The Plight of New Zealand's Freshwater Biodiversity

Elston E., Anderson-Lederer R., Death R.G. and Joy M.K.

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Authors: Elston E.[1] , Anderson-Lederer R.[1], Death R.G.[2] and Joy M.K.[2]
[1]Society for Conservation Biology (Oceania), New Zealand
[2]Institute of Agriculture and Environment-Ecology, Massey University, Private Bag 11-222, Palmerston North New Zealand

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This Conservation Science Statement was peer reviewed and is endorsed by:

Dr Gerry Closs, Associate Professor, University of Otago
Prof Jenny Webster-Brown, Director, Waterways Centre for Freshwater Management, Canterbury University
Dr Marc Schallenberg, Research Fellow, University of Otago
Paul Boyce, Researcher, Massey University
Corina Jordan, Environmental Manager, Fish and Game New Zealand
Prof Jon Harding, Professor, University of Canterbury
Dr Bruno David, Freshwater scientist
Trent Bell, EcoGecko Consultants
Tamsin Ward-Smith, Cape Sanctuary
Kyleisha Foote, Freshwater Scientist, Massey University
Dr Cynthia Winkworth, NZ FRS&T Postdoctoral Fellow, University of Otago

Front cover photo of Lake Rotoiti, Nelson Lakes National Park, courtesy of Amanda Taylor

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Executive Summary

New Zealand's freshwater habitats including rivers, lakes, estuaries and other wetlands; groundwater and geothermal ecosystems support a unique array of flora and fauna. Freshwater is New Zealand's greatest asset and is a taonga of paramount importance. It is valued for its contribution to biodiversity, recreation, the economy and overall well-being of New Zealanders. It is also a vital element of whakapapa and provides valuable resources such as mahinga kai (indigenous freshwater species that have traditionally been used as food, tools, or other resources), and underpins the country's ever-growing tourism industry. Reinforcing this importance, New Zealanders consider water quality to be the most important environmental challenge facing New Zealand[1].

This Conservation Science Statement uses the latest scientific understanding of New Zealand's unique freshwater ecosystems (rivers, lakes, other wetlands, groundwater ecosystems) to propose how effective policy and management based on scientific evidence can safeguard their future for generations to come. We identify six clear priorities to protect New Zealand's freshwater biodiversity:

1. change legislation to adequately protect native and endemic fish species and invertebrates, including those harvested commercially and recreationally;
2. protect habitat critical to the survival of New Zealand's freshwater species;
3. include river habitat to protect ecosystem health in the National Objectives Framework for the National Policy Statement on freshwater;
4. establish monitoring and recovery plans for New Zealand's threatened freshwater invertebrate fauna;
5. develop policy and best management practices for freshwater catchments which includes wetlands, estuaries and groundwater ecosystems and;
6. establish, improve and maintain appropriately wide riparian zones that connect across entire water catchments.

The importance of freshwater ecosystems

Freshwater lakes, rivers, estuaries, groundwater systems and other wetlands provide a range of ecosystem services for people and support a diverse array of other life. They are valued for their contribution to biodiversity, recreation, the economy and overall well-being. Across the globe more than 44,000 described species live in freshwater ecosystems, even though these ecosystems cover only 1% of the Earth's surface[2].

New Zealand's freshwater ecosystems are an important part of whakapapa and provide valuable resources such as mahinga kai (thinking, involving and understanding the simultaneous protection and use of resources). More than 770 lakes and innumerable ponds cover around 3400 square kilometres[3]. These lakes feed into 70 major rivers systems and hundreds of streams, and support other ecologically important ecosystems, including 73 nationally significant wetlands[4].

These freshwater ecosystems also support a unique flora and fauna. There are 66 freshwater fish species in New Zealand, with 31 only found on our islands (endemic)[5]. Half of these species spend some part of their lives at sea, including eels and whitebait which have important cultural and recreational values. There are at least 638 species of invertebrate found nowhere else and many more still to be discovered. There are also 38 endemic species of water plants and about 34 species of waterbirds[6].

So far, six wetlands of international importance or Ramsar wetland sites have been recognized in New Zealand, covering 39,068 ha. These sites are recognised for their unique cultural and biological significance. Historically, they provided Maori with food (particularly waterbirds, eels and other freshwater fish), taro cultivation, harakeke (flax) for weaving and other materials for medicinal, food, building, and craft use. There are five endemic mudfish species in New Zealand and four of them evolved to specifically occupy different wetland habitats[7,8]. Wetlands also provide feeding grounds for migratory shorebirds that move to New Zealand during the Northern Hemisphere winter.

Status of rivers, lakes, estuaries, wetlands, ponds and their biodiversity

There is growing evidence that freshwater ecosystems are degrading, more so than marine and terrestrial ecosystems, contributing to the biodiversity crisis[9,10,11,12]. In 2009, the International Union for the Conservation of Nature's (IUCN) Red List of Threatened Species listed 37% freshwater species as extinct or threatened around the world[13]. While alarming, these trends probably underestimate the true decline of freshwater species, due to insufficient data in many parts of the world. This problem is nowhere more prominent than in New Zealand's rivers, lakes and wetlands. For example, more freshwater fish species are under threat than ever before and increasing development, expansion of introduced fish and demand for water is increasing the threat ranking for many species and pushing some nationally critical species closer to extinction. The number of threatened or at risk species of freshwater invertebrate has increased from 17 in 2005 to 82 in 2013, and we have insufficient data to evaluate the other species.

The status of New Zealand's freshwater has become an issue of national significance. Over the past 25 years, New Zealand has experienced rapid intensification of lowland agriculture and increased urbanisation. This has resulted in an alarming decline in the quality of freshwater for both native biodiversity and human well-being. Water quality has consistently declined in the 77 National Water Quality Monitoring Sites (NRWQN), monitored since 1990, particularly in lowland rivers[41]. Further, 96% of the sites in 300 lowland pastoral catchments and all of the sites in urban catchments, monitored by local government, failed the pathogen standard for safe swimming and more than 80% of these sites exceeded nutrient guideline levels[15].

Lakes and groundwater ecosystems parallel these declines in water quality. Thirty-two percent of monitored lakes are now classed as polluted with nutrients, or 84% of lakes in pastoral catchments [16]. In groundwater ecosystems, nitrate levels are rising at 39% of monitored sites and groundwater pathogen levels exceed human drinking standards in 21% of monitored sites[17].

What is eutrophication?

Eutrophication occurs when water bodies (e.g. lakes) become enriched with nutrients. Nutrients run-off into waterways and cause phytoplankton to grow rapidly, producing algal blooms. These suffocate marine and freshwater organisms by using up all the oxygen. Nitrates and phosphates are the most common nutrients responsible for algal blooms in New Zealand.

Fig. 1. Green algal bloom in a small freshwater lake in New Zealand (photo courtesy of Rob Suisted Photography).

Freshwater biodiversity has declined over the past century, at particularly fast rates over the last 40 years. Proportionally, New Zealand has more threatened freshwater species than most countries around the world[18]. While only one native fish species is extinct, many are locally extinct throughout New Zealand. Numbers of all aquatic species listed as threatened have grown over the past 20 years, accounting for changes in criteria for risk assessments (Fig. 2). The New Zealand Department of Conservation recorded 10 species of freshwater fish species as threatened in 1990; by 2002 the number rose to 16 species[19]. Under the 2013 New Zealand classification, 74% of all native freshwater taxa and 76% of all non-diadromous taxa (i.e. confined to fresh water) are considered threatened or at risk[19,20].

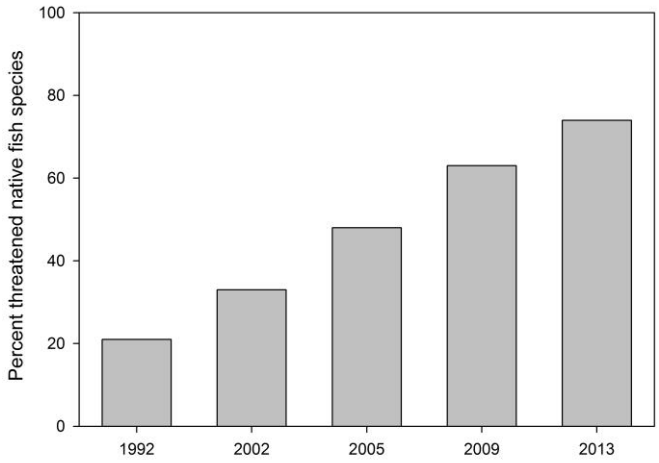

Fig. 2. Changes in percentage of threatened native freshwater fish in New Zealand, 1992 – 2013, based on IUCN data.

New Zealand's freshwater species are also threatened by several other factors, including invasive species[21]. Twenty-one introduced species of freshwater fish have established self-sustaining populations in New Zealand[22]. Exotic fish species outcompete or prey on native fish species. Also, invasive exotic plants threaten native species. Over 70 freshwater introduced aquatic plants are silently invading water ways.

In the last 150 years, 90% of New Zealand's wetlands have been drained. Even though wetlands are identified as ecosystems of national importance in the Resource Management Act (RMA), wetland loss has been exacerbated with recent intensification of farming, along with the effects of urbanisation and introduction of exotic species. These cumulative impacts have increasingly degraded water quality and ecosystem health and led to the decline of numerous native freshwater species.

Dams, levees and channels also cause major ecological problems to New Zealand's rivers and wetlands[23]. In addition to the habitat alteration of vulnerable species such as the banded plover (*Charadrius bicinctus*), New Zealand dabchick (*Poliocephalus rufopectus*) and blue duck (*Hymenolaimus malacorhynchus*) through waterway alteration, native fish that complete part of their life cycle at sea are particularly vulnerable to man-made barriers. Additionally, fish adapted to high water flows, such as the Torrentfish (*Cheimarrichthys fosteri)* (Fig. 3), can be negatively impacted when too much water is removed for irrigation[24].

Fig. 3. Torrentfish (*Cheimarrichthys fosteri*) only live in rapid flowing water (i.e. torrents). These fish are threatened by the diversion of water and building of dams, decreasing high water velocity on which they depend (photo courtesy of Rob Suisted Photography).

Drivers of freshwater species decline

Around the world and in New Zealand, there are ubiquitous threats to freshwater ecosystems including loss and degradation of habitats, caused by river regulation and diversions of fresh water, pollution, overharvesting, invasive species, disease and climate change. Invasive species, deteriorating water quality and reduced habitat remain the biggest threats to New Zealand's native freshwater species.

Water quality in urban and rural areas is rapidly deteriorating, as agricultural land use intensifies and urbanisation increases. Between 1987 and 2006, there was a 24% increase in built-up urban areas in and around Auckland[25]. Along with this growth, the density of people living on the land and their dwellings has increased (Fig. 4). Widespread urbanisation has boosted pollution of freshwater bodies and the marine environment, initially through the release of sediment during land clearing and earthworks, and later with heavy metals and toxins such as polyaromatic hydrocarbons (PAHs) from rain and storm water runoff from roads and unpainted galvanised roofs.

Most recently, diffuse pollution from more agricultural intensification in rural areas has become the worst threat to freshwater ecosystems. Between 2003 and 2007, the median levels of total nitrogen were five times higher in pastures than in native forests[26], impacting on runoff into rivers and wetlands. Increased stocking rates release fine soil particles, nutrients and harmful bacteria into streams and rivers[27]. In addition to this, forest clearance and poor management of erosion have also had major impacts on fish biodiversity[28].

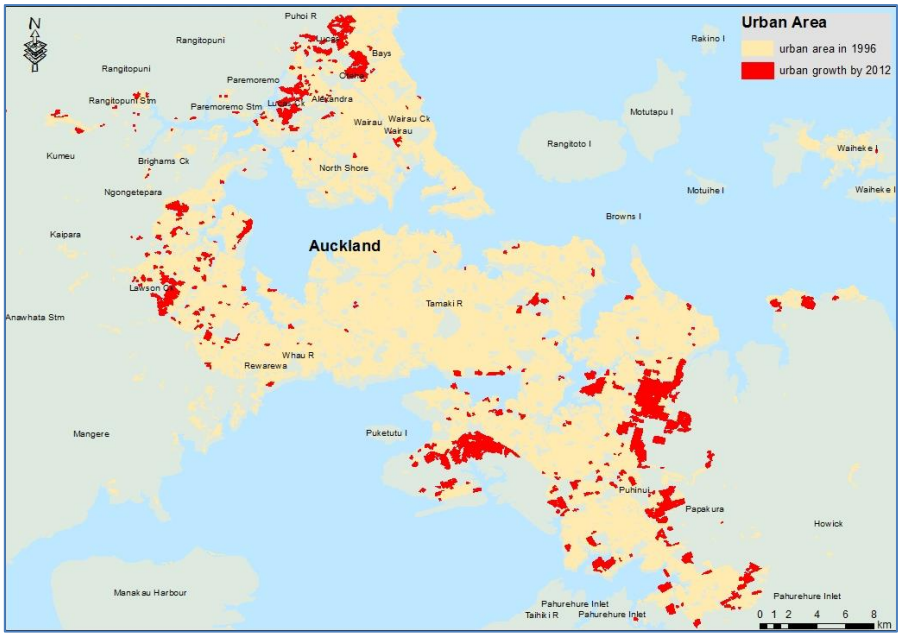

Fig. 4. Urban growth around Auckland, 1996-2012 (extracted from the Land Cover Database of New Zealand 2012).

Human activities also threaten New Zealand's remaining wetlands[29] which continue to be drained for urban or rural development. Governments and communities are also engineering rivers to mitigate floods that reduce habitat diversity, changes water levels, and damages existing vegetation, providing access for invasive species[30]. There is also reclamation of lake and river margins, lagoons and estuaries, and draining of farm swamps. Wetlands are also polluted by excess run-off of sediment and nutrients from farmlands. Stock grazing in wetlands and surrounding catchments damages vegetation, decreases soil stability and contributes to pollution and poor water quality.

The future of freshwater biodiversity

Governments and their committees continue to debate policies for the future management of New Zealand's freshwater ecosystems. Such policies significantly affect the viability of different plants, animals and other organisms that depend on our freshwater systems. The ecosystem services provided by our freshwater ecosystems are also critical to the quality of life of many New Zealanders. There remain major inadequacies in our legislation, including conflicting objectives, affecting sustainable management.

The *Freshwater Fisheries Regulations* (1983) formally protects introduced fish species such as brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*) and chinook salmon (*Oncorhynchus tshawytscha*), but does not protect native fish species; the exception is the New Zealand grayling (*Prototroctes oxyrhynchus*), which became extinct in 1930. There are also significant information gaps regarding population status and ecology of native fish and invertebrate species, resulting in a poor focus for policy and management. For example, Total Allowable Catches (TAC) under the Fisheries Act 1996 allows for quotas to be determined for native species despite insufficient information available to determine Maximum Sustainable Yield (MSY).

The New Zealand Government identified core priorities and objectives to improve freshwater management in the National Policy Statement for Freshwater Management 2014 (NPS-FM 2014)[31]. This established guidelines for water quality, which are insufficient to protect freshwater biodiversity[32]. One measure of freshwater ecosystem health is based on nitrate toxicity levels, currently set too low to avoid chronic ecological effects on native invertebrates and most native fish species.

Such short-term decisions carry long-term political and economic costs. For example, the cumulative costs of attempting to clean-up current freshwater problems on the Waikato River, the Whanganui River and Lakes Taupo and Ellesmere/Te Waihora, have already cost taxpayers hundreds of millions of dollars. Current policies will create future financial costs for generations to come but this need not occur.

The way forward for our freshwater biodiversity

As a signatory to the United Nations Convention on Biological Diversity, New Zealand is committed to protecting biological diversity. There is sufficient scientific knowledge to improve decision making. We provide the scientific rationale to improve conservation policy and management of New Zealand's freshwater ecosystems may prevent the further decline of New Zealand's remaining freshwater biodiversity.

1. Change legislation to adequately protect native and endemic fish species and invertebrates, including those harvested commercially and recreationally.

Under current freshwater reform, little attention has been paid to protecting native species. Increasingly freshwater plants and animals are threatened, requiring changes to their conservation status to higher levels of vulnerability. And yet, none of these freshwater species have statutory protection. At least five threatened native fish are harvested commercially and recreationally, without appropriate data to ensure sustainable management. Only those native fish not used for 'human consumption or scientific purposes' are currently protected. Changes are required to the *Freshwater Fisheries Act* (1983) to formally protect native species.

2. Protect habitat critical to the survival of New Zealand's freshwater species.

Many rare and range-restricted fish and invertebrates live in highly specialised habitats including seeps, wetlands, springs and braided rivers, which are all increasingly threatened by agriculture intensification and introduced species. Without formal protection of these habitats through conservation or reserve status, some species will become increasingly threatened and conceivably driven to extinction. Changes to the climate will also threaten these often isolated and fragmented populations. Some species (e.g. pencil *galaxias*) are in restrictive spring heads where no escape routes remain. For these species, a native fish hatchery and a holding facility, in case of drought, should be established as a safety bank to help manage these populations (as successfully implemented for birds on off-shore islands).

3. Include river habitat to protect ecosystem health in the National Objectives Framework for the National Policy Statement on Freshwater Management.

The National Objectives Framework outlines key attributes to protect and/or restore the ecosystem health of New Zealand's waterbodies. However, there is no attribute to protect species' physical habitat. Water quality and quantity can be maintained to preserve ecosystem health but, if there is no habitat for the animals to live, they will still not be able to survive. We recommend that some measure of habitat quality (e.g. Natural Character Index) be included as an attribute in the National Objectives Framework on its review in 2016. This will ensure that all three key environmental variables for preserving ecosystem health (water quality, quantity and habitat) are protected.

4. Establish monitoring and recovery plans for New Zealand's threatened freshwater invertebrate fauna

The small invertebrates of New Zealand's land and water are often overlooked in conservation activities despite their obvious importance. Although the Department of Conservation have recovery plans for some freshwater fish species we are not aware of any similar plans for the 334 species of threatened, at risk, or data deficient aquatic invertebrates (52% of the known fauna). In fact, there is as yet no coordinated monitoring plan to assess trends and state in biodiversity within the conservation estate. Invertebrates, in particular are largely over looked in conservation activities in New Zealand. We urgently need monitoring and recovery plans for some of our aquatic invertebrates; they are just as important to New Zealand as our fish, plants, and birds providing the food base for many important species.

5. Develop policy and best management practices for freshwater catchments which includes wetlands, estuaries and groundwater ecosystems.

There is currently no policy for wetlands, estuaries and groundwater ecosystems. There is little information on water quality limits for these areas and no clear national priorities for conservation of these hotspots of biodiversity. This is despite their importance and value to communities and the environment. Managing nutrients requires a whole catchment approach, but this is not included in current frameworks. Current nutrient limits for nitrogen and phosphorus in rivers far exceed the levels that would safeguard aquatic ecosystems from the effects of algal blooms. An independent review should be carried out of current freshwater frameworks and their effectiveness in addressing degradation of wetlands, estuaries and groundwater. This can underpin potential solutions that mitigate impacts on the health of the entire aquatic ecosystem.

6. Establish, improve and maintain appropriately wide riparian zones that connect across entire water catchments.

Riparian management can improve both water quality and habitat for aquatic life but success depends on connectivity. Rehabilitation of streams can be effective if riparian planting begins from the headwaters and progresses down through the catchment to produce a long and, continuous buffer. These riparian zones also need to be permanently protected and maintained. At present, the development of riparian zones is ad-hoc and voluntary. There is a need for national guidance to prioritise rehabilitation and ensure the inter-connectedness of planting, fencing and other restoration activities. In particular this should focus on small

headwater streams where the greatest biodiversity often occurs and where sediments and nutrients first enter streams to flow downstream.

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