proposed details further practical actions, ranging from reducing pollution to conserving our fisheries and retaining the connectivity of water, the life blood of this most vital of ecosystems. At a global scale, treaties and the 2030 UN Sustainable Development Goals provide frameworks for the better governance of water to sustain life on Earth. Together we can ensure water for life.

Fish heading upstream in the Juruena River,
Salto São Simão, Mato Grosso-Amazonian States, Brazil.


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WETLANDS BEING WIPED OUT: WHAT'S DRIVING THIS CHANGE?

Nearly 70% of wetlands have been lost since 1900, and they are still being destroyed three times faster than forests, with a negative impact on the well-being and livelihoods of many millions of people.

Chris Baker, Richard Holland and Jane Madgwick (Wetlands International)

The accelerated loss of freshwater biodiversity in rivers, lakes and wetlands highlighted by the LPI and the Global Wetlands Outlook [4] is the result of human-induced changes. In the 20th century, around two-thirds of all the world's remaining wetlands were drained, dammed and dyked, and they are still disappearing three times faster than rainforests [5, 6].

As patterns of loss – and, in some cases, recovery – of freshwater species and wetlands vary from region to region, from basin to basin, and within landscape units, there are also differences in the drivers that change freshwater ecosystems and their relative importance.

Direct drivers of freshwater ecosystem loss and degradation include changes to the physical regime through diversions and dams that reduce flows, sediment and connectivity; harvesting of species and the extraction of materials (wood, sand and gravel); the introduction of invasive species and pollutants (nutrients from farming, urban wastewater); and changes to habitat extent and functions (drainage, burning and conversion) [4]. Other threats include hydropower development and climate change [7].

Globally, land-use change is the direct driver with the largest relative impact on terrestrial ecosystems [8]. Land use also impacts freshwater ecosystems, with nearly three-quarters of freshwater withdrawals used for crop or livestock production [4, 8].

Direct drivers, in turn, are influenced by indirect drivers that include the prevailing systems for energy generation, food and fibre production (agriculture, livestock and plantations), urban and infrastructure development, and water supply. This is reflected by an average 1% annual increase in global water demand that is forecast to continue until 2050, which would amount to a rise of 20 to 30% above the current level of water use [9]. This projected increase indicates the increasing pressure on freshwater systems that may manifest itself in many ways including the loss of river and wetland connectivity, pollution and flow regime changes.

Climate change acts both as a direct and indirect driver and is projected to become increasingly important as a direct driver in the coming decades [8]. Directly, it causes changes to flow regimes, while indirectly it has an impact through mitigation measures, such as more hydropower or biofuel production, including on drained peatlands [4]. Climate change is a particular challenge for freshwater species given that many of them have limited mobility, being confined to a specific lake or stretch of river.

While dams provide significant benefits to people, they are also a primary cause of the loss and degradation of river ecosystems. Forty-eight per cent of river volume globally is moderately to severely impacted by flow regulation and/or fragmentation by dams [10, 11]. Hydropower dams, both existing and planned, threaten 191 of the 207 species of freshwater megafauna [12]. Dams have also limited the ability of species to migrate in response to changing conditions [13].

Global wetland extent and trends

The most recent estimate of the global inland and coastal wetland area is more than 12.1 million km^2, an area almost as large as Greenland. The largest areas of wetlands are in Asia and North America, which represent more than half the global total.

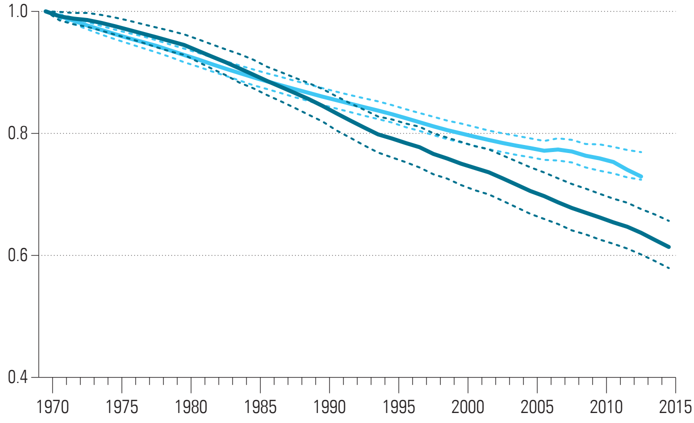


Figure 1: Wetland Extent Trends (WET)
Index relative to 1970 for global natural inland and marine/coastal wetlands (Darrah et al., 2019)[5].

Key

- Global Natural Inland WET index
- Confidence limits
- Global Natural Marine/Coastal WET index
- Confidence limits

It is estimated that nearly 90% of global wetlands have been lost since 1700, with rates of loss increasing in the past 50 years [4]. The UN Environment World Conservation Monitoring Centre's Wetland Extent Trends (WET) Index collates more than 2,000 individual time-series records of change in wetland area from local sites, and aggregated national trends from 1970 to 2015 [14, 5]. The global and regional natural wetland indices show a higher average loss of coastal/marine wetlands than inland wetlands (39% and 35% respectively), though with the decline in inland wetlands increasing in recent years. The highest losses are seen in Latin America and the Caribbean (40%), whereas losses in Oceania and North America are less than 20% over the same period – this may reflect historic losses in these regions before 1970.

From 1970 to 2015, the average annual rate of decline in natural wetlands globally was −0.95% per year, with rates almost doubling to −1.6% per year in the five years from 2010-15. This means that wetland loss has been over three times faster than reported rates of forest loss (−0.24% per year, 1990-2010) [15].

As natural wetlands decline, human-made wetlands – e.g. rice paddies and water storage bodies – have increased considerably in global area and they now form about 12% of the world's wetlands. The WET index shows an increase of 233% in human-made wetlands since 1970.

The reduction in wetland extent leads to many populations of wetland-dependent species being in long-term decline and threatened with extinction, as is evidenced by other leading indicators such as the LPI for Freshwater (see page 12) and IUCN Red List data.

The Ataturk hydro electric plant produces electricity and irrigation for the arid South East region, Anatolia, Turkey.

FROM SOURCE TO SEA: MAPPING THE DECLINE OF RIVER SYSTEMS

The recent mapping of millions of kilometres of rivers reveals just how much humans have altered their natural flow and connectivity. This has had a profound impact on freshwater biodiversity and the services that these watercourses provide.

Michele Thieme, Jeff Opperman, Stuart Orr and David Tickner (WWF) and Guenther Grill and Bernhard Lehner (McGill University)

River systems, including their floodplains and deltas, are among the most biologically diverse and productive ecosystems on the planet. River fisheries provide the primary source of protein for hundreds of millions of people worldwide; and, by depositing nutrient-rich silt on floodplains and deltas, rivers have created some of the most fertile agricultural land [22].

The benefits that rivers provide require that they largely retain key characteristics and processes, such as connectivity and flow, so rivers that retain these can be considered free-flowing [11]. However, infrastructure development – especially dams – is resulting in a dramatic decline in the number of rivers that retain these natural processes.

Recently, WWF and McGill University, with seven additional universities and three conservation organisations, developed a Connectivity Status Index (CSI) to measure the multiple dimensions that affect a river's free-flowing status, and a methodology to define which rivers can be considered free-flowing [11]. The research found that most of the world's longest rivers have been dammed or otherwise altered; only a third of the world's 242 longest rivers, more than 1,000km long, remain free-flowing. Most of these are within remote areas, such as the Arctic, and the Congo and Amazon basins.

These remaining free-flowing rivers are bastions of freshwater biodiversity and support some of the most productive remaining river fisheries. In many places, their natural flows and ability to move sediment support floodplain agriculture and delta replenishment – the latter is a particularly essential service as sea levels rise [23, 24]. Yet as of 2015 there were more than 3,600 hydropower dams at some stage of planning around the world [25].

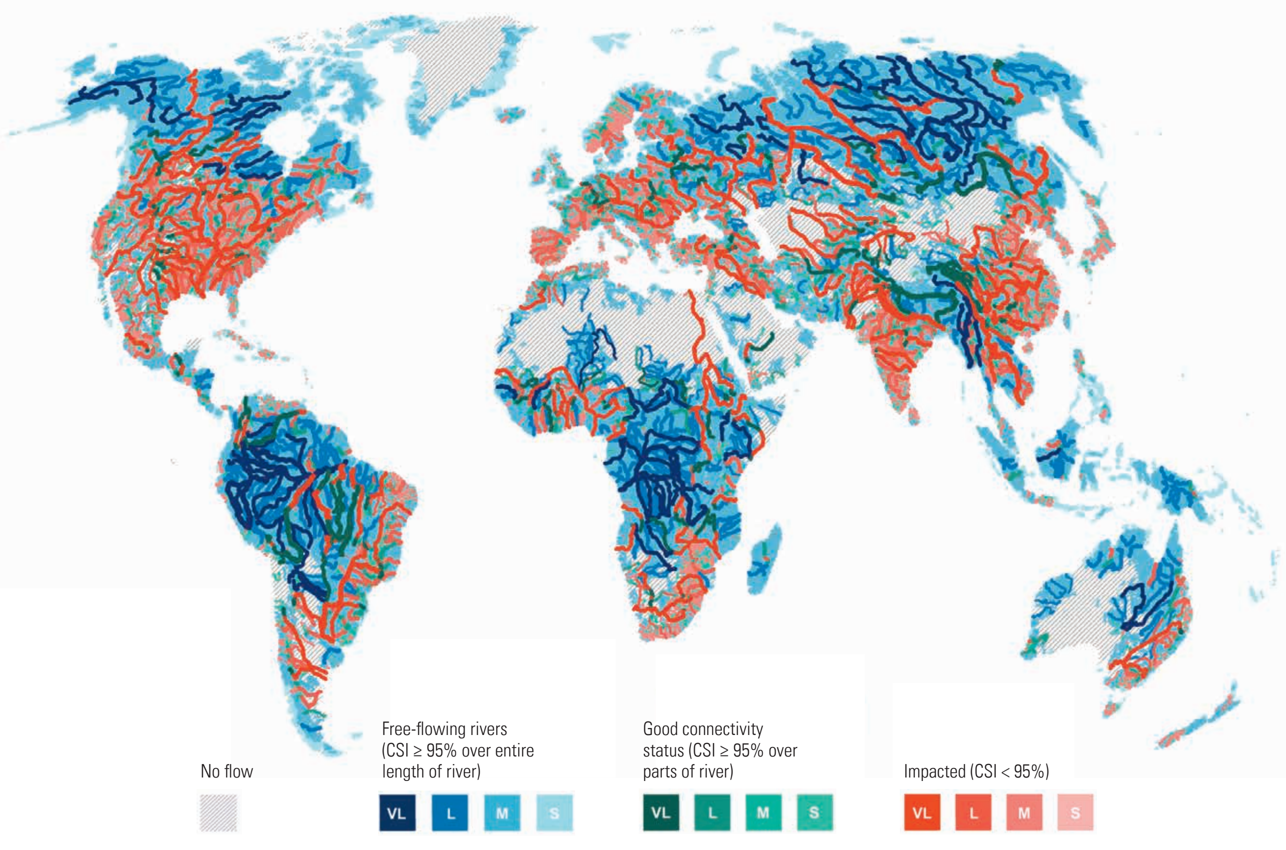
The scientific understanding and mapping of the world's free-flowing rivers also reveals where river connectivity and flows can be improved or restored through actions such as the release of environmental flows, floodplain reconnection, or the removal of ageing dams. More than 1,500 dams have now been removed across Europe and the US, and analyses of river connectivity metrics like the CSI combined with other ecological, social and economic variables can reveal where the greatest gains in connected rivers, and the values that they provide, can be achieved for the lowest cost [26-29].

Despite providing a crucial new perspective on the status of global rivers, this research was limited by a problem that often affects studies of this sort – that the global data available to estimate mechanisms of disconnection is of low resolution at the local scale. So, the researchers are providing open access to the source code used in the analysis, enabling others to recalculate the main results, and to carry out regional studies using available higher-resolution data. Such efforts could be invaluable for biodiversity conservation, for example, because measures of the intactness of rivers and floodplains can serve as signposts for habitat-protection programmes.

Figure 2: Global distribution of free-flowing rivers, contiguous river stretches with 'good connectivity status', and impacted rivers with reduced connectivity [11]
An online version of this map means that you can explore each region and country in more depth [30].

Key

VL	Very long river (> 1000 km)
L	Long river (500-1000 km)
M	Medium river (100-500 km)
S	Short river (10-100 km)



THE FRESHWATER LIVING PLANET INDEX

On average, population trends for monitored freshwater species appear to be falling steeply, with megafauna particularly at risk.

Louise McRae, Stefanie Deinet, Valentina Marconi, Kate Scott-Gatty and Robin Freeman (ZSL)

Almost one in three freshwater species are threatened with extinction, with all taxonomic groups showing a higher risk of extinction in the freshwater, compared to the terrestrial, system [31]. If we look at population trends using the Living Planet Index, a similar story emerges.

The 3,741 monitored populations – representing 944 species of mammals, birds, amphibians, reptiles and fishes – in the Freshwater Living Planet Index have declined by an average of 84% (range: -89% to -77%), equivalent to 4% per year since 1970 (Figure 3). Most of the declines are seen in freshwater amphibians, reptiles and fishes; and they're recorded across all regions, particularly Latin America and the Caribbean.

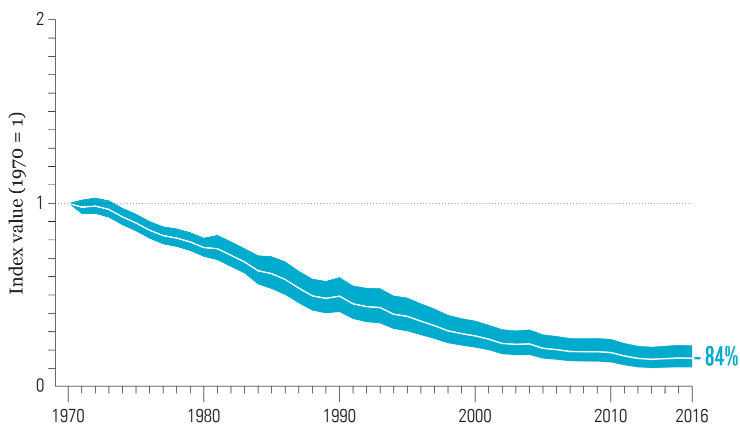
Habitat degradation through pollution or flow modification, overexploitation, invasive species [32] and sand mining in rivers [33] are among the threats affecting freshwater species. Conservation action often fails to target freshwater species or habitats [34-36], partly because the protection of freshwater environments often requires large-scale, multi-sectoral efforts [37].

Figure 3: The Freshwater Living Planet Index: 1970 to 2016
The average abundance of 3,741 freshwater populations, representing 944 species, monitored across the globe declined by 84% on average. The white line shows the index values and the shaded areas represent the statistical certainty surrounding the trend (range: -89% to -77%) [38].

Key

Freshwater Living Planet Index

Confidence limits



The bigger the size, the bigger the threats

Species with a larger body size compared with other species in the same taxonomic group are sometimes referred to as 'megafauna'. Across the world, these species are particularly at risk [39]: they tend to be less resilient to changes in the environment because they generally require complex and large habitats, reproduce at a later stage in life and have fewer offspring [40].

In the freshwater system, megafauna are species that grow to more than 30kg, such as sturgeon and Mekong giant catfish, river dolphins, otters, beavers and hippos. They are subject to intense anthropogenic threats [41], including overexploitation [39], and strong population declines have been observed as a result [42]. Mega-fishes are particularly vulnerable. Catches in the Mekong river basin between 2000 and 2015, for example, have decreased for 78% of species, and declines are stronger among medium- to large-bodied species [43]. Large fishes are also heavily impacted by dam construction, which blocks their migratory routes to spawning and feeding grounds [44, 41].

Large-scale cross-boundary collaboration is required to effectively protect freshwater species [37], and some persistent conservation efforts have proved successful. The Eurasian beaver (*Castor fiber*), for instance, has now been reintroduced into many countries from which it had disappeared, including Czechia, Estonia, Finland, Sweden and the UK [45].

Close up of the head of a West Indian manatee (*Trichechus manatus*) under water, Crystal River, Florida.

BIODIVERSE FRESHWATER SYSTEMS FOR BETTER HUMAN HEALTH

Despite the importance of water for life and health, with natural systems playing an essential role in freshwater regulation, these ecosystems are the most threatened on Earth. Their disruption and destruction is costly and, in many ways, harms human health.

Thomas Pienkowski
and Sarah Whitmee
(Oxford University)

Intact ecosystems help to maintain the quality and quantity of renewable water sources, such as surface water, in a variety of ways [46]. This is particularly important in least developed countries, where one in three people still depend on unimproved drinking water sources [47].

Forests and other vegetative cover can increase the infiltration of water into the ground, thereby removing pollutants [48, 49]. Plant biomass – particularly in wetlands – can also physically filter out particulates and absorb nutrients such as nitrite, enhancing water quality [50-52]. Microbes in the soil can help destroy human pathogens, such as cryptosporidium parasites, one of the more common causes of infectious diarrhoea in humans [53].

Biodiversity underpins all these processes. Ecosystems containing many species are productive, efficient, stable, and likely to contain organisms that play special roles in enhancing water quality [54, 52]. While the relative importance of these processes for health remains uncertain [55], there is growing evidence of lower rates of water-borne illness in areas with higher natural habitat cover [56-59]. For instance, one study in 35 developing countries found that a 30% greater upstream forest cover was linked with a 4% lower risk of downstream diarrhoeal disease [58].

The destruction of these natural systems can impair their ability to support human health, while presenting new health threats. For example, the construction of dams has put nearly 400 million people at greater risk of schistosomiasis, a parasitic disease carried by snails [60]. Dams disrupt the ecology of snail-eating river prawns, increasing snail numbers and the risk of human infection. One-third to a half of humans at risk of schistosomiasis could benefit from the restoration of rivers to re-establish prawn populations [60].

Freshwater and wetland ecosystems also support health in a wide range of other ways. Freshwater capture fisheries contribute to improved food security and dietary quality for hundreds of millions of people globally [61]. These inland fisheries also support the livelihoods of nearly 60 million people, generating incomes that may be invested in preventing and treating illness [62, 63]. Furthermore, these ecosystems are important for recreation, potentially contributing to mental and social health globally [64].

The cost of replacing the lost livelihoods and health services provided by freshwater ecosystems can be high. One study estimates that ecosystem degradation increased water treatment costs in almost a third of cities globally [65]. Within these cities, average maintenance and operation costs increased by over 50%. Along with the higher costs of replacing equipment, this represented a total additional cost of US$5.4 billion each year.

Biodiverse freshwater ecosystems play important roles in human health but are highly threatened. These threats can harm both nature and the health of millions of people who depend on the contributions provided by freshwater systems.

The Rufiji River snakes through mangrove forests at its delta, Tanzania, East Africa.

AN EMERGENCY RECOVERY PLAN FOR FRESHWATER BIODIVERSITY

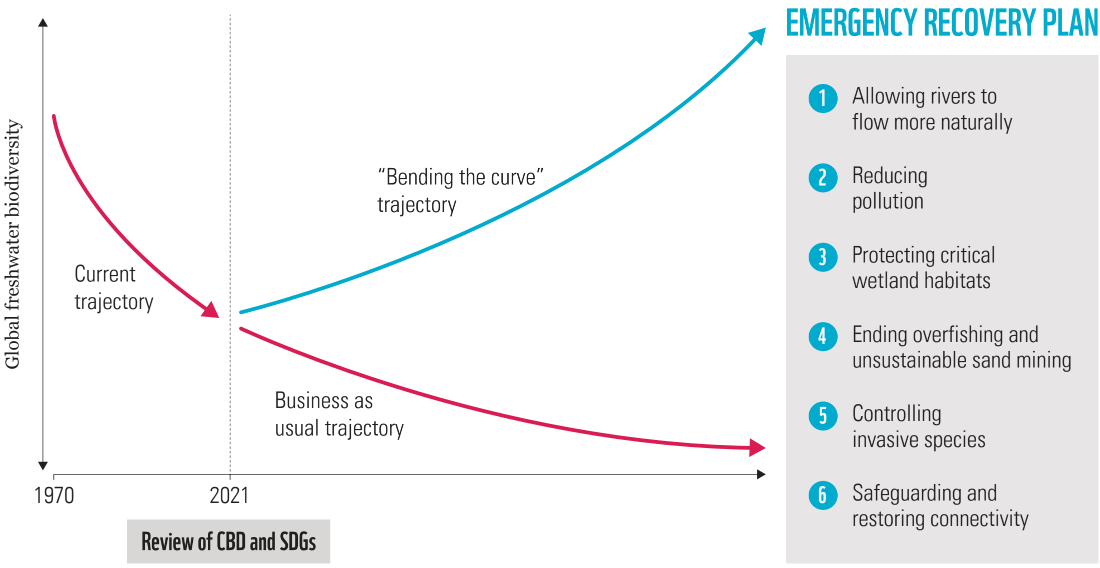
We know that freshwater biodiversity is declining far faster than that in our oceans or forests. A global team of scientists and policy experts has recommended a six-point Emergency Recovery Plan, based on proven measures, to reverse the dramatic decline.

David Tickner, Michele Thieme and Jeff Opperman (WWF)

Recommendations to address wider biodiversity loss have too often assumed, simplistically, that measures designed to improve land management will inevitably benefit freshwater ecosystems, or they have neglected to consider freshwater biodiversity at all. This has obscured distinct threats to freshwater flora and fauna and precluded effective action. Equally, only focusing on freshwater habitats, and not surrounding landscapes, is ineffective. Both are needed.

In 2019, an international group of freshwater ecosystem experts gathered to define priorities for bending the curve of freshwater biodiversity loss. Borrowing from post-disaster recovery planning processes, they set out an ambitious but pragmatic Emergency Recovery Plan for Global Freshwater Biodiversity[66].

Figure 4: The Emergency Recovery Plan for freshwater biodiversity
Six priority global actions to bend the curve of freshwater biodiversity loss that should be reflected in the post-2020 biodiversity framework. Threats to freshwater biodiversity are often synergistic, so coherent planning of interacting priority actions to address multiple threats improves management efficiency[66].



A giant otter (*Pteronura brasiliensis*) holding onto a branch in a lagoon off the Paraguay River, western Pantanal, Brazil.

The Plan is structured around six priorities for action

1. **Allowing rivers to flow more naturally:** Water management for power generation, flood risk reduction, or to store and deliver water for agricultural, industrial or domestic uses, changes the quantity, timing and variability of water flows and levels. In doing so, it contributes substantially to losses of freshwater biodiversity. Maintaining or restoring ecologically important attributes of hydrological regimes improves biodiversity outcomes. The science and practice of environmental flow assessment enables identification and quantification of these attributes. Environmental flows have already been incorporated into policies in many jurisdictions, and examples of environmental flow implementation from a range of contexts have been documented [67].

2. **Reducing pollution:** Many pollutants affect freshwater ecosystems, including nutrients from sewage; fertilisers or animal wastes; synthetic chemicals; pharmaceuticals from human and agricultural use; plastics; and sediments mobilised by agriculture, forestry and mining. Policy and management responses include improved wastewater treatment, regulation of polluting industries, market instruments, improved agricultural practices, and nature-based solutions such as floodplain wetland restoration. Evidence is urgently needed on sources, pathways and impacts of some pollutants, including microplastics and pharmaceuticals, to inform policy and management.

3. **Protecting critical wetland habitats:** An estimated 30% of natural inland wetlands have disappeared since 1970 [68]. Causes include land conversion to agriculture and reduced hydrological connectivity after dam and levee construction. Climate change can also alter wetland distribution and extent while forestry, mining and urbanisation have affected freshwater habitats downstream. Community conservation of habitats, formal protected area designations, land-use planning and habitat restoration programmes can, if designed and managed with freshwater biodiversity as an explicit focus, all support habitat protection. Systematic freshwater conservation planning tools, which take specific account of hydrological factors, can aid prioritisation of freshwater habitats for efficient conservation and restoration investments.

4. **Ending overfishing and unsustainable sand mining:** The exploitation of living organisms and mineral substrates impacts freshwater biodiversity directly through the removal of individuals and their habitats, and indirectly through alterations

to freshwater ecosystem processes. A wide range of freshwater taxa are exploited, including plants, invertebrates (such as crabs), fish, amphibians, reptiles (including turtles and their eggs), waterbirds and mammals (including river dolphins and otters). The 2016 Rome Declaration, convened by the UN Food and Agriculture Organization, describes steps needed for sustainable freshwater fisheries. Extraction of riverine substrates, especially sand and gravel for use in construction, is increasing rapidly in many regions. Solutions can include reducing demand for construction materials (e.g. through improved building design), substituting new concrete with recycled materials, and improved supply chain standards[69].

5. **Controlling invasive species:** Freshwater habitats are especially susceptible to invasive non-native species (INNS), and impacts range from behavioural shifts of native species to the complete restructuring of food webs and the local extinction of entire faunas. The economic costs are also significant, reaching billions of dollars in the US alone[70]. Preventing the introduction of INNS is the best way of limiting their impacts. A few countries have taken steps to identify and prioritise INNS for action. In the US, invasive species advisory councils bring together regulators, researchers and stakeholders to address research, policy and management needs related to INNS.

6. **Safeguarding and restoring connectivity:** Many freshwater species depend on connectivity between upstream and downstream river reaches, or between river channels and floodplain habitats, for their migration and reproduction. Dams and weirs fragment longitudinal (upstream-to-downstream) connectivity and, through flow alterations, also affect lateral (river-to-floodplain), vertical (surface-to-groundwater) and temporal (season-to-season) connectivity. Coherent planning for energy and water, including strategic siting of new infrastructure and due consideration of alternative options, can balance connectivity maintenance with hydropower generation or water storage[71]. Targeted removal of obsolete dams can restore longitudinal connectivity in degraded ecosystems. Removal or repositioning of levees can improve lateral connectivity while enhancing water storage and/or conveyance on floodplains as part of flood risk management strategies.

The Emergency Recovery Plan is rooted in practical actions that have already been implemented somewhere in the world. The challenge now is to transition from ad hoc freshwater conservation and restoration successes to a strategic approach that achieves results at a far larger scale.

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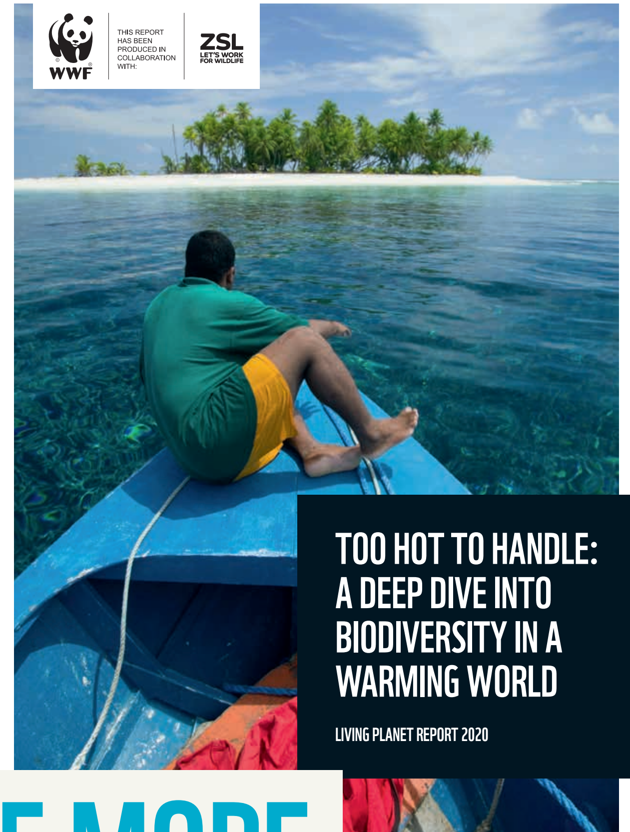

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