

NUMBER 59 • DECEMBER 2020

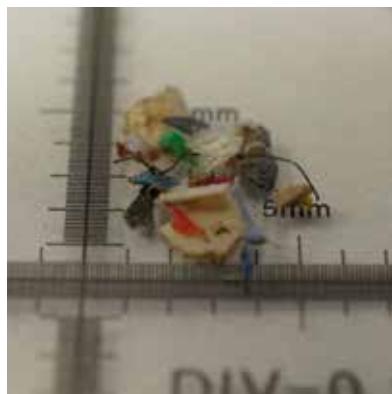
NEW ZEALAND
Freshwater Sciences Society

NEWSLETTER



www.freshwater.science.org.nz

Find us on:
facebook®



MAIN COVER PHOTO:

Te Waihora being opened to the sea.

Photo © Angus McIntosh

COVER LOWER PHOTOS:

LEFT: Checking the whakaweku for globally endangered, white-clawed crayfish.

2nd FROM LEFT: Microplastics found in one water sample from an Invercargill waterway. Photo © Cicy Zhang

2nd FROM RIGHT: Giant kōkopu, Tuna Bay Stream, Tennyson Inlet. Photo © Natasha Petrove

RIGHT: Students collecting *E. coli* samples. Photo © EOS Ecology

New Zealand Freshwater Sciences Society accepts no liability with respect to this publication's content or use. This publication may not be reproduced or copied in any form without the permission of the New Zealand Freshwater Sciences Society and/or Organisation/Individual credited. All photographs within this publication are copyright of the Organisation/Photographer credited, and may not be used without written permission.

© 2020, New Zealand Freshwater Sciences Society

ISSN 1178-6906 (online)



Design & layout EOS Ecology, www.eosecology.co.nz

CONTENTS

INTRODUCTION TO THE SOCIETY	2
EDITORIAL.....	4
PRESIDENT'S PIECE.....	5
INVITED ARTICLES & OPINION PIECES.....	8
Critical Ecosystem Pressures on Freshwater Environments (CRESP) 4-year Research Strategy.....	9
Ngā Mahi a te Rōpū Māori.....	12
Stream Health Assessment to Determine Impacts of Rapid Urban Development in Wanaka.....	16
STUDENT NEWS.....	18
CRITTER OF THE YEAR 2020.....	19
RESEARCH NEWS.....	20
Universities.....	21
Government Organisations & Crown Research Institutes.....	29
Councils & Unitary Authorities.....	38
Research & Consultancy Companies.....	44
Non-Profit Organisations.....	61
RECENT PUBLICATIONS.....	62
AWARDS.....	66
BUDGET FOR THE YEAR ENDED 30 JUNE 2019.....	68
MINUTES OF THE 52 ND ANNUAL GENERAL MEETING OF THE NEW ZEALAND LIMNOLOGICAL SOCIETY INC.....	77
ABOUT THE NEW ZEALAND FRESHWATER SCIENCES SOCIETY.....	88
CONTACTS LIST.....	92

INTRODUCTION TO THE SOCIETY



The New Zealand Limnological Society was formed at a meeting in Christchurch in January 1968. It was renamed the New Zealand Freshwater Sciences Society (NZFSS) in 2005 to reflect the broad interests of the membership. Its fundamental aims since inception have been to promote a common meeting ground for freshwater workers in New Zealand and to encourage and promote the exchange of news and views among them. In particular, a newsletter and a list of research workers and their interests is compiled and circulated at least once a year and an annual conference is held. The 2020 subscription is \$55.00 per annum; or \$15 for students, the unwaged, or retired persons. Committee members for 2020 are:

President

Kate McArthur
kate@kmwater.co.nz

Immediate Past President

Marc Schallenberg
marc.schallenberg@otago.ac.nz

Secretary-Treasurer

Melanie Vermeulen
melanie.joy.vermeulen@gmail.com

Newsletter Editor

Amanda Valois
amanda.valois@niwa.co.nz

Awards Coordinator

Jennifer Price
Jennifer.Price@mfe.govt.nz

Elected Committee Members

Jenny Webster-Brown
jenny@geokem.co.nz
Phil Jellyman
phillip.jellyman@niwa.co.nz

Māori Representatives

Ian Kusabs
ian@kusabs.co.nz
Yvonne Taura
TauraY@landcareresearch.co.nz
Joanne Clapcott
joanne.clapcott@cawthron.org.nz

Student Representatives

Issie Barrett
isabelle.barrett@pg.canterbury.ac.nz

Website Manager

Lisa Carlin
lcar372@aucklanduni.ac.nz

Website Editor

Kati Doehring
kati.doehring@cawthron.org.nz

Advocacy/Submissions Manager

Richard Allibone
waterwayscon@gmail.com

Community Outreach

Sophie Allen
sophie@workingwaters.org

SIL Trust Awards Committee

Elected Committee Members

Natasha Grainger
ngrainger@doc.govt.nz
Mary deWinton
m.dewinton@niwa.co.nz

SIL Trustee

Carolyn Burns
carolyn.burns@otago.ac.nz

Honorary Membership

Mr A.M.R. Burnet
Prof. C.W. Burns
Dr V. Cassie Cooper
Dr M.A. Chapman
Dr G.R. Fish
Dr E.A. Flint
Dr D.J. Forsyth
Dr M. Lewis
Dr R.M. McDowall
Dr D. Scott
Dr B. Sorrell
Dr V.M. Stout
Dr E. White
Emeritus Prof. M.J. Winterbourn

Past Presidents

1968–73 Dr V.M. Stout
1973–75 Dr M.A. Chapman
1975–76 Dr J.M.A. Brown
1976–78 Dr C.W. Burns
1978–80 Dr M.J. Winterbourn
1980–84 Dr B.T. Coffey
1984–88 Ms S.F. Davis
1988–92 Dr J.C. Ward
1992–96 Dr P. Ryan
1997–00 Dr I.K. Boothroyd
2001–02 Dr J.S. Harding
2003–06 Mr N.A. Deans
2006–10 Dr K.J. Collier
2010–14 Prof. D. Hamilton
2015–18 Dr Marc Schallenberg

Previous Secretary-Treasurers

1968–73 Mr A.M.R. Burnet
1973–76 Dr C.W. Burns
1976–78 Ms L.H. Tierney, Ms S.F. Davis
1978–80 Dr B.T. Coffey
1980–82 Dr J.A. Robb
1982–84 Dr D. Forsyth
1984–86 Mr B. Biggs
1986–89 Dr I.W. Lineham
1990–92 Dr D. Rowe
1992–94 Dr J. Jasperse
1994–96 Dr I. Boothroyd
1996–98 Dr K.J. Collier
1999–00 Dr J.S. Harding
2000–12 Dr B. Sorrell
2012–16 Ms J. Wech

Previous Editors

1968–70 Dr M.A. Chapman
1970–72 Dr S.F. Mitchell
1972–75 Dr M.J. Winterbourn
1975–80 Dr T.K. Crosby
1980–82 Dr M.F. Beardsell
1982–85 Dr J.A. Robb
1986–88 Dr J.C. Ward
1988–89 Dr J.D. Stark
1989–02 Ms J. Talbot
2002–04 Dr R. Young
2004–06 Dr M.J. Winterbourn
2007–09 Dr N. Philips
2010–12 Ms H.J. Rainforth
2012–16 Mrs K. Doehring
2017–18 Ms Natasha Petrove ■

EDITORIAL



Kia ora koutou,
We are approaching the end of a very long year. Across the world, scientific field work has come to a halt as field stations have shut down and universities and research institutions have suspended their long-term monitoring programmes. The International Institute for

Sustainable Development Experimental Lakes Area (IISD-ELA) in northwestern Ontario (where I used to work ages ago) has had to quickly adapt to maintain its 50+ year record of data collection. The IISD-ELA has proven to be very adaptable, with budget cuts almost destroying the institution, along with the careers of many Canadian freshwater scientists. So the IISD-ELA quickly shifted its focus to maintaining its long-term sampling with a small field crew. New research had to be shelved. They even created some helpful and humorous infographics explaining social distancing in terms their researchers would understand; how many *Chaoborus* nets do we need to keep between us?

Here in New Zealand, many of us had to put our field work on hold and now are scrambling to catch up. Unlike our colleagues overseas, we are fortunate to be able to go

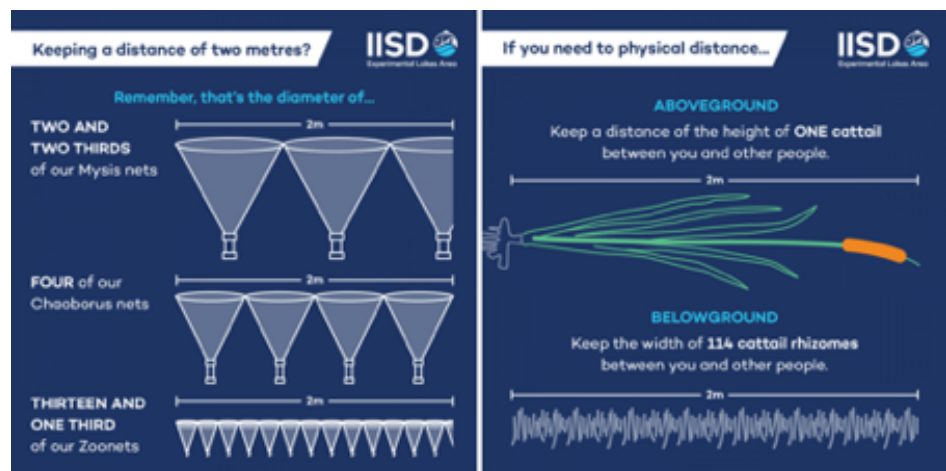
out in the field relatively unencumbered these days. I was in the middle of collecting samples on plastic pollution for my project investigating the role of rivers as transport vectors of plastics to the marine environment. I was able to collect samples just before New Zealand moved to Level 4. When I returned at Level 2, I found (quite obviously) a very huge decrease in the amount of plastics – and litter in general – in the river and along the banks. Many other projects have found similar results, e.g., decreases in carbon dioxide emissions and nitrogen oxide levels. The unexpected implications of COVID-19 on our 2020 field season will be written about in reports and publications for years to come.

Despite all the challenges, this year's newsletter is filled with many interesting projects. I find it really inspiring to read about what everyone is working on and seeing the breadth of collaboration among New Zealand scientists. I am very grateful for Bronwyn Gay and EOS Ecology for their amazing graphical skills and are responsible for the newsletter looking as good as it does. I would like to thank the NZFSS committee for being so welcoming and working so hard help further freshwater science in New Zealand.

Ngā mihi nui

Amanda Valois

NEWSLETTER EDITOR ■



PRESIDENT'S PIECE



Tēnā koutou,

2020 has certainly been an extraordinary year full of change, difficulty, and uncertainty. A year I am finding very difficult to put into words. For many across the world times have been exceptionally hard. Other than a brief lockdown-induced respite to global emissions, we have seen climate change continue to affect our natural environment and the political discourse. Social and racial injustice and inequality have been front of mind, and a global pandemic continues to rage outside our borders. Governments have changed and science-based decision-making has been thoroughly tested.

Although we have more opportunity to connect in person lately, and I certainly hope that will last, many are exhausted by the demands of remote connection, learning and work. I wish you all time to rest and recuperate over the summer break. The coming years look increasingly busy for those of us working in the freshwater science space.

For me and my whānau we have had to hold on to kernels of hope that there will be positive change that comes from this chaos. We have held tight to each other, and to our networks of friends and colleagues to keep going, and to find new ways of being and doing. I hope you have all been able to do the same.

EXEC NEWS

The Exec Team have been busy developing an annual operating budget so we can continue our discussion with members on the spending of the Society's surplus funds – who knew spending our cash could be so difficult! Last year's conference also made a profit on top of our existing surplus, and we look forward to making some firm spending decisions early next year and getting funded projects underway. The exec decisions on annual spending included dedicated funding to ensure meaningful indigenous leadership and support for Te Wai Māori rōpū at future conferences, increased funding for student travel, and two post-graduate freshwater scholarships, one Māori and one open to all applicants.

NZFSS AWARDS

The Awards Committee are delighted to award the 2020 NZFSS medal to Kevin Collier for his outstanding contribution to freshwater science and management. Kevin's contribution to our knowledge of the freshwater ecosystems of Aotearoa New Zealand is exceptional and he has been an exemplary scientist, prolific writer, mentor, supervisor, colleague, and friend to many of us over the years. Congratulations Kevin, very well-deserved!

The Executive Committee are extremely pleased to nominate and acknowledge the mahi of Jon Harding for an Honorary NZFSS membership for his lifetime contribution and commitment to freshwater science and the Society. Jon has signalled his intent to retire from Canterbury University, where he will be greatly missed by students and colleagues alike. We thank you for your years of dedication to freshwater science, scientists and the Society Jon and wish you well. .

CONFERENCES

With the disruption to meetings this year we regrettably postponed our joint INTECOL meeting planned for Christchurch until October 2021 and have cancelled our joint conference with AFSS and SFS planned for Brisbane in 2021. We are working to reschedule this international joint meeting for 2023. Given the huge changes and disruptions, we were very pleased when the NZ Hydrological Society and Rivers Group invited us to join their meeting in Invercargill. I look forward to seeing as many of you there in person as can make it. Our gratitude to Jane Kitson and Brett Cockeram for stepping in and committing your time and efforts as our representatives on the organising committee.

CLOSING MESSAGE

On behalf of the Executive Committee and the Society I would like to express our gratitude to executive members leaving at the end of this term: Phil Jellyman, for his years of contribution to the Executive Team and Amanda Valois for two years of excellent newsletter editorship. Melanie Vermeulen and Jen Price volunteered as co-opted Secretary and Awards Coordinator respectively and we have really appreciated their assistance on the executive team this year – many thanks to you both.

I would like to particularly acknowledge the continued mahi of Te Wai Māori rōpū who sustain the Society's network of experts and practitioners in indigenous science and mātauranga and provide critical support on the executive team. Te Wai Māori is an integral part of our Society as a result of the continued effort of its members and leadership from Ian Kusabs and Joanne Clapcott, supported by Yvonne Taura.

It has been a real privilege for me to serve the Society as President over the last two years and to work with many of you on a range of issues and initiatives. Our Society runs on the energy and commitment of its members and also on our continued connection to one another. I am very excited to see many of you soon in 'real life' and to see all that you have accomplished over the last year in the face of many challenges.

Ngā mihi nui kia koutou,

Kate McArthur
PRESIDENT
NEW ZEALAND FRESHWATER SCIENCES SOCIETY ■



Kate & Aiden. Photo © Kate McArthur



Nesameletus
.....
Photo © Angus McIntosh

Clutha River in April

Photo © Angus McIntosh

INVITED ARTICLES & OPINION PIECES



Critical Ecosystem Pressures on Freshwater Environments (CRESP) 4-year Research Strategy

Nixie Boddy & Hugh Robertson



The Department of Conservation (DOC) has a core responsibility to protect and enhance New Zealand's indigenous freshwater ecosystems and species. This includes advocating for the conservation of freshwater values by influencing national and regional policy and natural resource plans and consents, including through collaborative catchment management.

A key objective of freshwater advocacy, and freshwater conservation in general, is to reduce pressures on indigenous biodiversity. The Critical Ecosystem Pressures on Freshwater Environments (CRESP) research programme addresses four pressures on New Zealand's freshwater ecosystems: water levels and flows, critical habitat loss, sediment and nutrients, and fish passage.

We currently have incomplete knowledge of how these pressures are affecting New Zealand's freshwater ecosystems and their associated biodiversity and cultural values, limiting our ability to effectively advocate for and manage freshwater systems. Through Biodiversity 2018 funding, DOC has committed to addressing this problem and increasing its advocacy for freshwater ecosystems and species.

STRATEGY PURPOSE

This research strategy has been developed to provide strategic direction and inform annual investment priorities for research under DOC's CRESP programme for the next 4 years (2020–2023).

It aims to:

- support DOC's advocacy and management of freshwater ecosystems and species,
- uphold DOC's section 4 obligations under the Conservation Act 1987 by undertaking freshwater research in partnership with our Treaty partners,
- link to other relevant strategies to build a holistic approach,
- identify critical science needs and apply a prioritisation framework to strategically invest in research,
- promote opportunities for collaboration, and
- outline conservation outcomes that will be influenced by this programme.

RESEARCH PROGRAMME SCOPE

The CRESP research programme addresses the following four key abiotic pressures and their effects on freshwater ecosystems (specifically freshwater fish and invertebrates) across New Zealand, including rivers, lakes and wetlands.

Water levels/flows – This includes any hydrological alteration to freshwater ecosystems, such as changes in seasonal variation in the patterns of flow and water levels in rivers, lakes and wetlands. The primary pressures associated with water levels/flows include water abstraction, diversion, augmentation and drainage.

Habitat loss – This includes the total loss of habitat, habitat deterioration and habitat modification in rivers, lakes and wetlands through activities such as piping and draining streams, removing aquatic plants, and channelisation.

Sediment and nutrients – This includes the effects of deposited and suspended sediment on freshwater ecosystems and species, and the direct and indirect effects of nutrient enrichment, focussing specifically on nitrogen and phosphorus.

Fish passage – This includes the effects of instream structures that alter freshwater habitats or block fish movements upstream and/or downstream. It encompasses the removal and modification of barriers, as well as the installation of barriers to protect native species.

It is recognised that the abiotic and biotic pressures that affect freshwater ecosystems often interact and/or have cumulative effects, and that scientific knowledge on how these pressures interact is limited. Whilst not a primary focus of this programme, multiple stressors and associated pressures, such as climate change and introduced species, will also be considered.

RESEARCH PROGRAMME OBJECTIVES

The CRESP research programme has three key objectives.

1. To deliver research that produces new evidence and data on the ecological responses of freshwater systems to changes in critical ecosystem pressures (water levels/flows, habitat loss, sediment/nutrients and fish passage).
2. To contribute knowledge to improving freshwater advocacy and management in New Zealand.
3. To work in partnership with Treaty partners and regional, national and international organisations.

SUPPORTING CONSERVATION OUTCOMES

The CRESP research programme is being led by DOC's Aquatic Unit. It aims to provide knowledge that will strengthen DOC's advocacy and management of indigenous freshwater ecosystems and species.

Addressing the four critical pressures outlined above is fundamental for achieving DOC's freshwater stretch goal and natural heritage (intermediate) outcomes.

CRITICAL SCIENCE NEEDS

Knowledge gaps for each pressure (water levels/flows, habitat loss, sediment/nutrients and fish passage) have been assessed based on current understanding of their ecological impacts, their significance to the conservation of freshwater ecosystems and species, and DOC's ability to advocate for or manage them effectively.

We applied a prioritisation framework to rank the knowledge gaps and thus determine the primary research areas for each pressure. Prioritisation was based on four key criteria.

1. The spatial scale of the research impact on freshwater systems (local, regional or national).
2. The magnitude of the research impact on DOC advocacy and management of freshwater systems (low, medium or high).
3. The collaboration opportunity (yes or no).
4. The time pressure – timing of collaboration or urgency of the knowledge requirement (not urgent or urgent).

Input obtained from across DOC, Treaty partners, universities, regional councils, Crown Research Institutes (CRIs) and other research agencies was collated to identify which knowledge gaps were perceived as being most critical. Treaty partners and the DOC RMA team were asked to independently prioritise potential projects for funding, and this feedback used in addition to the prioritisation framework outlined above to rank potential projects for funding.

PRIORITY RESEARCH AREAS

The four research areas outlined in the tables following have been identified as priorities for DOC investment over the next 4 years. External collaboration on these research areas is welcomed and encouraged.

Many of these priority research areas will have multiple research questions or lines of enquiry associated with them

COLLABORATION OPPORTUNITIES

Gaining an improved understanding of the vulnerability of New Zealand's freshwater ecosystems and species to changing water levels/flows, deteriorating water quality, habitat loss and fish barriers presents a complex science challenge that can only be effectively addressed through research collaboration.

Through the CRESP research programme, DOC is keen to work in partnership with Treaty partners and regional, national and international organisations to collectively build evidence that supports ecologically sustainable approaches to managing the effects of land and water use on freshwater biodiversity. Collaborative research will particularly be sought with iwi and hapū, councils, CRIs, universities, and other research agencies. This includes partnerships with Ministry of Business, Innovation and Employment (MBIE)-funded freshwater research programmes and National Science Challenges. Opportunities for supporting post-graduate and post-doctoral study will also be targeted.

If you have project ideas that align with our priorities for collaboration or funding or you would like more information, contact Nixie Boddy at nboddy@doc.govt.nz. ■

Water levels/flows

Project title	Description	Outcome
Flow preferences of native fishes	Describe the habitat flow requirements of native fish species in rivers and wetlands.	Flow habitat curves are developed and nationally applied to protect native species.
Wetland setback distances	Define the minimum setback distances required to avoid drainage impacts on wetland hydrological regimes.	Best practice for wetland setbacks is adopted nationally.
Ecological impacts of reduced flow	Quantify the effects of reduced flow on aquatic ecosystem processes, progressing from the current species-centric approach.	An ecosystem-level metric that describes the impacts of reduced flow is developed for use in limit setting.

Critical habitat loss

Project title	Description	Outcome
At risk small- order streams	Evaluate the ecological importance of small-order headwater streams and their vulnerability to habitat disturbance.	Knowledge is gained to improve advocacy and legal protection for the conservation of headwater streams.
Spawning requirements of native fishes	Understand habitat and flow requirements/mechanisms of native fishes for spawning.	Key spawning habitats are identified and protected.
At risk small wetlands	Describe the ecological value of small, unmapped wetlands and their vulnerability to habitat disturbance.	Knowledge is gained to improve advocacy and legal protection for the conservation of small wetlands.

Sediment/nutrients

Project title	Description	Outcome
Physiological tolerances of native species	Define the physiological tolerances of native species to changing levels of nutrients and sediment (deposited and suspended), for use as evidence for thresholds of ecosystem health.	Physiological tolerances of native species are used to set regional and national limits on water quality.
Ecosystem resilience	Investigate ecosystem resilience to changes in sediment, nutrients, dissolved oxygen and temperature, particularly in response to climate change.	Knowledge of ecosystem resilience is used to improve advocacy and management of threatened ecosystems.
Riparian setback distances	Determine the minimum riparian setback distances required to avoid nutrient and sediment impacts on lakes, wetlands and rivers.	Knowledge of minimum riparian setback distances is applied nationally to protect freshwater ecosystems.

Fish passage

Project title	Description	Outcome
Effectiveness of fish passage remediation	Test the effectiveness of different methods of facilitating fish passage for different species and size classes.	Best practice methods are applied to enhance native fish passage.
Fish screens	Determine the attributes and installation requirements of fish screens on water takes to avoid impacts on native fishes.	Best practice methods are applied to enhance native fish passage.
Stream flow for migrations	Define stream flow requirements for the effective upstream and downstream migration of native fish species.	Migration flow requirements are applied nationally to protect native fish passage.

Ngā Mahi a te Rōpū Māori

By Ian Kusabs, Joanne Clapcott & Yvonne Taura

Mō wai, mōu māori mā – Water for all

Tēnā koutou katoa,

Kei te rere tonu ngā mihi ki a tātou Ngāi Māori, otirā te rōpū kairangahau Māori, me ngā taura, huri noa o te motu, e whakapeto nei i ō tātou ngoi ki te whaitakenga o ēnei o ā tātou mahi whakahirahira. Kua mauria mai e tēnei tau he momo tumatumatanga ki te nuinga o mātou i ēnei wa ngākaua, e arotahi ana mātou ki o mātou whānau, ki ngā hāpori a ka mahi tonu tātou i ngā mahi rangatira ki te wai māori.

We continue to acknowledge you, as Māori, in particular as Māori scientists, researchers and students throughout New Zealand, with all our efforts in and for this important work. This year has brought a variety of challenges to most of us, in these unprecedented times, we focus on our whānau and local communities, while continuing our important work in freshwater.

He ai ki ngā kōrero o mua:

***Whāia te iti kahurangi, ki te tuohu koe,
me he maunga teitei***

**Seek the treasure you value most dearly, if you bow your
head, let it be to a lofty mountain**

NZFSS EXECUTIVE COMMITTEE SUPPORT FOR TE WAI MĀORI

The NZFSS Executive Committee continue to recognise and value the contribution that Te Wai Māori – NZFSS Rōpū Māori make to the overall Society aim to ‘*establish effective liaison between all persons interested in any aspect of fresh and brackish water research in New Zealand*’. In particular, the Executive appreciate rōpū input into shaping annual conferences, engaging with mana whenua and facilitating kaitiaki attendance. The rōpū representatives have liaised with the Executive about the best ways to support the rōpū in this capacity.

- The annual update of the Rōpū Māori Terms of Reference (ToR) that clearly defines the purpose and structures of the rōpū. Our tikanga approaches are guided and supported by our kaiarahi representatives Associate Professors Hēmi Whaanga and Tom Roa from the University of Waikato. *The vision of the NZFSS Rōpū Māori is the successful participation of Māori in freshwater sciences, management and research where Māori principles, values and interests are identified and valued within the New Zealand Freshwater Sciences Society (NZFSS)*. The full ToR can be viewed here: <https://freshwater.science.org.nz/te-wai-maori-nzfss-ropu-maori>

- A member of the rōpū will be invited to be part of the organising committee for all future conferences
- Conference organising committees will be responsible for ensuring sufficient sponsorship is acquired to support local kaitiaki and kaiarahi attendance at conferences.
- In the event of a sponsorship shortfall, up to \$5,000 of Society contingency funding will be made available to facilitate mana whenua participation and support appropriate conference tikanga.
- In years when NZFSS conferences are held overseas, up to \$5,000 of Society contingency funding will be made available to enable rōpū members to meet and network at a central site (note: the hui is not a replacement for the overseas conference).
- Rōpū representatives will be responsible for requesting and allocating contingency funds.
- Free first-year NZFSS membership for taura Māori.
- Being invited to contribute to the Society website, check out our activity here: <https://freshwater.science.org.nz/te-wai-maori-nzfss-ropu-maori>
- Produced regular newsletters and sent numerous emails to rōpū members.
- Increased our social media profile via Twitter @NZFSS Rōpū Māori (700+ followers).
- Increasing our membership annually, currently at 59 members.

HE MANAWA-Ā-WHENUA POSTGRADUATE SCHOLARSHIP

The Executive have agreed to establish a new \$7,500 scholarship to be awarded to a Māori postgraduate student studying a Bachelor Honours degree (or equivalent) or Master's degree with a focus on freshwater ecosystems. The inaugural scholarship was open to applicants in 2020.

***Ko te wai a Rona he manawa-ā-whenua;
e kore e mimiti e***

**The waters of Rona are from an underground spring
which will never run dry**

NZHS/NZRG/NZFSS JOINT CONFERENCE, INVERCARGILL, NEW ZEALAND

This year the NZFSS is joining forces with the NZ Hydrological Society and the NZ Rivers Group to deliver a conference focused on our freshwater environments. Te Wai Māori rōpū members Jane Kitson and Brett Cockeram have been supporting the organising committee. The conference will be opened by Ngāi Tahu ki Murihiku and includes a mātauranga Māori session and a workshop on the application of Te Mana o Te Wai in Murihiku. The conference programme is full and varied with concurrent sessions that offer topics on riparian management, indigenous fishes, lake management, groundwater and surface water interactions, wetlands, estuaries, climate change and much more. In addition, there is a field trip option into the Oreti catchment exploring the cultural landscape, the history and values, and people that are shaped by the awa. The organising committee has made available complementary registrations to mana whenua of Murihiku (12 registrations) and kaitiaki working in freshwater, engineering or river management (an extra 6 registrations).

RECOGNISING EXCELLENCE

NZ BIOSECURITY AWARDS 2019 – Te Arawa Catfish Killas

The NZ Biosecurity awards celebrate people across NZ who are contributing to biosecurity. Te Arawa Lakes Trust (TALT), Rotorua, were awarded top honours for their initiative 'Catfish Killas', winning both the NZ Biosecurity Supreme Award and the NZ Biosecurity DOC Community Pihinga Award. The Catfish Killas project, a response to an incursion of catfish in Lake Rotoiti, is a collaboration led by TALT and Bay of Plenty Regional Council and supported by volunteers from the local community.

KUDOS AWARDS 2020

The Kudos Science Trust seeks to inspire communities by recognising the value of science and how it impacts and empowers lives. This year, a new category, University of Waikato Vision Mātauranga Science Award, recognises those whose research unlocks the science and innovation potential through mātauranga Māori, resources, and people to benefit all New Zealanders. The finalists include a few of our rōpū members:

Manaaki Taiao ki Kirikiririroa (Māori research team of MWLR) – Yvonne Taura, Mahuru Wilcox, and Lara Taylor

Dr Ian Kusabs (Kusabs & Assoc Ltd)

Assoc. Prof. Kura Paul-Burke (UoW) and Dr Nina Scott (Waikato DHB) are also included in the finalist list.

Congratulations to Dr Ian Kusabs, 2020 Kudos award winner.

Kei te nui tā mātou mihi maioha,
nā Ian Kusabs, Joanne Clapcott, mātou ko Yvonne Taura
MĀORI REPRESENTATIVES

NEW ZEALAND FRESHWATER SCIENCES SOCIETY

Get in touch with us! Any Māori freshwater scientists, researchers or students who would like to join the NZFSS Rōpū Māori, please email māori.fwss@gmail.com.



Catfish Killas representatives with Hon. Shane Jones at the NZ Biosecurity Awards 2019. Photo supplied by William Anaru

CURRENT PROJECTS

Te Reo o Te Repo

Wetlands play a significant role in water-quality improvement, flood abatement, erosion prevention, and carbon management, and support a diverse range of ecosystems and species. Wetlands are highly valued by Māori for their historical, cultural, economic, and spiritual significance and were important sources of kai, rongoā Māori, and building materials. Since 1840, however, over 90% of wetlands throughout Aotearoa have been lost, together with the ecosystem services they provide

The current trend of water quality degradation across Aotearoa is a major issue that has resulted in the development of new freshwater legislation. A focus of this legislation is the new National Policy Statement for Freshwater Management 2020 (NPS-FM 2020) that recognizes the importance of all freshwater ecosystems, and has specific requirements to avoid any further loss or degradation of wetlands, map existing wetlands, and encourage wetland restoration activities.

User-friendly and practical resources are required to improve public understanding and appreciation of wetlands, recognize their values, and support efforts for their protection and restoration. This year, kairangahau Yvonne Taura (Manaaki Whenua – Landcare Research), has led the development of two key resources that promote cultural wetland values and approaches to wetland restoration.

Te Reo o Te Repo Volume II

This handbook is currently under development and continues the inspired work of *Te Reo o Te Repo: The Voice of the Wetland* (Taura Y, van Schravendijk-Goodman C, Clarkson B 2017) that promoted the enhancement and protection of cultural wetland values. The second volume promises to deliver various case studies and approaches, robust scientific research, and stunning imagery from all around the country. The handbook contains personal journeys of iwi and hapū, the successes and challenges of undertaking iwi-led restoration projects, and the

reconnection of mana whenua with wetlands in their rohe. This publication is funded by SSIF Resilient Wetlands Project (MWLR) and will be available for download early 2021.

In the meantime, check Te Repo o Te Repo www.landcareresearch.co.nz/publications/te-reo-o-te-repo and www.sciencelearn.org.nz/topics/te-repo

Tuihonoa Te Reo o Te Repo

Manaaki Whenua – Landcare Research and the Science Learning Hub have partnered to create Tuihonoa Te Reo o Te Repo, digital educational wetland resources drawn extensively from Māori-led wetland research published in *Te Reo o Te Repo: The Voice of the Wetland*. The team worked closely with a selection of kura kaupapa Māori (Māori medium schools) located nearby wetlands, throughout the country. This ensured that the resources developed aligned to the needs of kaiako, taurira, and wider whānau, hoping to inspire kura to become kaitiaki of their own wetlands and to encourage the pursuit of science pathways. These resources include up to 30 articles and activities (based on chapters from *Te Reo o Te Repo*), associated teacher learning guides, and multiple video interviews with a selection of wetland experts and kaitiaki. The project has been funded by MBIE Unlocking Curious Minds 2020, supported by SSIF Resilient Wetlands Project (MWLR) and the University of Waikato. *Tuihonoa Te Reo o Te Repo* is published on the Science Learning Hub website www.sciencelearn.org.nz and will be accessible to all kura and schools.

Ngāti Tūwharetoa RMA Section 33

This year, Ngāti Tūwharetoa became the first iwi to be granted the responsibility of monitoring water quality around Taupō-nui-a-Tia (Lake Taupō), under Section 33 of the RMA. Section 33 enables a local authority (in this case, Waikato Regional Council – WRC) to transfer any one or more of its functions, powers or duties under the act to another public authority – in this case Tūwharetoa Māori Trust Board. WRC supported the Section 33 transfer, and public submissions demonstrated 60% in support of the proposal. This unique relationship means that the Trust Board holds legal title as trustee and acts as kaitiaki over the waters, on behalf of Ngāti Tūwharetoa. Under the transfer, the responsibilities of the Tūwharetoa Māori Trust Board include testing popular swimming beaches in the summer, monthly testing of rivers flowing into the lake, and biannual groundwater monitoring at two local schools. WRC continues to fund costs associated with the water quality functions and administer training for the processes involved in testing.

The use of mātauranga Māori in the UK –

Inspired by Dr Ian Kusabs's use of tau kōura (traditional fishing method) as a monitoring technique, we decided to give it a go on the other side of the world!

The white-clawed crayfish *Austropotamobius pallipes* is a globally endangered species that has become extinct in many parts of England and Wales. In recent years, conservationists have been setting up Ark sites at isolated headwater streams and lakes well away from invading non-indigenous crayfish. In Staffordshire, in the English Midlands, we have 20 Arks and are keen to establish

more. The key to this approach is the donor sites. We need to be able to collect large numbers quickly and efficiently, while at the same time keeping stress to the animals and impacts on the habitat to a minimum. To this end, we have experimented with crayfish reefs (constructed from perforated bricks, brushwood bundles, and pre-drilled saturated wood) that can be disassembled each year to aid collection. This year we trialled tau kōura for the first time using whakaweku (bracken fern bundle) made from bracken *Pteridium aquilinum*. We have been delighted with the results. In one whakaweku we collected 23 white-claws: 11 females & 7 males (Carapace Length from 13.9 to 32.3 mm) & 5 juveniles (CL: <10 mm). This will really help with collection for future Arks.

Contact Nick Mott, Freshwater Ecologist, Staffordshire Wildlife Trust, UK on Twitter @NickMott7, on email at n.mott@staffs-wildlife.org.uk. See tau kōura video: <https://twitter.com/NickMott7/status/1313437794853945345>

RECENT PUBLICATIONS

The relative effects of willow invasion, willow control and hydrology on wetland zooplankton assemblages, Yvonne Taura and Ian Duggan

Recently published in the international *Wetlands Journal*, this research aimed to quantitatively examine zooplankton composition among grey willow (*Salix cinerea*) stands within the South Taupō Wetland, Aotearoa, to determine whether these assemblages were affected by willow growth and willow control treatment using the herbicide metsulfuron ($C_{14}H_{15}N_5O_6S$). An examination of whether wetland hydrology had an over-riding influence. Results demonstrated that zooplankton communities were not affected by the presence of willow, dead or alive, or by ground control treatment using metsulfuron. Rather, zooplankton communities seemed to be regulated by wetland hydrology than by willow presence.

Ngā Puna Aroha: Towards an indigenous-centred freshwater allocation framework for Aotearoa New Zealand, Lara Taylor et al. 2020

Recently published in the *Australasian Journal of Water Resources*, this article argues that policy and implementation need to be created to ensure indigenous Māori engagement and outcomes in freshwater governance, planning, and management. An outline of a potential water allocation framework, *Ngā Puna Aroha*, seeks to provide direction, confidence, and certainty to the implementers of national water policy. This type of bicultural proposal could inform freshwater and wider natural 'resource' management policymaking, regulatory frameworks, and implementation nationally and internationally. ■



Photo © Yvonne Taura

Taupō-nui-a-Tia, taken from the lake front.



Photos © Nick Mott, Staffordshire Wildlife Trust



ABOVE: Ko ngā tohu taiao – Cultural indicators page of Tuihonoa Te Reo o Te Repo, Science Learning Hub website.

Credit Science Learning Hub

RIGHT: Te Reo o Te Repo

handbook. Photo supplied by MWLR



Photo © Ian Kusabs

Wānanga at Waikohatu Marae, Rotorua, 8 July 2018.

TOP: Whakaweku made from bracken bundles trialled in a donor site. Shropshire Brook, Staffordshire

MIDDLE: Checking the whakaweku for globally endangered, white-clawed crayfish.

BOTTOM: Checking the whakaweku for globally endangered, white-clawed crayfish.

Stream Health Assessment to Determine Impacts of Rapid Urban Development in Wanaka



By Melanie Vermeulen

Urban streams are subject to ecological degradation such as increased sedimentation, elevated concentrations of contaminants, and changes in species composition to pollution tolerant species (e.g., snails and midges) as a result of changes in land use within the catchment (e.g., removal of vegetation, stream channel modification, infrastructure). The Upper Clutha area is experiencing rapid changes in land use through urban and rural development and growth in population and tourism and the community has become concerned about the impacts of these changes on stream and lake water quality.

Last year's NZFSS newsletter featured work for an investigation undertaken by ecologist Melanie Vermeulen for Wildland Consultants Ltd in late 2019 to understand the effects of land use on urban water and sediment quality and consequently their effects on in-stream biota (freshwater invertebrates and fish) and this year's newsletter provides the results. This project was funded by the Upper Clutha Lakes Trust (now Wai Wanaka) and the Otago Fish and Game Council.

The project involved baseline sampling of three urban streams in relation to stormwater discharge points: Bullock Creek, Stoney Creek and the Water Race Drain. Bullock Creek is a spring-fed stream that runs through the heart of Wanaka from Stone Street to the shore of Lake Wanaka. Bullock Creek is highly valued by the community for its strong aesthetic and recreational values. Stoney Creek and the Water Race Drain have intermittent flow from mountain and/or spring sources, lie in the western side of the town, flow into Lake Wanaka and are highly modified.

Stormwater catchments for each stream were mapped in GIS and land use was characterised. Stream sampling included physicochemical water quality parameters (e.g., dissolved oxygen concentration), laboratory analysis of deposited sediment for contaminants – heavy metals (e.g., lead), polycyclic aromatic hydrocarbons (sources include wear of roading material, exhaust emissions), *Escherichia coli* and Ammonium-N (NH₃ and NH₄⁺) (sources include wastewater discharge), deposited sediment quantity using the Quorer technique, a habitat survey, a benthic macroinvertebrate survey using a kick-net and fish survey using an electric fishing machine. The results were then compared against water and sediment quality guidelines to assess the potential ecological effects of contaminants in stream bed sediments and models were used to test for relationships.

The results showed that Wanaka's urban streams are experiencing some ecological degradation with elevated dissolved oxygen (an indicator of excess plant/algae) and

arsenic concentrations (likely natural from bedrock material), increased quantity of deposited sediment (possibly from subdivision development) and low scores for habitat quality (e.g., lack of riparian vegetation), benthic macroinvertebrate taxonomic richness and Macroinvertebrate Community Index scores (water quality indicator) at some sites. Overall, Bullock Creek is in better ecological condition than Stoney Creek and the Water Race Drain.

The models found a positive statistically significant relationship between macroinvertebrate community metrics and habitat quality which demonstrates that an improvement in habitat would most likely result in an improvement in water quality and biodiversity. The models also found a negative statistically significant relationship between heavy metals and macroinvertebrate community metrics. A range of recommendations have been made for stormwater management and improvement of stream health.

In addition, the presence of kōaro (At Risk-Declining) in Bullock Creek during spawning season suggests that the stream is important habitat for this threatened species.

Melanie presented the results from the project at the Wai Wanaka community stakeholder meeting in September. The full report is available from www.waiwanaka.nz/actions/research. ■

TOP: One of two Kōaro (*Galaxias brevipinnis*) caught by Paul van Klink (Otago Fish & Game Council) at the downstream fish survey reach of Bullock Creek between Ardmore and Dunmore Streets. Kōaro have an At Risk-Declining threat classification status. Photo © Department of Conservation

MIDDLE: Freshwater ecologist Melanie Vermeulen sampling freshwater macroinvertebrates using the kick-net method in Bullock Creek, Wanaka.

BOTTOM: Bullock Creek site 7 near the corner of Dungarvon and Tenby Streets (stormwater outfall pipe pictured in centre) had the highest habitat quality score of 20 sites across Bullock Creek, Stoney Creek and the Water Race Drain.



STUDENT NEWS



Issie Barrett

Kia ora NZFSS students,

It's been a strange year, to say the least. I know many of you have had fieldwork, lab work, and writing interrupted, and I am so impressed by the phenotypic plasticity you've all shown.

While it is disappointing that INTECOL had to be postponed to 2021, I am so happy that a conference looks able to go ahead this year, joint with the NZ Hydrological Society and the NZ Rivers Group. There are some great social events planned throughout the week, which will be a great chance to meet and network with scientists, practitioners and other students.

I look forward to seeing some of you there!

For those of you on the fence about coming to Invercargill this year, the V. H. Jolly Conference Travel Awards are open for applications, offering up to \$250 per person. More information can be found on the NZFSS website.

The NZFSS annual general meeting will also be held at this year's conference, and will be remotely accessible for those unable to attend in person. NZFSS is dedicated to supporting students, so your presence at the meeting is extremely valuable. I hugely encourage you to attend if you can. We will also be looking for a new student representative, so if you're interested in being a part of the NZFSS committee, we would love to hear from you!

For those of you who won't be making it to this year's conference, I hope you have a great year ahead: may the skies be blue for fieldwork, coding errors disappear, and the thesis writing flow.

Noho ora mai,

Issie Barrett
STUDENT REPRESENTATIVE
NZFSS COMMITTEE ■

CRITTER OF THE YEAR 2020

By Karen Shearer

My avid readers, this year I have bowed to a request from the floor to focus on a critter that has been categorised by a colleague under the highly technical scientific term of 'Superious coolii!'. In your mind's eye, imagine peering into a freshwater stream that is sparkling a luminous green like the night sky (except for the green bit). Now stop daydreaming and read on about a wondrous yet small and innocuous-looking mollusc belonging to the genus *Latia*.

Latia are a small (maximum size 11 mm), limpet-like pulmonate. However, unlike most other freshwater pulmonates *Latia* is not a true air-breather, instead relying on a water-filled pulmonary sac to breathe. They generally prefer good water quality and their streamlined shell and strong muscular foot make them well suited to living in flowing stony bottomed streams. *Latia* are endemic to the warmer climes of the North Island of New Zealand (sorry Southerners!). *Latia neritoides* (Gray 1850) is the only known living species of this genus, with their nearest relatives, *Chilina* snails, all found in the southern half of South America. In a website of baby names (my go to for etymological queries), I found out that the name *Latia* is an alternate form of the girl's name Letitia (Latin), meaning 'joy'.

And now for the part you've been hanging off the edge of your seat for - the super cool thing about *Latia* is...drum roll... it's the ONLY glow-in-the-dark (bioluminescent) freshwater mollusc in the world! When frightened or annoyed, *Latia* release a little blob of glowing, sticky mucus that oozes out from under their limpet-like shell. Like all the greatest superheroes, angry *Latia* glow a good, honest 'radioactive' green, but you do need a dark night and well-adjusted eyes to see their expression of green outrage. For the chemically inclined, the light is produced by the luciferin-luciferase reaction, which is brought about when a luminescent substrate luciferin is catalysed by an enzyme luciferase. A paper that I read recently about *Latia* had the sentence 'To a human, the luminescent mucus is tasteless'. Riiiiight - glad I wasn't part of that culinary experience!

The jury is still out as to why these guys bioluminesce, although popular ideas have included:

- to attract and capture prey (think glow worms)...not really an option for *Latia* that are grazers, scraping organic matter including diatom algae from stone surfaces.
- to attract a mate (think fireflies!) - for the hermaphroditic *Latia* living near each other...an unlikely reason.
- *Latia* enjoying a bit of a party and no serious mollusc party is complete without some bright lights (my own personal theory, obviously, but I believe it has merit).
- a defence mechanism to deter predators. Aha! Arguably the most plausible reason to hang your hat on for *Latia*'s display. The main theories are that the sudden appearance of green light may startle predators causing confusion and alarm, while another theory is that predators may be distracted by the slime detaching from *Latia* in the water current and chase it, or attack the slime rather than the animal.

Well readers, I hope you've enjoyed this small insight into our truly unique, amazing and obviously very 'super cool' mollusc of the freshwater world. Surely worth a night-time expedition in the North to watch the next performance of 'Stars in our Streams' (and remember to look behind you next time you walk through a stream at night!). ■



Latia during a peaceful, reflective moment.

Photo © Stephen Moore



An angry *Latia*'s 'incredible hulk' impression.

Photo © Shaun Lee

References:

<https://www.landcareresearch.co.nz/tools-and-resources/identification/freshwater-invertebrates-guide/identification-guide-what-freshwater-invertebrate-is-this/no-jointed-legs/molluscs/limpets/luminescent-limpet-latia>

<http://www.mollusca.co.nz/speciesdetail.php?taxa=3948#prettyPhoto>

<https://en.wikipedia.org/wiki/Latia>

http://nwp.rsnz.org/content/projects_latia.htm

<https://www.facebook.com/nznativefish/posts/these-cute-little-snails-are-the-worlds-only-glow-in-the-dark-freshwater-animal-/2476060072417640>

Meyer-Rochow VB, Moore S1988. Biology of *Latia neritoides* Gray 1850 (Gastropoda, Pulmonata, Basommatophora): the only light-producing freshwater snail in the world. *Internationale Revue der gesamten Hydrobiologie* 79(1):21-42.

Winterbourn MJ 1973. A Guide to the Freshwater Mollusca of New Zealand. *Tuatara* 20(3):141-158.

Alex Barclay from UC picking pond
invertebrates in Two Thumb range

Photo © Angus McIntosh

RESEARCH NEWS



UNIVERSITIES

University of Canterbury Freshwater Ecology Research Group (FERG)



New staff or students: Amy van Lindt (BSc Hons), Kate Hornblow (MSc), Hilde Martens (MSc), Ben Crichton (MSc), Brittany Earl (MSc), Olivia Hore (MSc), and Jessica Schofield (MSc)

Staff leaving/Students who have completed their thesis:

Hayley Devlin and **Helen Warburton** are both on parental leave – congrats on your new arrivals in 2020! **Issie Barrett** has just submitted her PhD thesis and has taken up a position in the UC/LU Waterways Centre for Freshwater Management, **Liam McIver** completed his MSc thesis, and **Bridget White** finished her Honours year and is off to do a PhD in Tasmania. **Chris Meijer** is about to finish his stint with CAREX and is starting a PhD on inanga with UC's MERG.

The FERG has continued to be a hive of activity in a fairly challenging year. The group has thankfully managed to adapt to situations that COVID-19 has brought along, with people making at-home labs and offices work. **James Brasington's** arrival as new Director of the UC/LU Waterways Centre for Freshwater Management that FERG is part of has seen lots of planning to expand and enhance the Centre's activities. In what will be another very significant change for the FERG, **Jon Harding** has announced he will be retiring at the end of the first semester in 2021. The School of Biological Sciences has signalled their intention to advertise for a new Freshwater Ecologist in 2021 to start at the beginning of 2022. We'll be celebrating Jon's many contributions next year!

On the teaching front, student numbers in undergraduate freshwater-related classes have continued to be strong. This is fantastic, but has caused some challenges because we're starting to exceed the capacity of the Cass Field Station, for example. In another exciting development, UC will be offering a Bachelor of Environmental Science with Honours degree in 2021. This new multi-disciplinary degree will have majors in Fresh Water, Environmental Change, and Ecosystem Health and Biosecurity amongst others. Staff from FERG will have significant roles in the new degree, as well as continuing to champion the ecology theme within the Bachelor of Science as we always have.

KEY PROJECTS

Rethinking ecological networks in changing environments

– **Jono Tonkin** continues to build his lab supported by the above-titled Rutherford Discovery Fellowship. Student recruitment has been a slow process given the current border closures. But he continues his collaborations with **Dave Lytle** developing the theory of interaction-neutral community modelling, which is a key focus of the fellowship.

Living Water Project (DOC-Fonterra) – Jon Harding

has been collaborating with **Chris Meijer** on the LII as part of partnership with Living Water Project (DOC-Fonterra). He also has been continuing research on urban streams with a comparison of benthic communities along the Avon River today compared to 20 years ago. Jon has also been conducting a multi-year study of Tadpole shrimps (which are true ephemeral pond specialists) near Lake Heron and has finally finished his duties as a Special Tribunal member in the Water Conservation Order on Te Waikoropupū Springs, Takaka.

Aquatic food webs and trophic structure across environmental gradients – Angus McIntosh

and **Helen Warburton** have continued to work on aquatic food webs and trophic structures across a range of environmental gradients. This involves collaborations with **Hamish Greig**, on riverine habitat size, **Amanda Klemmer** on cross-ecosystem subsidies, **Richard White** on rainforest mudfish pool communities, new work on braided rivers with **Tara Murray** and **Richard Maloney** (DOC), and many others on a meta-analysis of stable isotope based trophic structure.

Community structure of alpine tarns – Alex Barclay

is putting the finishing touches to her MSc work with **Angus McIntosh** and **Helen Warburton** on the macroinvertebrate community structure of alpine tarns. This work reveals substantially different community structure in tarns above tree line compared to those in the high country, with unique vulnerable communities occurring at high altitudes.

The influence of LED lighting on adult insects in Canterbury rivers

– MSc student **Jessica Schofield** under the supervision of **Jon Harding**, **Kristy Hogsden** and **Michelle Greenwood** (NIWA), is investigating the effects of a range of different colour temperature LED lights on adult aquatic insect species.

Influence of fishing pressure on kōkopu population characteristics

– **Ben Crichton** (MSc student) and supervisors **Mike Hickford**, **Angus McIntosh**, and **David Schiel** have been investigating whether kōkopu population characteristics differ between whitebaited and closed streams. Initial findings suggest that kōkopu

populations do differ between closed and fished streams, although there is no evidence of whitebaiting induced recruitment limitations.

More harm than good? The impacts of Ultraviolet (UV) filters on the ecology of Canterbury's recreational waterbodies – **Hilde Martens** (MSc student), under the supervision of **Jon Harding** and **Sally Gaw**, is quantifying concentrations and seasonal patterns of UV filters in selected waterbodies across Canterbury and investigating their toxicity on selected local freshwater taxa.

Trout influences on non-migratory galaxiids under natural and reduced flow conditions – MSc student **Olivia Hore** (supervised by **Angus McIntosh**, **Jonathan Tonkin** and **Nixie Boddy** [DOC]) is investigating how the effects of trout (e.g., predation & competition) on non-migratory galaxiids are altered under low flow conditions.

Reigniting healthy resilience: using functional traits to achieve stream restoration, Biological Heritage National Science Challenge – Research linking stream restoration, resistance, resilience and functional traits as part of the Biological Heritage National Science Challenge. Team co-led by **Helen Warburton** and **Catherine Febria** (University of Windsor, Ontario), together with **Kristy Hogsden**, **Elizabeth Graham** (NIWA), **Angus McIntosh** and **Jon Harding**.

Students involved are PhD student **Issie Barrett**, MSc student **Kate Hornblow**, and honours students **Bridget White** and **Amy van Lindt**.

Reigniting healthy resilience: a trait-based approach to overcoming negative resistance and resilience in stream restoration – **Issie**

Barrett has just handed in her PhD thesis is investigating negative resistance and resilience in stream restoration. Her research with **Angus McIntosh** and **Helen Warburton** investigated the often neglected biotic interactions that likely play a fundamental role in determining restoration success. This involved both extensive artificial stream experiments and a meta-analysis of existing data sets, using the added perspective of species traits to gain a deeper insight into community structure and function.

How many snails is too many? Sustained high densities of tolerant taxa in post-restoration waterways may hinder recovery through priority effects – MSc student **Kate Hornblow** (supervised by **Helen Warburton** and **Angus McIntosh**) is investigating how mayfly, stonefly and caddisfly colonization into abiotically restored stream systems is affected by different densities of established *Potamopyrgus antipodarum*.

Kekēwai (crayfish) as a stream restoration tool to weaken unhelpful biotic interactions and facilitate biological recovery – Honours student **Amy van Lindt** (supervised by **Helen Warburton** and **Angus McIntosh**) is investigating whether kekēwai could be useful tool to disrupt dominance of *Potamopyrgus antipodarum* in abiotically restored streams and facilitate mayfly, stonefly and caddisfly colonization.

Introduced tadpole trophic impacts on New Zealand pond systems – Students **Brittany Earl** and **Ryan O'Regan** under the supervision of **Helen Warburton** and **Angus McIntosh** set up a mesocosm experiment to investigate effects of the tadpole of the introduced Australian brown free frog (*Litoria ewingii*) on pond trophic processes. Several variables were investigated, including algal densities, macrophyte grazing, organic particulate matter, and



Jon Harding talks to 4th Year class.



Digging sediment trap Living Water, Oct 2020. Photo © Jon Harding



Instream open channel bioreactor Living Water, Oct 2020.

Photo © Robin Smith



Living Water wood chip bioreactor to reduce high nitrate trail.

Photo © Chris Meijer



Tadpole mesocosm experiment. Photo © Brittany Earl, Ryan O'Regan



Amy van Lindt and mesocosms. Photo © Angus McIntosh



Australian brown free frog (*Litoria ewingii*) focus of mesocosm experiment. Photo © Brittany Earl, Ryan O'Regan

The Department of Environmental Management at SIT has been wrapping up a year of diverse student research efforts in rangahau wai from a quantification investigation of microplastics in waterways to a social perception survey of drinking water in Southland. Our microplastics citizen science project has also received some media attention lately (Dr **Christine Liang** was interviewed for NewsTalk ZB national radio and several local newspapers) and we hope to expand the programme beyond Invercargill to help with nationwide efforts in quantifying, monitoring, and subsequently mitigating the spread of microplastics in the environment. Another goal of the project is getting kids interested in freshwater sciences and fostering interest in STEM fields at an early age!

KEY PROJECTS

Rethinking ecological networks in changing Microplastic concentrations in Invercargill city waterways: a case for bottom-up citizen science approaches

– Research students **Niamh Edginton** and **Cicy Zhang**, with supervisors **Dr Anna Palliser**, **Dr Claudia Gonnelli**, and **Dr Christine Liang** have developed an SOP for quantifying microplastics in waterways by adapting and collating existing literature on collecting microplastics samples from waterways and laboratory procedures for separation and visual examination. Dr Christine Liang is currently developing this into a Citizen Science initiative and trialling the programme with Pūtaiao Tamariki (Science Kids). She is also working with WasteNet Southland, who will provide a website hub for schools and citizen scientists to upload and view their microplastics data. **Outputs:** Liang CY. 2020. Reform of vocational education as an opportunity to reform the state of microplastics quantification in New Zealand. NZHS, NZ Rivers Group & NZFSS Joint Conference 2020: “Weathering the Storm”, Invercargill, New Zealand.

Concentration and categorisation of microplastics from inner-city waterways in Invercargill

– Research student **Cicy Zhang** (continuing the mahi from last year’s student Niamh Edginton) has this year identified that Invercargill waterways showed a presence of microplastics in 15 out of 16 samples. She categorised the microplastics into four main shapes: foam, film, fibre, and fragment, and into seven different colours. The most common

shape by far was hard plastic fragments (up to 219 pieces per sample) and the prevailing colours were white and transparent pieces. **Outputs:** Zhang XX, Liang CY. 2020. Concentration and categorisation of microplastics from inner-city waterways in Invercargill. NZHS, NZ Rivers Group & NZFSS Joint Conference 2020: “Weathering the Storm”, Invercargill, New Zealand.

Natural flood management – using trees to reduce the risk of flooding

– **Dr Tapuwa Marapara**, working alongside collaborators Dr Bethanna Jackson and Dr Stephen Hartley from the Victoria University of Wellington and Dr Deborah Maxwell (WSP), highlights how, when and where trees and forests can be effectively used to assist in managing the risk of flooding. The research discusses how the interaction is affected by different species, age, position in the landscape, catchment scale, soils and magnitude of rainfall events under changing geology and climatic conditions. This review also produces relevant policy information on how to effectively use trees and forests as flood risk management tools in temperate regions. **Outputs:** Marapara *et al.* (2020).

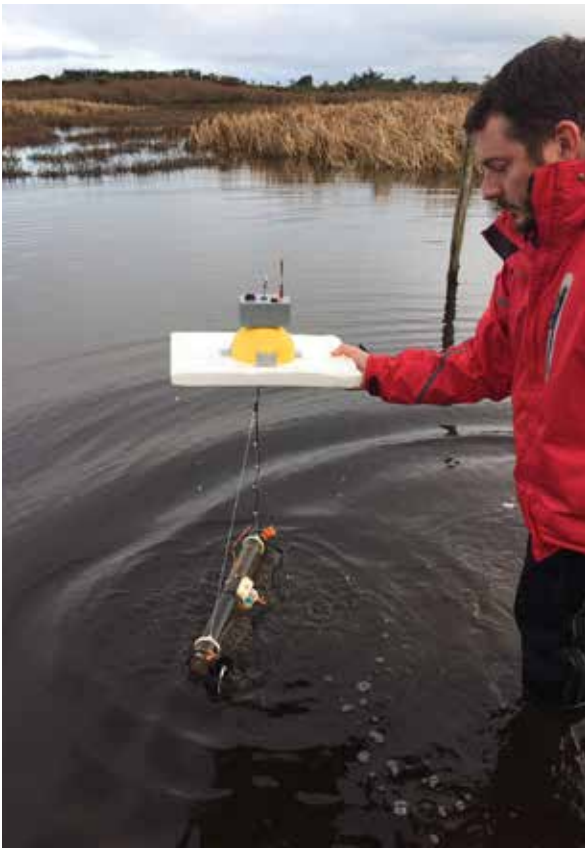
The Niskin bottle: investigating technologic advances in water sampling

– Research student **Brennan Mair**, along with supervisor Dr Tapuwa Marapara and collaborator Dr Tim Hopley (Environment Southland) designed and created a water sampling device using 3D printing technology and a small open source computer with custom make software control program that was able to be run from a cell phone, computer or tablet. After the device was created, it was tested in the field alongside a traditional method (Van Dorn water sampler) and the device performed as expected with no significant differences between methods. With the final prototype weighing in at 1.2 kg, it is a suitable size and weight to be deliverable by drone technology.

Outputs: Mair B, Marapara T, Hopley T. 2020. Investigating technologic advances in water sampling. NZHS, NZ Rivers Group & NZFSS Joint Conference 2020: “Weathering the Storm”, Invercargill, New Zealand.

PUBLICATIONS

Marapara, T. R., Jackson, B. M., Hartley, S., & Maxwell, D. (2020). Disentangling the factors that vary the impact of trees on flooding (a review). *Water and Environment Journal*. DOI:10.1111/wej.12647. ■



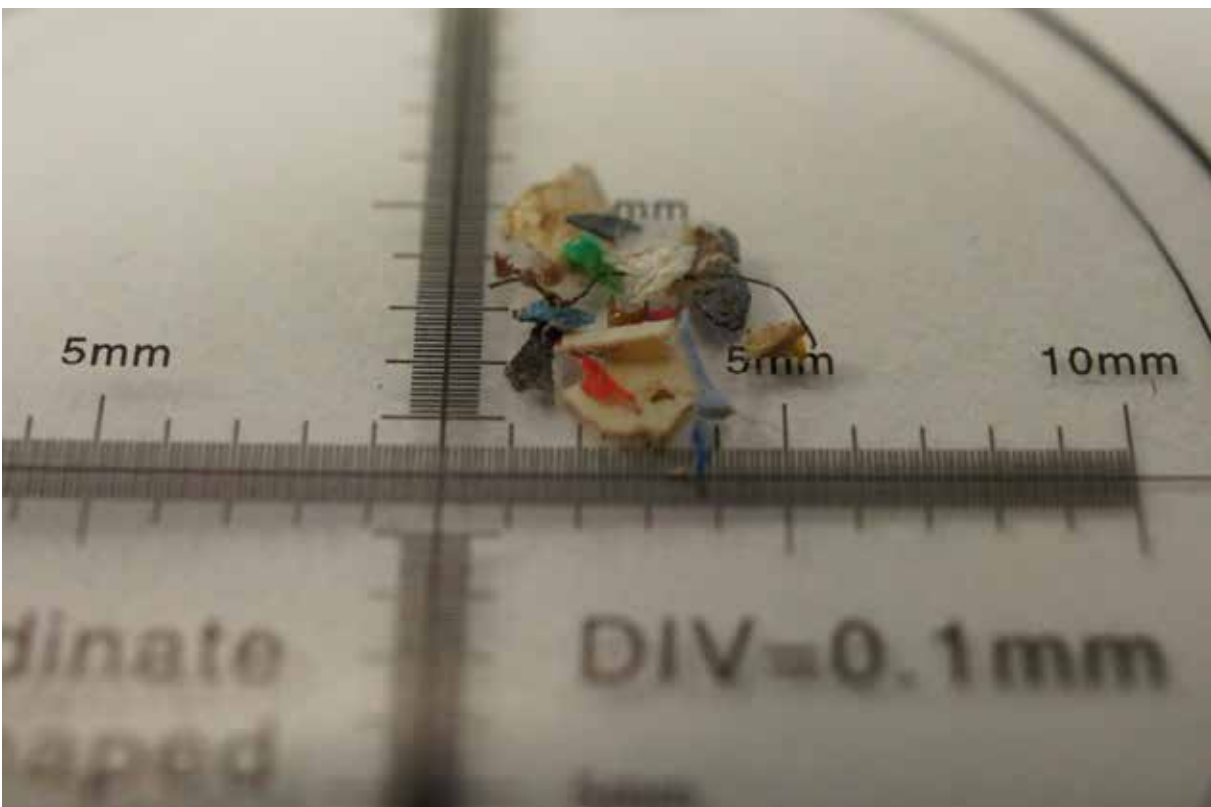
Brennan Mair testing the Niskin bottle technology he built using 3D printing and low-cost off-the-shelf electronics and hardware. Photo © Brennan Mair



Tapuwa wetland. Photo © Tapuwa Marapara



A student sampling for microplastics in the Waihopai River, Invercargill. Photo © Christine Liang



Microplastics found in one water sample from an Invercargill waterway. Photo © Cicy Zhang

Research in freshwater science at the University of Waikato is about to change with the retirements of **Kevin Collier** and **Brendan Hicks**. **James Brasington** has also departed his role as the Waikato Regional Council Chair of River Science to lead the Waterways Centre at Canterbury. **Troy Baisden** continues his research in lake catchments while Bay of Plenty Regional Council Chair (BOPRC) ends, and selected activities continue with BOPRC and land-to-water focus. We are fortunate to have **David G. Schmale III** from the School of Plant and Environmental Sciences, Virginia Tech, Blacksburg, Virginia, USA, arrived as a Visiting Professor on a Fulbright Scholarship. David's has extended his stay using drones and robots to sample water quality and to collect multispectral imagery. He is working closely with the Eye on Lakes Smart Ideas project and Cawthron's and GNS's Lakes 380 research.

Two students are conducting research into fish passage for their MSc research, supervised by **Paul Franklin** and **Eleanor Gee** (NIWA, Hamilton) and **Brendan Hicks**. **Amy Yasutake-Watson** is studying the impacts of tide gates on freshwater fish and **Rachel Crawford** is investigating the effect of temperature on the swimming ability of juvenile galaxiids. **Morgan Riding** has a PhD scholarship from the George Mason Charitable Trust to study stream ecosystem function in Taranaki, focusing on temperature, light availability, fish and invertebrate biomass, and food web structure. She is supervised by **Brendan Hicks**.

Michael Pingram and **Deniz Özkundakci** from Waikato Regional Council continue to work closely with University of Waikato staff and students on freshwater research.

Tom Moore completed his PhD thesis, which included a recent publication invasive macrophytes and oxygen, pH, and temperature in a hydropeaking reservoir. This was the first of two scientific publications that investigated how

kākahi populations respond to dense invasive weed beds and overarching hydrology in Karāpiro. The second publication looked at hydrology-mediated invasive macrophyte impacts on freshwater mussels in a New Zealand hydropeaking reservoir is in review. Research was funded by the Biological Heritage National Science Challenge. **Michele Melchior** continues her PhD on the glochidial ecology of mussels.

KEY PROJECTS

Eye on Lakes – The project is developing tools for remotes sensing of cyanobacterial blooms using multispectral remote sensing for a MBIE Smart Ideas project. Early stages have involved development of an optical classification system for NZ lakes, and we are moving on to cyanobacterial quantification. **Lisa Reed** and **Dilshan de Silva** are using the project as part of their MSc degrees, under the supervision of **Moritz Lehman**, **Brendan Hicks** and **Ian Hawes**.

Classification of aquatic features in Antarctica's McMurdo Dry Valleys – Initially focusing in lentic systems, **Clive Howard-Williams** and **Ian Hawes** are developing a classification of aquatic ecosystems in continental Antarctica's largest protected area. In this cold desert, we identify over 6000 ponds and lakes and classify these into nine main classes. The classes are being used to develop management plans and guidelines for operations in this sensitive landscape.

Zooplankton ecology and invasions – With Ian and **Piet Verburg** (NIWA), MSc student **Galilee Miles** is currently examining the long-term collection of zooplankton samples from Lake Taupō. Ian has also been working on long-term zooplankton datasets from shallower Waikato lakes with **Deniz Özkundakci** and **Bruno David** (WRC), where it has been found that the greatest changes to zooplankton communities through time have come about due to species invasions rather than water quality changes. Ian has worked with former student **Yvonne Taura** (Manaaki Whenua) to publish on the effects of willow invasion on zooplankton assemblages in the South Taupō Wetland. With **Kelly Le Quesne**, they have published their work on zooplankton communities on farms, finding these to be relatively uninvaded by non-native species relative to urban waters.



Scent-detection dog Coby assessing a water sample for catfish on the automated carousel.

Freshwater mussels (kākahi) research – Two papers on potential kākahi-zooplankton interactions have been accepted, including an algal competition experiment between a non-native *Daphnia* and kākahi, and a mesocosm experiment examining the effects of the mussels on zooplankton communities, both with **Ian Duggan** and **Anita Pearson**.

Scent detection of pest fish by dogs – Waikato Scent Detection Research Group has received MBIE Smart Ideas funding to develop a low-cost, rapid screening tool for detecting invasive fish using pet dogs sourced from the community. This research is directed by **Clare Browne**, **Nick Ling**, and **Grant Tempero**. Water samples are brought into the scent-detection facility and placed into automated carousel for assessment by scent-detection dogs under controlled conditions. Findings by MSC student **Lauren Little** show that the dogs can reliably distinguish between water samples that have contained either catfish or goldfish. PhD student **Melissa Collins** has determined that the dogs' scent-detection limit for koi carp is 0.5 mg biomass/L or the equivalent of one adult koi in four Olympic swimming pools of water.

Rotorua Lakes and Catchment Research – **Troy Baisden's** team has focused on catchment research to improve water quality, including the use of water and nitrate isotopes to better define the sources of nutrients reaching

lakes spearheaded by Dr **Rachel Murray** (currently on parental leave), **Claire Eyberg's** MSc and **Meti Yulanti's** MFAT-supported PhD. Work has also been underway on trace elements to understand geothermal P sources, with Dr Amanda French and MSc student **Kirstie Cochrane** completing a study of arsenic sources, fate and speciation in Lake Tarawera. Nicola Wilson MSc is developing the ability to link water, N and P flows for scenarios in the 8 interconnected lakes of the Tarawera catchment. **James Dare** continues his role at BOPRC while linking to the team as a half time PhD student working on improving monitoring methods to quantify nutrient load to lakes.

The Rotorua Lakes buoy programme has been operationalised through **Chris McBride's** company Limnotrack, while Chris remains active at the University in lake modelling and data initiatives including the TAIO programme. **Grant Tempero** is busy assessing phytoplankton N and P limitation in Rotorua, and a range of other projects. The Takiwā Lakes platform has been updated to retain lake and catchment data in a compatible format for users undertaking future work with Takiwā, but without a subscription model that would duplicate council and LAWA data services. **Outputs:** <http://limnotrack.com>, <https://lernz.takiwa.co>, <https://taiao.github.io/taiao> ■



Left to right: Brendan Hicks, Warrick Powrie, and Morgan Riding electrofishing a Taranaki stream.



Moritz Lehman using Munsell colour cards to determine water colour of Lake Rotongaroiti, Waikato Region.



David Schmale with his DGI drone fitted with a multispectral camera at Lake Ohinewai, Waikato Region.



Harvey Bay Stream, Tennyson Inlet

Photo © Natasha Petrove

GOVERNMENT ORGANISATIONS & CROWN RESEARCH INSTITUTES

Department of Conservation



New: Marine Richarson, Jane Bowen, Kerry Bodmin, Kris Ramm, Johlene Kelly, Jane Taylor, David Nathan, Carol Nicholson, Chris Woolmore, Ashley Alberto, Richard White, Andrew Kirk, Kaitlin Morrison (some new to DOC, some new into DOC freshwater roles).

The DOC freshwater whānau has continued to grow this year, as we continue to upscale our work under the increased funding from Budget 2018. The freshwater work programmes under this Biodiversity 2018 funding focus on river catchments, three migratory freshwater species (shortjaw kōkopu, inanga and longfin eel), freshwater biosecurity, reducing critical ecosystem pressures under the RMA, and associated monitoring.

Andrew Kirk, Marine Richarson, Jane Bowen and Nicole Hancock have joined our national science and technical teams in the Freshwater Northern, Freshwater Southern and Mountains to Sea teams, which are managed by **Keith Ikin, Elizabeth Heeg and Kris Ramm**. **Kaitlin Morrison** has also joined the team, covering for **Natasha Grainger** who's been on secondment at Waikato Regional Council since February. Our freshwater Operations capability is also expanding, with **Kerry Bodmin and Helen McCaughan** in the biosecurity coordinator roles for the North and South islands respectively, **Carol Nicholson** (in the North) and **Chris Woolmore** (in the South) as migratory fish coordinators, and several river restoration coordinators across the country (see the Ngā Awa update, below). We also look forward to new freshwater pest/migratory freshwater species rangers starting soon.



Upland bully found during surveys of spring habitat in the Rangitata catchment. Photo © Sjaan Bowie

KEY PROJECTS

Freshwater Biosecurity – Helen McCaughan, Matt Brady, Kerry Bodmin, Katie Collins and Kaitlin Morrison are focusing on addressing priority freshwater biosecurity threats nationwide. Key tasks for the team are increasing interagency and partner projects, improving surveillance and control operations, continued research for improved surveillance, and control tools. Rangers are also being employed in a staged way to support the freshwater biosecurity programme as it develops.

Works in Waterways Advisory Group – Natasha Petrove and Helen McCaughan have been working on a project (led by Tanya Blakely at Boffa Miskell) to help develop practical national guidelines for fish relocations and other works in waterways, along with a range of other agencies and industry.

Fish Passage – Sjaan Bowie continued to lead and coordinate DOC's fish passage programme. This programme continues to grow, with staff providing lots of advice internally and externally to seek improvements in fish passage management and formal adoption of the national fish passage guidelines, and work underway to develop a DOC Fish Passage Management Strategy. The strategy development is coordinated by **Mara Wolkenhauer and Peter Hardstaff** (our Aquatic Principal Advisors Science Investment), with input from a cross functional team from across DOC. Sjaan continues as the DOC representative on the multi-agency water intake technical working group that is inputting into a multi-year research programme (led by Irrigation NZ). This programme aims to see redesign of typical water intakes that meet good practice and adoption of good practice nationally for fish screening to prevent impingement and entrainment of fish in water intakes.

The New Zealand Fish Passage Advisory Group (NZFPAG) has continued to promote a more consistent and improved approach to fish passage management and has created a number of new resources including updating all Lessons Learnt fact sheets, creating a few new lessons learnt, and



producing summary fact sheets for new installs, remediating fish passage barriers and providing passage at temporary structures. Further key resources are underway, including a video and fact sheet for the Fish Passage Assessment Tool. Sjaan has worked with **Paul Franklin** (NIWA) to make improvements to the Fish Passage Assessment Tool and to combine several regional and national data sources to create a national instream structure layer that is now available on the web interface. This national layer also has translated any previous fish passage assessments into the new FPAT format, so they are available online. **Marine Richarson** has joined Sjaan on the NZFPAG, and the Ministry for the Environment has recently joined DOC to coordinate the NZFPAG. **Outputs:** www.doc.govt.nz/fishpassage, www.doc.govt.nz/nature/habitats/freshwater/fish-passage-management/resources, www.doc.govt.nz/nature/habitats/freshwater/fish-passage-management/advisory-group, <https://fishpassage.niwa.co.nz>

Ngā Awa: Working collaboratively to restore 14 river catchments

The Ngā Awa programme aims to restore the ecological integrity and resilience of 14 river catchments in collaboration with others. Establishing a network of River Rangers to coordinate and drive the work has been an integral part of the programme. **Steve Bielby** (Waikanae), **Brad Edwards** (Rangitata and Waikanae), **Debra Magner** and **Tihou Messenger Weepu** (Arahura) have spent the year building stronger relationships with Treaty Partners and commencing discussions about setting objectives for the catchment work and information gaps that need to be filled. **Heli Wade** is the Pelorus/Te Hoiere catchment coordinator, employed by Marlborough District Council through a partnership arrangement between DOC, MDC and MfE. **Jane Taylor** (Te Awa Tupua/Whanganui), **David Nathan** (Waipoua), **Johlene Kelly** (Eglington and Waikawa) and **Madeleine (Maddy) Jopling** (Waihou and Doubtless Bay catchments) are our newest additions to this network. The programme is supported from a technical perspective by **Sue Clearwater** (Science Advisor to the programme), **Rosemary Miller**, **Philippe Gerbeaux**, **Natasha Petrove**, **Sjaan Bowie**, **Andrew Kirk**, **Dave West**, **Emily Funnell** and **Jane Bowen**.

We're working to build the Ngā Awa programme on a strong foundation of collaboration and co-design with Treaty Partners within each catchment. Other collaborators are also important, and we've been connecting with regional and

district councils, universities and research institutions, NGOs and community groups. For example, one of our collaborations is with University of Canterbury and Environment Canterbury on a PhD on sediment dynamics in the lower Rangitata River. We've also been getting some science and research underway in the catchments, including an evaluation of erosion hot spots in the Waipoua River, further survey of the distribution of lowland longjaw galaxias in the Rangitata, fish community survey work in both the Rangitata and Waipoua, and inanga spawning surveys in the Whanganui and Arahura. **Outputs:** www.doc.govt.nz/our-work/freshwater-restoration/nga-awa

National Integrated Freshwater Monitoring Program – Elaine Wright, Kate McNutt, Ashley

Alberto, Ollie Gansell and **Richard White** are working on the design and implementation of a national freshwater monitoring program on Public Conservation Land (PCL). The objective of the program is to robustly measure and report on the status of components of ecological integrity of rivers and streams on PCL in New Zealand. The team are preparing for the first season of monitoring, which will include trialling a suite of methods for monitoring fish and invertebrate communities including eDNA in non-wadeable rivers. The team has also been engaging with regional councils to explore opportunities for collaboration in the freshwater monitoring space, particularly on elements of sample design.

Migratory Freshwater Species – Our migratory species work programme aims to secure the populations of three migratory fish species (tuna/longfin eel, shortjaw kōkopu and inanga) across 12 bioregions. Recently joining the work programme team are Jane Bowen (Technical Advisor, Invercargill) and Marine Richarson (Science Advisor, Dunedin). They have been actively leading operational and research planning activities and will work closely with the migratory fish coordinators (Chris Woolmore, Hokitika; Carol Nicholson, Whangārei) in supporting the delivery and implementation of the programme regionally across both islands. A highlight of the year has been commencing shortjaw kōkopu resurveys. To date these surveys have taken place in Nelson, Tasman, Marlborough and the West Coast of the South Island.

Critical Ecosystem Pressures (CRESP) – The CRESP research programme addresses research gaps associated with four pressures (water flows/levels, critical habitat loss, sediment/nutrients and fish passage), to support DOC's advocacy throughout New Zealand under the RMA. **Nixie Boddy** is the programme lead, and is supported by **Nicholas Dunn**, **Hugh Robertson**, **Sjaan Bowie**, **Philippe Gerbeaux**, **Natasha Petrove** and **Jacob Williams**.

Over the last 12 months, we've developed a 4-year research strategy for the research programme, and a number of projects are now underway. Highlights include:

Nixie Boddy and Nicholas Dunn collecting data to develop physical habitat suitability curves for priority species with assistance from **Marine Richarson** and **Emily Funnell**. Habitat requirement reports will be analysed and written by Amber Sinton at NIWA.

TOP: Manuherikia River, Clutha River catchment.

Photo © Nicholas Dunn

asuring fish during a survey in the Rangitata River.

Photo © Sjaan Bowie

BOTTOM: Upland bully found during surveys of spring habitat in the Rangitata catchment. Photo © Sjaan Bowie

Funding for MSc Research project by Olivia Hore (UC), which Nixie is co-supervising, to investigate the interactions between trout and non-migratory galaxias under reduced flow conditions, in collaboration with Angus McIntosh (UC), Matt Dale and Matt Wylie (Ngāi Tahu).

Arawai Kākāriki: Leading the ecological restoration of five significant wetland sites in New Zealand

Arawai Kākāriki aims to develop best practice restoration and management tools, and to work collaboratively with iwi and other partners to restore and protect wetlands. Improving water quality and wetland hydrology are key goals. Recent highlights include **Hugh Robertson** and **Tom Drinan** presenting data on the state and trends of water quality in lakes and streams in Ō Tū Wharekai to the Ashburton Water Zone Committee, with the aim of working collaboratively to improve degraded lake and stream health. Other highlights include improving wetland hydrology through blocking historical drains. This year drains were blocked in Awarua-Waituna wetland, which will restore the water table to a more natural state and allow wetland vegetation to re-establish. Monitoring at Moawhitu has shown that vegetation cover has approximately doubled since the drains were blocked two years ago.

One of the programme's key objectives is scientific research and partnerships. A research partnership with Cawthron and GNS saw the inclusion of Lake Moawhitu and several Ō Tū Wharekai lakes in their Lakes380 project, which has increased our knowledge of the long-term history and health of these lakes. Arawai Kākāriki has also partnered with Landcare Research to develop a wetland monitoring tool to understand the pre-human state of wetlands. **Outputs:** More details of our research and work can be found at our updated website: www.doc.govt.nz/our-work/freshwater-restoration/arawai-kakariki-wetland-restoration. Report card on phosphorus monitoring in Whangamarino wetland: <https://ftp.doc.govt.nz/public/file/YBiUWq-8IU6GP6NIUcpLxg/Report-card-Whangamarino-phosphorus-2019.pdf>. Recent papers and reports include: Blyth *et al.* (2020), Burge *et al.* (2020), De Winton (2020) and Holmes (2019).

Whitebait Management Improvement Project – Whitebait Fishing Regulations Review

DOC began a consultation in January 2020 on proposals to improve whitebait management after our engagement in 2018 and 2019. The consultation proposed changes to how DOC manage whitebait species in New Zealand and the whitebait fishing regulations. DOC received over 11,000 responses.

DOC made recommendations to government to improve whitebait management and these include changes to fishing regulations. They are informed by the 2020 consultation response. The government will review the recommendations after the election. **Outputs:** Further information can be found at www.doc.govt.nz/get-involved/have-your-say/all-consultations/2018/improving-whitebait-management

Taxonomic description of non-migratory Galaxias fishes

Nicholas Dunn is continuing his work on the morphology and taxonomic descriptions of non-migratory Galaxias in the Galaxias vulgaris and Galaxias paucispindylus species complexes. These species constitute the majority of those categorised as having a threatened conservation status and occur across eastern and southern South and Stewart islands. Formal descriptions will aid the management of diversity within the Galaxiidae family of fishes. **Outputs:** Further information can be found in Dunn *et al.* 2020a and Dunn *et al.* 2020b.

Upland longjaw muster

Just before lockdown, **Sue Clearwater, Sjaan Bowie, Nixie Boddy, Rosemary Miller** (from our freshwater and mountains to sea teams) and **Mara Wolkenhauer** (our Principal Advisor Science Investment) joined **Dean Nelson** and **Sam Gale** from the Twizel office, and Environment Canterbury funded contractor **Richard Allibone** for a week of non-migratory fieldwork. Highlights from the week included monitoring at two sites in Fraser Stream (a small, spring-fed stream where the first trout barrier in the district was installed to protect lowland longjaw galaxias (*Galaxias aff. cobitinis* "Waitaki River") and bignose galaxias (*Galaxias macronasus*). Lowland longjaw and bignose numbers rebounded dramatically when trout were removed, but declined again when populations of kōaro and Canterbury galaxias began to increase above the barrier. Any kōaro and Canterbury galaxias found are now regularly shifted below the barrier, and the two pencil galaxiids seem to be thriving again. We also continued trout removal from above two trout barriers in the Fork Stream, along with a group from Environment Canterbury, and headed to the Cass, lower Tasman, Macaulay and Godley rivers to look for upland longjaw galaxias (*Galaxias aff. prognathus* "Waitaki River"). Upland longjaws seem to still be hanging out in small riffles with loose substrate, in small, shallow channels and side streams, but were generally found in only ones and twos at the sites fished (most caught in one place was 11). ■

TOP: Drain blocking at Toetoes, Awarua Waituna. Photo © DOC

MIDDLE: Giant kōkopu, Tuna Bay Stream, Tennyson Inlet. Photo © Natasha Petrove

BOTTOM: Shortjaw kōkopu habitat in Tuna Bay Stream, Tennyson Inlet. Photo © Natasha Petrove



Barry Biggs and **Chris Hickey** have retired, both with an impressive 40+ year career with NIWA and its predecessor companies.

KEY PROJECTS

Development of an automated detection tool for early incursion of invasive submerged weeds

– NIWA's (Freshwater Biosecurity Team)

development of an automated detection system for invasive aquatic weeds has taken an important step forward with early confirmation that machine learning and image recognition can distinguish between target invasive weeds (e.g., *Lagarosiphon major*) and two plants of similar appearance. Imagery captured by NIWA's autonomous boat at different speeds, camera angles, resolution and plant densities, under experimental conditions at our Ruakura Research Facility (Hamilton), provide datasets for training the detection algorithms for target species currently under management by various government agencies. Upscaling of these approaches may be able to detect aquatic pests at spatial and temporal scales never envisaged before so that effective management strategies can be implemented to protect our freshwater environments. **Staff involved:** Daniel Clements, Jeremy Bulleid, Aleki Taumoepeau.

Regulatory barriers to uptake of farm-scale diffuse source pollution mitigation measures

– Constructed wetlands, detention bunds, woodchip denitrification filters and planted riparian buffers are examples of a growing suite of edge-of-field and farm-scale mitigation systems that are being trialled across rural New Zealand to reduce the impact of diffuse pollution on freshwater quality. With funding from MBIE and DairyNZ and input from various regional council staff, we reviewed regional plan requirements relevant to the construction, operation and maintenance of mitigation systems, particularly when sited close to or within waterways and drains. Examination of five recent edge-of-field mitigation projects across four regions indicated that it is difficult to meet many of the conditions associated with permitted activity rules. Although we found that resource consents will generally be required to implement mitigation systems, it should be possible to simplify the process to obtain consent through developing guidance on how to manage potential adverse environmental effects associated with their construction, operation and maintenance. This guidance could inform the development of new rules as part of plan changes or review processes that specifically address diffuse

pollution mitigation systems. **Staff involved:** Juliet Milne, Jordan Luttrell **Outputs:** Milne, J.R., and Luttrell, J. (2020) Regulatory barriers to uptake of farm-scale diffuse pollution mitigation measures: An assessment of Regional Plan requirements and regional council incentives. NIWA Client Report 201913HN prepared for DairyNZ and MBIE. Download from: https://niwa.co.nz/sites/niwa.co.nz/files/Reg%20Barriers%202020_FINAL.pdf

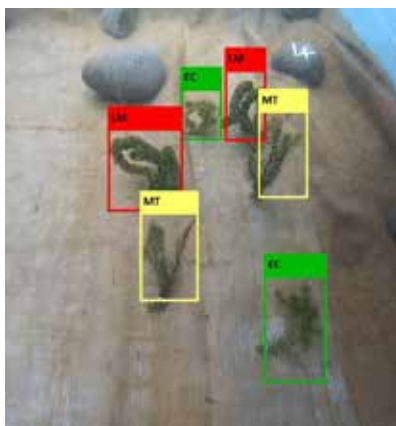
National Environmental Monitoring Standards

– National Environmental Monitoring

Standards (NEMS) are a key initiative seeking to improve the consistency and robustness of environmental monitoring across New Zealand. During the past year NIWA has worked closely with regional councils and commercial laboratory providers to complete new draft Standards on the collection and processing of periphyton and macroinvertebrate samples. These Standards focus primarily on long-term State of the Environment monitoring in Wadeable reaches of rivers but also provide guidance on sampling under the NPS-FM and in relation to resource consents. The Standards revisit and will supersede existing sampling periphyton and macroinvertebrate protocols prepared by Biggs and Kilroy (2000) and Stark *et al.* (2002), respectively. They present protocols for: sample point selection, visit metadata, sampling equipment, on-site measurements, sample collection and handling, laboratory processing, and data quality assurance and archiving. **Staff involved:** Juliet Milne, Brian Smith and Cathy Kilroy **Outputs:** The draft NEMS Periphyton and NEMS Macroinvertebrates are available from: www.nems.org.nz

Plastics in freshwater environments

– Plastics are significant pollutants in the NZ environment and plastics are accumulating in oceans worldwide. We have just finished the second year of the Smart Idea Endeavour Funded project Rivers as Vectors of Plastic Pollution which is analysing plastic transport in an urban-affected river which discharges to the Wellington Harbour. This year we installed autosamplers to look at fine-scale changes in microplastic concentrations during storm events. We collaborated with Nelson City Council (**Joanna Wilson**), Auckland Council (**Stephanie Robinson**) and Sustainable Coastlines (**Camden Howitt**) to expand the Litter Intelligence platform to include standardised litter monitoring for stormwater and freshwater environments and allowing for modelling of litter mobilisation from the land to the sea. In February, Dr. Jen Drummond (University of Birmingham), travelled around New Zealand to collect microplastics from a variety of rivers as part of the 100 Plastic Rivers project. Jen sampled the Hatea, Waikato, Manawatu, Hutt, Haast, and Motueka rivers while in New Zealand. New Zealand also contributed



TOP: A banded kōkopu swims in NIWA's swim tunnel, the fish equivalent of a hamster-wheel. Photo © Eleanor Gee

BOTTOM LEFT: Lamprey attempt to climb a smooth ramp in NIWA's Hamilton freshwater ecology lab. Photo © Eleanor Gee

BOTTOM MIDDLE: Detection algorithms. Photo © Daniel Clements

BOTTOM RIGHT: NIWA's autonomous boat collecting datasets for training detection algorithms for target invasive submerged species currently under management by government agencies. Photo © Daniel Clements

to another international microplastic study, GLEON's Global Lake Microplastics project. NIWA collaborated with Northland Regional Council (**Manas Chakraborty**) to sample two dune lakes, the only dune lakes included in this study.

Staff involved: Amanda Valois, Jennifer Gadd, Lee Rauhina-August, Olga Pantos (ESR), PhD student Julia Rambacher supervised by Sally Gaw (University of Canterbury) **Outputs:** www.litterintelligence.org

Fish Olympics – NIWA's Freshwater Ecology team have been putting native fish through their paces in order to improve our understanding of constraints on migration. Fast flows through culverts and vertical drops over weirs are just some of the anthropogenic impediments to migration that native fish face. We have been undertaking endurance and critical swimming speed trials to quantify swimming performance and examine differences in swimming capability between different species and life stages and to investigate the effect of temperature on swimming performance. As we know, however, a number of native species also have impressive climbing abilities. Using lamprey, koaro and banded kōkopu, we are testing different types of rough and smooth substrates at various angles to determine which surface is preferred by each species. Kinematic and morphological analyses are also underway to provide insight into the mechanisms that facilitate climbing in these species. Results of these studies will inform revisions to the New Zealand Fish Passage Guidelines. **Staff involved:** Cindy Baker, Paul Franklin, Eleanor Gee, Peter Williams, Emily White, Gordon Tieman, Nicola Pyper, Rachel Crawford. ■



TOP: Sediment sample for microplastic analysis.

BOTTOM: Jen Drummond collecting microplastic. Both photos © Amanda Valois



Costachorema

Photo © Angus McIntosh

COUNCILS & UNITARY AUTHORITIES

Christchurch City Council



New: Katie Noakes, who was covering Belinda Margetts during her second maternity leave, has now been made permanent as an additional Waterways Ecologist for the Council.

We have been advising on a number of large Council projects (such as waterway dredging and the building of stormwater facilities), undertaking waterway restoration projects in conjunction with community groups, carrying out detailed state of environment monitoring, advising on resource consent applications under the District Plan, and advising and liaising with stakeholders. We have also been undertaking investigations to inform our day-to-day practices and to gain a better understanding of how we might improve the health of our waterways.

KEY PROJECTS

Cashmere Stream Restoration – Both **Belinda Margetts** and **Katie Noakes** have been advising on the restoration works of kilometres of Cashmere Stream, as part of an extensive work programme in the catchment to reduce contaminant discharges into the stream. In the 1800s, this wetland area was drained and Cashmere Stream was straightened into a canal. The stream is home to a number of threatened and mahinga kai species, such as kōura, kākahi, tuna and inanga. One of the goals of the project is to incorporate habitat and riparian features to improve the abundance of these species, as well as improve water quality and prevent the need for the common practice of macrophyte removal (by increasing shading). A baseline survey has already been conducted and detailed restoration monitoring is proposed in the future.

Effectiveness of constructed fish habitat – A number of past and future Council projects involve the installation of constructed fish habitat, as a way to provide habitat where natural means are difficult. **Katie Noakes** has begun work on developing a monitoring programme to assess whether these constructed habitats are effective in increasing fish abundance and diversity, and whether maintenance is needed to ensure their effectiveness. This will build on investigations undertaken by others nationally (e.g., for eel condos).

Leaching from instream structures – A number of temporary and permanent instream structures are used within waterways to allow the construction of things such as bridges and culverts. Some of these structures have the

potential to leach contaminants into waterways, negatively affecting both water quality and biota. **Belinda Margetts** has undertaken a literature review on the effects of three commonly used materials: copper-chrome-arsenate (CCA) treated timber, galvanised steel and concrete. A Lincoln University summer student will now carry-out a survey of current practices within New Zealand, to determine how the recommendations made in the literature review would be achieved. The next steps are to undertake more research to understand the effects on biota in our local waterways. ■



TOP: Kākahi in Heathcote River. Photo © Instream Consulting Limited

BOTTOM: Stream drop-off in Banks Peninsula.

Photo © Belinda Margetts

Greater Wellington Regional Council is responsible for regulating the use of the region's natural resources. This is done through regional policies, plans and resource consents, helping the community to restore ecosystems (such as streams and wetlands) and helping businesses become more environmentally sustainable. GWRC provide drinking water to the region, monitor and report on the state of the environment, manage environmental threats like pest plants and animals, protect the region from flooding, provide a 24-hour pollution response service and support environmental education programmes in schools.

WAIRARAPA MOANA ACHIEVES RAMSAR STATUS

Wairarapa Moana, the North Island's third largest wetland ecosystem, has become Aotearoa New Zealand's seventh wetland to receive RAMSAR status as a wetland of international importance. Wairarapa Moana Wetland is home to 96 bird species, 25 native fish species, and countless plant species, many of which are nationally or internationally important. This achievement recognises the extensive partnership and hard work from landowners, iwi, local hapū, local authorities and the community to protect this taonga and to restore it back to health. For more information about the Wairarapa Moana Wetlands Project go to www.waiwetlands.org.nz.



Marae-based kaitiakitanga – learning how to set a net.

Photo © Bart Cox

KEY PROJECTS

Marae based kaitiakitanga program – Ngā

Kanohi Marae o Wairarapa rangatahi and kaiako are building relationships with GWRC through whakawhanaungatanga around mauri and ecosystem health with the backdrop of Wairarapa Moana. A hands on marae based kaitiakitanga program for rangatahi encourages learning and practise of kaitiakitanga, whakapapa, karakia, manaakitanga, hauora and mātauranga and science, with a focus on freshwater monitoring and education. It helps to uphold the mana o te wai and the intrinsic value of each and every person, manaakitia te tāngata. The work is based on the philosophy that if the people, mind and body are healthy, then that will be reflected in the whenua and vice versa. Therefore, kai is central to this kaupapa; because everybody needs kai for sustenance. But we also need to protect mahinga kai for us now and for future generations as well. Kōrero and mātauranga are also important kai for the hinengaro and, as a part of our learning and working together we spend time sharing meals, participating in traditional games and sharing korero. This allows us to build a safe and inclusive rōpū and to hone our physical, mental and our wairua so that we are ready to tackle the rigors of standing together with the whenua. GWRC science staff have been privileged to collaborate and share knowledge and friendship working alongside rangatahi and their kaiako. It is usually a fluid exchange of tuākana tēina learning and getting to know each other's practices such as tikanga, histories and philosophy. **Contact:** Bart Cox (bart.cox@gw.govt.nz) or Sam Ludden (sam.ludden@gw.govt.nz).

Wairarapa school nurtures muddy paddock into thriving wetland –

Kahutara School, in the Wairarapa, is fostering students' connection with te taiao (nature) through the development of a wetland to encourage biodiversity back to the local area. The wetland grew out of restoration work on land donated to the school in 2017, following the school's participation in the Whitebait Connection programme. The programme was led by Mountains to Sea Wellington, supported by GWRC and numerous community groups. The restoration work has been integrated into the school's curriculum with students learning about wetland processes and getting involved in seasonal planting and monitoring. Three years on, students are already witnessing positive changes in their local wetland – with flourishing locally sourced kōwhai, kahikatea, harakeke, cabbage trees, black beech and frequent visits from kotare, ducks and the occasional white heron. The school has also used the programme to reel in a range of experts to inspire the students. A recent visit from Scottish dragonfly experts, Ruary MacKenzie Dodds and Kari

de Koenigswarter, helped students discover that the wetland is a hotspot of baron dragonfly larvae. The message is clear that educational and environmental projects provide practical opportunities to support the student's wellbeing and ultimately set our region up for success by leaving a healthy and thriving biodiversity legacy. **Contact:** Micheline Evans (Micheline.evans@gw.govt.nz)

Native freshwater mussels – The freshwater mussel, or kākahi, is endemic to New Zealand, and once formed extensive beds in lakes and rivers, living shallowly buried in sand or mud. However, in Wairarapa Moana, this little mollusc faces an increasingly uncertain future. Results from the annual kākahi monitoring survey day at Wairarapa Lake Shore Scenic Reserve found plenty of adult kākahi (about 20–30 years old) but only four juveniles were discovered. **Amber McEwan**, GW freshwater ecologist, says although the results were not surprising, it was deeply troubling for the long term future of the species in the region. Historically, kākahi were a source of food with their shells used as tools by Maori. They also play an important role in the ecosystem – one kākahi can filter about one litre of water per hour. The primary problem facing kākahi populations currently was likely a lack of native host fish species – their favourite being the kōaro – to facilitate successful reproduction. As host fish, kōaro act like a taxi whereby kākahi larva, called glochidia, are sneezed out and latch on to a passing fish using a hook at the top of their shell. An explosion of pest fish in the lake such as perch, rudd, and brown trout have decimated native host fish populations, hence the scarcity of juvenile kākahi, McEwan said.

The kākahi monitoring programme is one of several projects under way at Lake Wairarapa as part of the Wairarapa Moana Wetlands Project, a joint initiative of Greater Wellington Regional Council, the Department of Conservation, South Wairarapa District Council, Kahungunu ki Wairarapa and Rangitane o Wairarapa Inc. **Contact:** Amber McEwan; biodiversity@gw.govt.nz.

Waikanae River catchment restoration programme Waikanae ki Uta ki Tai unfolds

– The long-awaited 'mountains to sea' project to restore the Waikanae River has appointed its Governance Group and Steering Committee, and will be moving next to develop an Action Plan in collaboration with the Waikanae community. Based on shared values and priorities to support the life and health of the awa and its community for future generations, the committee will continue to engage with the Waikanae community in this collaborative, inclusive catchment and community-wide process.

GWRC and Kāpiti Coast District Council have been working with DoC to align their roles and resources, and an alliance has been formed with mana whenua, Ātiawa ki Whakarongotai, to support this project. The group has also been working with LEARNZ to produce virtual field trips for school kids all over NZ. So come share our river journey from the mountains to the sea, exploring how rivers work, what

makes them sick and what we can do to enhance te mana o te wai – the quality and vitality of our rivers (www.learnz.org.nz/rivers201). **Contact:** Amanda Death (Amanda.death@gw.govt.nz) or www.facebook.com/WaikanaekiUtakiTai.

Titahi Bay community plant the seeds for environmental leadership

– Whānau in Titahi Bay have been planting native seedlings to enhance their local environment as a part of the Kahotea Stream Restoration Group, funded by Greater Wellington Regional Council's Community Environment Fund. The fund has helped a wide range of local community groups to restore and protect te taiao (the environment) in Te Awarua-o-Porirua Harbour and catchment area. It is estimated that this eager group planted around 400 plants on the day, including natives such as kōwhai, tōtara, karamu and whau. The students are part of a multi-school project in western Porirua, which aims to empower young people to lead positive change for their local environment. Funding from Greater Wellington allows for longer-term planning and better community engagement, says Becky McCormack, who leads the Kahotea Stream Restoration Group and is an education coordinator at Porirua Harbour and Catchment Community Trust. "Since we have guaranteed funding for plants over the next three years we can channel our focus into achieving a bigger and stronger vision for Kahotea Stream, that will bring the community alongside it," says Becky. **Contact:** Micheline Evans (Micheline.evans@gw.govt.nz).

Mahi Waiora / The wellbeing of water

– Mahi Waiora aims to help GWRC work more effectively across teams towards its water quality and biodiversity priorities. The project is testing inter team practice and environmental improvement at a catchment scale in three 'prototype' catchments; Waitohu in Kāpiti whaitua, Pouewe in Te Awarua-o-Porirua and Parkvale in Ruamāhanga. Each prototype team includes representatives from mana whenua and council staff from our science, policy, consenting, land management, flood protection, biodiversity, parks and pest management departments. Regional scale 'state of environment' monitoring gave teams broad understanding of environmental issues, but all teams wanted catchment scale understanding of 'hot spots' and high priority areas for their catchment actions. Short-term and high-resolution sampling for *E. coli*, nutrients and dissolved oxygen provided the focus for each team's actions that are aimed on addressing higher risk parts of the catchment. Teams have also engaged particular segments of the catchment population towards improving catchment targets. In the Waitohu catchment, whānau of Ngā hapū o Ōtaki monitored inanga spawning habitat, then partnered with prototype team members and the land owner to remove pine trees, fence and plant grasses to improve spawning habitat in a 400 metre section of Waitohu Stream. The team has moved beyond ideas, and now, with the community, they are taking action. **Staff involved:** Lisa Young (Project Manager Mahi Waiora) **Contact:** Lisa Young, Project Manager Mahi Waiora (lisa.young@gw.govt.nz).



TOP LEFT: Kari de Koenigswarter looks for dragonfly larvae with Kahutara students. Photo © Mountains to Sea Wellington

TOP RIGHT: A kakahi rests on a sandy bed.

MIDDLE RIGHT: One of only four juvenile kakahi found during annual count at Wairarapa Lake Shore Scenic Reserve. Photo © GWRC

BOTTOM: Norman Mackenzie Doods and Kari de Koenigswarter with Kahutara students. Photo © Mountains to Sea Wellington

Citizen Science continues to grow – GW staff continue to support a variety of citizen science projects across the organisation, including:

- freshwater monitoring training with schools, iwi and community groups,
- mammal monitoring,
- region-wide biodiversity monitoring,
- fish passage barriers,
- cultural health monitoring indicators,
- restoration activities, and
- kakahi count.

And thanks to Mountains to Sea Wellington, freshwater monitoring training for community went online during COVID-19 lockdown using the platform make Ripples. If you are keen to learn more about how to monitor your local stream, register at <http://mountainstoseawellington.org/freshwater-citizen-science-registration-form> **Contact:** Sheryl Miller (Sheryl.miller@gw.govt.nz) ■



TOP: Measuring kakahi during annual count at Wairarapa Lake Shore Scenice Reserve. Photo © GWRC

BOTTOM: Porirua College students learning how to use freshwater monitoring tests. Photo © Sheryl Miller



Lake Mahinapua

Photo © Angus McIntosh

RESEARCH & CONSULTANCY COMPANIES

Cawthron Institute



Calum MacNeil has joined our freshwater team from an island even smaller than New Zealand – the Isle of Man. **Annika Wagenhoff** has re-joined the team part-time after her maternity leave. **John Hayes** enjoys his move to part-time work and ticking things off his lists for which he never found time for before. **Kati Doehring** is one year into her PhD in Science Communication through the Centre for Science Communication in Dunedin (part-time) looking at the effectiveness of online storytelling as a science communication tool for rural communities. Her research will inform the design of a new LAWA module which will quantify land management actions that help improve water quality at catchment scales (for more detail see specific project description). **Katie Brasell** is now into her 3rd year of PhD research, focusing on lake disturbance regimes, resistance, and resilience at multiple trophic levels. **Karen Shearer** just celebrated 25 years at Cawthron. She is not sure whether to be proud or embarrassed, although Calum put it all in perspective for her by telling her that even a life sentence these days is only 10 years.

Apart from keeping busy with various national and regional consulting projects (see specific project descriptions below), many of our freshwater scientists have increased collaboration with the Cawthron social sciences team (officially 'People, Policy and Planning'), reflecting the overall shift of focus in New Zealand's freshwater management from a purely bio-physical scientific discipline to a socio-ecological discipline. The PPP team is led by **Jim Sinner** and consists of **Kiely McFarlane**, **Charlotte Šunde** and **Marc Tadaki**.

KEY PROJECTS

DOC biodiversity Monitoring Pilot – 2020 –

Cawthron has been assisting the Department of Conservation (DOC) in the process of designing and implementing a national freshwater monitoring programme. This programme will collect data on plant and animal communities and habitat characteristics at a range of monitoring locations throughout the country. The objective of this programme is to provide data to enable robust status and trend assessment of the ecological integrity of freshwater streams and rivers within the Crown-managed public conservation estate. The planned pilot monitoring programme comprised 41 sites on public conservation land and waters (PCL) around New Zealand. Due to the outbreak of COVID-19 and associated restrictions on inter-regional travel, a total of 19 of the originally planned 41 sites were monitored. A range of parameters were measured at each site, encompassing metrics for sediment and sedimentation, primary productivity, waterway biological function, water chemistry and physicochemical factors and assessments of habitat availability. **Staff involved:** David Kelly, Laura Kelly, Robin Holmes, Mark Newton, Paula Casanovas. **Outputs:** *Cawthron report* - Kelly L, Casanovas P, Kelly D 2020. DOC Tier 1 monitoring pilot assessment – draft report. Prepared for the Department of Conservation. Cawthron Report No. 3540. 52 p. plus appendix.

National Register of Land Management Actions – National Science Challenge Our Land and Water –

The National Register Team (**Kati Doehring**, **Roger Young** (Cawthron), Christina Robb (Happen Consulting), Sylvia Tapuke (SCION), Jonathon Alsop (Effect) and **Aneika Young** (Cawthron)) are well into the second year (of three) with their NSC Our Land and Water project. To recap: we will develop a new LAWA module which reports on what land management actions have been done, where and to what extent. Over the past year, we have built strong relationships with the people in our four pilot catchments Pomahaka (Otago), Motueka (Tasman), Waingongoro (Taranaki) and Te Arawa Region (Bay of Plenty), learning about what questions stakeholders, rural communities and iwi/hapu have about land management actions that help improve water quality and the recording and reporting of those. This knowledge will help us make sure we design the register in a useful way for as many end users as possible. To build new research capability in young

māori researchers, Cawthron hosted Fern Kumeroa over the 2019/20 summer (Nga pae o te maramatanga scholarship) who helped with the selection of the four pilot catchments. In the second year, we will start designing and populating the register with land management action data. **Outputs:** <https://ourlandandwater.nz/news/how-can-we-connect-farmers-actions-to-see-the-big-picture-on-improving-water-quality>, Doehring *et al.* (2020).

Te Whakakotahitanga mō te taiao: New models of collective responsibility for land and water

– *Te Whakakotahitanga mō te taiao: New models of collective responsibility for land and water* – is well underway. Funded by Our Land & Water National Science Challenge, we are developing guidance to help catchment groups to achieve freshwater objectives. We are working with catchment communities, including tangata whenua, in the Bay of Islands, Hawkes Bay, Marlborough and Southland, and with a policy advisory group, to identify ‘what works’ to motivate and support effective collective management. The research team includes **Jim Sinner** and **Marc Tadaki** of Cawthron, Ed Challies of University of Canterbury, Christina Robb of Happen Consulting, Hirini Tane of Takarangi Research, and Margaret Kilvington of Independent Social Research, Facilitation and Evaluation. The team published an opinion piece in August arguing that catchment groups have a key role in meeting NZ’s freshwater goals. Here is a link if you missed it: www.stuff.co.nz/opinion/122399133/catchment-groups-key-to-healthy-waterways

Green bottoms – Looking at why benthic green algae proliferations are recently being seen in clean low nutrient lakes around the world – has been disrupted by COVID restrictions but keeps going. An international workshop (Royal Society Catalyst program) planned for April 2020 was cancelled. Instead, with the help of a University of Waikato Summer Scholar student, we are running a workshop looking at groundwater impacts on benthic green algae in Lake Taupō in February 2021. Our international visitors will attend virtually. We’re currently looking into future work to characterise grazer control on benthic filamentous algae. Simon Stewart will provide an update on this work at the December meeting. **Staff involved:** Simon Stewart, Sean Waters, Dave Kelly, Susie Wood and Ian Hawes (University of Waikato).

Dissolved Organic Nitrogen – Cawthron Scientists are exploring approaches for better characterising dissolved organic nitrogen (DON). We are currently trialling liquid chromatography mass spectrometry analysis to quantify the various amino-acids using samples from Lakes380. Eventually we would like to use these data to develop better bioassay techniques so that we know where and when we need to consider DON in setting nitrogen targets in lakes. **Staff involved:** Simon Stewart, Jonathon Puddick, Dave Kelly, Susie Wood, Ian Hawes (UoW) and Tina Beyer (ECan).



Beautiful 255 mm koaro caught in the Crow River, Upper Karamea catchment. Photo © Cawthron Institute

Lakes 380 – After a lock-down induced pause the lake coring campaign continues across the country with Hawkes Bay and Manawatu visited recently and Waikato, North Canterbury and Marlborough coming up in the next month or two.. **Charlotte Šunde** is a Cawthron social scientist who works in collaboration with iwi on lakes in the Wairarapa, Rangitikei, Manawatū, and on Rangitoto ki te Tonga (D’Urville Island). Charlotte initiated the Wairarapa Moana Pūrākau Kete (a digital storytelling portal) which features short documentaries on the ecological and cultural history of Wairarapa Moana, current concerns for its health and prospects for restoring te mana o te wai. Discover these lake stories here: lakestoriesnz.org. **Staff involved:** Susie Wood, Kiely McFarlane, Xavier Pochon, Javier Atalah, Dave Kelly, Johnathan Puddick, Sean Waters, McKayla Holloway, Lucy Thompson, Georgia Thompson-Liang, Elaine Asquith, Laura Kelly, Katie Brasell, Maily Picard, Konstanze Steiner.

Pathways to Ecosystem Regeneration –

Cawthron is co-leading a new 4-yr research program for Biological Heritage National Science Challenge focussed on quantifying social-ecological linkages for use in managing, protecting and restoring land and water ecosystems. **Joanne Clapcott** (co-lead) in partnership with Danielle Shanahan (Zealandia) have shaped the program around amplifying the impact of community collective restoration efforts. Cawthron team members include **Kiely McFarlane**, who is leading a critical review of social-ecological frameworks to reveal the mechanistic pathways through which the connections between people and Te Taiao can lead to successful ecosystem regeneration; and, **Robin Holmes** and **Marc Tadaki**, who

are co-leading a think piece on the role of valued introduced species in bio-heritage regeneration (see below for more detailed information). Research partners leading other projects include Kiri Wallace (University of Waikato), who is scoping the breadth of community collectives in Aotearoa with a view towards developing research exemplars; Phil Lyver (Manaaki Whenua Landcare Research), leading a team quantifying resilience in social-ecological systems using cross-cultural value networks; and, Esther Richardson, who is working towards establishment of an adaptive management network to upscale native forest restoration outside conservation land.

Is there a role for trout in regenerating Aotearoa’s biological heritage?

– This think piece asks what place introduced salmonids might have in regenerating our biological heritage and enabling flourishing and just social-ecological systems. Trout, as a valued introduced fish that predates upon and competes with native fish, are a pertinent example of an introduced species with complex socio-ecological roles and cultural meanings. The research includes a review of the historical and scientific literature as well as interviews with scientists, Māori knowledge holders, and fishery managers on the history and outcomes of trout management in Aotearoa. The research aims to disentangle the ecological and cultural values that have become bundled together in the ‘trout debate’. We aim to publish our results in a report and journal article in 2021.

Staff involved: Robin Holmes, Marc Tadaki, Jane Kitson (Kitson Consulting Limited), Kiely McFarlane. ■



Electric fishing in Stoney Creek, Upper Mokihinui Catchment. Photo © Cawthron Institute

KEY PROJECTS

Eastern Bays Shared Path project – Wellington’s Eastern Bays are closer to having a safer pedestrian and cycleway connecting their communities from Eastbourne to Point Howard. This **Hutt City Council** project has been selected as one of the Government’s ‘shovel ready’ projects, with the resource consent application hearing set for December this year. **Shelley McMurtrie, Alex James** and **Kirsty Brennan** have provided intertidal, subtidal and freshwater ecological advice for the project, including GIS expertise for the wider team. The new seawall design will not only provide resilience to the pathway and road, it will incorporate design features to improve intertidal habitat where old seawalls currently exist. Creating textures and rock pools along the length of the seawalls will improve the existing habitat and encourage the community to engage with intertidal ecology. This project is an example of effective engagement of ecologists on infrastructure projects with benefits for the environment and community.

Canterbury Mudfish/Kōwaro – Habitat improvement and transfer plans – EOS Ecology has been working with Environment Canterbury to ensure future habitat for Canterbury mudfish in the region. Led by **Shelley McMurtrie** with the assistance of **Siobhán Culhane, Elizabeth Butcher, Kirsty Brennan, Emily Demchick, Nick Hempston** and **Erron Henderson**, the team has used drone and GIS capabilities, along with more traditional survey techniques, to quantify the proportion of suitable habitat and food supply currently available at the release sites.

We’ve developed plans for the effective transfer of mudfish to their new habitats and their long-term management, and are now working on improving habitat conditions prior to their introduction. **Outputs:** Management plan, Transfer plan.

‘Nature Agents’ monitoring *E.coli* – As an extension to our schools ‘Nature Agents’ stream monitoring programme, this year we added an *E.coli* module in collaboration with the School of Biological Sciences at **University of Canterbury** (UC). Eleven schools across Christchurch are participating in three rounds of stream testing for *E.coli*. Our aim is to discover how accurately students can 1. collect water samples for *E.coli* testing, and 2. count *E.coli* colonies, comparing the results to those of a UC microbiologist. **Kirsty Brennan** has integrated this new measurement into ‘Nature Agents’ water quality testing component. **Bronwyn Gay** produced a ‘how-to’ collect & count resource and an interim report card for schools to compare their results. **Outputs:** Resources & report card.



TOP: Students collecting samples. RIGHT: *E.coli* report card.



LEFT: Hess sampling mudfish habitat. RIGHT: Habitat map of Hinds survey area. All images on page © EOS Ecology



[S](#) About Water Clarity | [Current Programmes](#) | [View Data](#) | [Submit Data](#) | [Jobs](#) | [Our Supporters](#)

Water clarity data entered by ALL Streamed programme is summarised below. There are a number of dashboards that group the data into clarity categories. This allows you to view how water clarity changes between sites, over time and due to different land-based effects.

Information about the data and how it's displayed can be found in the text box on the left side of the browser. This can be hidden or expanded using the arrow on the vertical divider. To view the different data click the navigation tabs below.

If you use this data you agree to the [Disclaimer](#) on our [Terms of Use](#) page, plus you will acknowledge the source (i.e., Streamed, www.streamed.nz, date accessed) and the group/s who collected the data.

[Interactive site map](#) | [Land-based effects](#) | [Over time](#) | [Compare sites](#)

Latest Water Clarity Readings for ALL Streamed Sites

Area:
Latest Water Clarity Reading – As mentioned above the coloured markers on the map show the location of all the monitoring sites, while the colour of each marker indicates the water clarity category reading from the last monitoring. See the legend to find out what the category colours mean. Click on the markers for additional site information which is provided in a pop-up window, including:

- Date of the latest reading and the water clarity category it fell within.
- Site information = name/number, project affiliation/name, site owner, waterway name.
- Catchment information = dominant land use (rural, urban, etc.).

Site Name:	Omaru Stream at Oamaru Bay Road (Site 1)
Project Affiliation:	Nature Agents
Project Name:	Nature Agents - Carterbury Water Clarity
Site Owner:	Te Pahi Rakaiputu
Waterway Name:	Omaru Stream
Dominant Land Use:	Rural (ag/hort)
Zoom:	100%

Licensed from the NZCA Data Service and licensed for use under the Creative Commons License



This project's key focus is to identify potential inaka/whitebait spawning areas at the head of Whakaraupō/Lyttelton Harbour and determine their current state of spawning success. We will then develop and implement appropriate spawning habitat restoration plans through an understanding of mahinga kai. Finally, we aim to engage the local community and landowners with their inaka habitat and empower landowners to monitor and evaluate their own spawning zones into the future.

- We'll achieve this with these methods:
- Using a standardised habitat assessment for spawning sites and egg surveys. We'll evaluate the current state of spawning areas and what needs to be done to achieve greater spawning success.
 - Working closely with landowners to develop appropriate restoration design plans.
 - Habitat restoration works will be evaluated following construction works with more habitat assessments and egg surveys.
 - We'll develop a monitoring and evaluation plan for landowners so the project will continue to improve and succeed into the future. Using an online platform, landowners will be able to monitor the progress of habitat restoration over time and continue to evaluate the effectiveness of habitat for inaka spawning.



‘Nature Agents’ GIS module – To give ‘Nature Agents’ students a deeper understanding of the stream monitoring data they collect, **Kirsty Brennan, Elizabeth Butcher** and **Bronwyn Gay** have developed a GIS module using ArcGIS Online. Setting each school up with a *GIS in Schools* account and providing a variety of tools, students are able to enter their ‘Nature Agents’ monitoring data online and immediately view it on maps and interactive dashboards. Through incorporating GIS into ‘Nature Agents’ students are able to investigate their data in the wider context of their catchment, as well as comparing their data with other schools, or seeing how it changes over time. Teachers are supported through new resources designed specifically for this module and teacher training workshops. **Outputs:** Teaching resources and online interface <https://na-eos.maps.arcgis.com/apps/opsdashboard/index.html#/6b39198f0a6b4c519237b584489024f6>

Īnaka ki Whakaraupō/Whitebait to Whakaraupō – In collaboration with **Te Hapū o Ngāti Wheke** and **University of Canterbury Marine Ecology Research Group, Shelley McMurtrie** and **Kirsty Brennan** are looking to improve spawning success of inanga/inaka at the head of Whakaraupō/Lyttelton Harbour. Outputs from the project will contribute to the Whaka-Ora Healthy Harbour Plan and long-term landowner engagement. The project will focus on five catchments, and working closely with landowners, undertake saltwater, habitat and spawning surveys in order to co-develop restoration plans for long-term inaka spawning success. **Outputs:** Restoration plans.

Assessment of suitable salmon spawning habitat in tributary waterways of the Ōtukaikino – **Shelley McMurtrie** undertook work for Isaac Conservation and Wildlife Trust to investigate the potential for salmon spawning in tributaries of the upper Ōtukaikino River. The project involved categorising present habitat according to a scaled suitability for salmon spawning, with surveys undertaken by Shelley, **Nick Hempston** and **Ariana Painter**, and mapping by **Elizabeth Butcher** and **Kirsty Brennan**. Our findings indicated that these upper tributaries are currently unlikely to support spawning, with more suitable habitat present downstream of the surveyed sections.

SH2 Improvements, Central Hawkes Bay – **Alex James** undertook a detailed stream walkover and fish survey to determine if fish passage was required at several road culverts which are to be upgraded as part of a road realignment and widening project. Waterways were ephemeral directly downstream and upstream of the project area meaning the upgraded culverts need not consider fish passage. Eels, however, were abundant in deep drainage channels further downstream of the project area. **Outputs:** Client report and NZFFD entry of fish data.

Masterton District Council Water Treatment Plant ecological survey – **Alex James** and **Siobhán Culhane** undertook an aquatic macroinvertebrate and fish survey in relation to Masterton District Council’s town water supply intake. There was no evidence of the water take having negative impacts on fish and macroinvertebrates of the Waingawa River. Future work may involve investigating fish entrainment at the intake structure. **Outputs:** Client report and NZFFD entry of fish data.

‘Streamed’ – Community-sourced New Zealand Freshwater Data – With the support of Internet NZ, the EOS Ecology team has successfully launched ‘Streamed’ – an online water clarity monitoring tool to store and display data collected by members of the community. The aim of ‘Streamed’ is to provide a digital voice for local communities and the waterways they monitor.

The publicly available website allows communities to enter and view real-time data through dashboards, as well as learn more about water clarity, providing communities with a greater awareness and evidence-based understanding of their local freshwater environments. We currently have three community monitoring programmes and over 4,100 data records on the site, and with the launch of ‘Streamed’ we hope to get more communities actively monitoring water clarity throughout New Zealand.

The Streamed website was developed by **Shelley McMurtrie, Elizabeth Butcher, Bronwyn Gay** and **Kirsty Brennan**, with support from Eagle Technology using ArcGIS Hub, an online platform developed by Esri. **Outputs:** www.streamed.nz

Long-term monitoring programmes –

1. Cut slope soil erosion trial (CSSET) monitoring: After a successful first year of construction and monitoring, which also included pest control, Year 2 is now underway to determine the best combination of products and vegetation to reduce erosion from loess cut slopes. This project continues to be led by **Shelley McMurtrie**, with input from **Elizabeth Butcher**, in collaboration with science partners Manaaki Whenua/Landcare Research, construction partners Fulton Hogan, Wai-ora Nursery and Christchurch Adventure Park.
2. West Coast landfill water quality: **Emily Demchick** and **Elizabeth Butcher** continue to assist Westland District Council with their surface water and groundwater monitoring requirements at two closed landfills. Implementing the re-designed monitoring programme developed last year, this continuous monitoring is helping build a picture of the water quality whilst highlighting any impacts of the landfills. **Outputs:** For CSSET www.ecan.govt.nz/get-involved/news-and-events/zone-news/banks-peninsula/roadside-cutting-trial-proving-huge-success, and water quality monitoring reports for West Coast landfills. ■

TOP LEFT: Masterton District Council Water Treatment Plant ecological survey. TOP RIGHT: CSSET monitoring.

MIDDLE LEFT: Salmon spawning habitat in the Ōtukaikino. MIDDLE RIGHT: Streamed website.

BOTTOM LEFT: A chubster eel found during SH2 Improvements survey. BOTTOM RIGHT: Īnaka ki Whakaraupō project intro.

All images on this page © EOS Ecology

Since completing his PhD thesis last year, Steve has moved back to his whenua in Northland and is again operating as an independent ecologist, processing stream invertebrate samples for environmental monitoring programmes, and working on research contracts. The main research projects, done in collaboration with Brian Smith (NIWA), Russell Death (Massey University), Olly Ball (NorthTec) and Mike Winterbourn (University of Canterbury), for the Department of Conservation, focus on trying to improve our understanding of aquatic insect biodiversity and the methods used to survey and monitor their populations. Steve also continues to gather data for his various mayfly taxonomy and DNA library projects.

Other collaborations include an investigation led by Russell Death for Northland Regional Council looking at possible drought impacts on macroinvertebrates in Northland over the last decade, and a study with Lara Shepherd (Te Papa–Museum of New Zealand), Olly Ball, Mike Winterbourn and Sharyn Goldstien (Science Synthesiser) assessing phylogenetic relationships of the New Zealand mayfly fauna.

KEY PROJECTS

Macroecology of New Zealand

Ephemeroptera – Steve’s PhD thesis on the New Zealand mayfly fauna was submitted last year and included large-scale aspects of ecology, population genetics and conservation. A particular focus was the latitudinal and altitudinal distribution of species and community assemblages. Steve is supervised by Jon Harding, Mike Winterbourn and Sharyn Goldstien. **Outputs:** PhD thesis and 5 published papers (2018–2020). One more in preparation.

Improving conservation status knowledge of aquatic EPT insects – This project was based on aquatic insect surveys at 50 sites across the north-western quarter of the South Island and aimed to improve our knowledge of the biodiversity present in those regions, and more generally species distributions and conservation status. To date, interesting results include six new species, new records of several undescribed (but known) taxa, additional locations and range extensions of uncommon species and new records of Threatened and Data Deficient species.

Assessment of methods for monitoring aquatic insect biodiversity – This programme of research looks at assessing and developing methods and protocols for aquatic insect biodiversity surveys and surveillance monitoring. There are currently five independent threads to the research programme, all being based on a 1-year, approximately monthly sampling programme at 18 forest sites in Northland. The present study assesses the effectiveness of three insect sampling methods, with other threads planned to investigate seasonal flight activity, the optimal spatial and temporal sampling replication for monitoring programmes, and the use of reach-scale habitat by invertebrate communities. ■

TOP: Steve Pohe setting SLAM trap in the Pukenui Forest, Northland. SLAM’s (Sea Land Air Malaise) are modified Malaise intercept nets and are one of the three sampling methods currently being assessed for their effectiveness for use in aquatic insect biodiversity surveys. Photos © Taylor Kees

BOTTOM: New species of mayfly, currently tagged as *Zephlebia* aff. *pirongia* sp. 1, and one of four new species of *Zephlebia* mayfly needing to be described. Photos © Olly Ball / Steve Pohe Collection



New: Bryony Alden, Deni Murray, Steve Rate, Megha Sethi, Melanie Vermeulen

Ryder Environmental has had a strong year despite the disruptions of COVID-19. We are fortunate to have many clients that have supported us with continued commitment to existing work streams and our forward workload is as busy as ever. **Greg** has a new role on the Environmental Protection Authority Board and was appointed as a Freshwater Commissioner by the Ministry for the Environment, **Ben** has been completing assessments of wastewater discharges throughout Otago and Southland, **Ruth** has been undertaking technical reviews, **Mandy** has been working with the Department of Conservation on lizard management and freshwater restoration programmes, **Mark** is wrapping up the Waipipi Wind Farm project (Taranaki) after a decade of involvement, and **Christiane** our administrator keeps our ship running smoothly. We have a great lab team of enthusiastic and knowledgeable staff, including **Mike** our quality assurance expert, that support our scientists as well as providing excellent service to several external clients.

We have brought on board a number of new and returning staff this year: **Bryony** has returned part-time as manager of the Ryder Laboratory while she pursues a PhD at Otago University; **Deni** has joined us from the U.S. and is our statistical analyses guru; **Steve** is a senior ecologist/botanist with a speciality in wetland environments; **Megha** has recently completed her MSc and is part of the laboratory team, and **Melanie** has a consultancy background and is undertaking a mix of field and laboratory work.

KEY PROJECTS

Otago Regional Council biomonitoring –

Ryder Environmental continue to assist ORC by completing monthly monitoring of 37 sites throughout Otago. Monthly assessments of sediment cover, and periphyton cover and biomass, and annual macroinvertebrate sampling and habitat assessments, have been undertaken at a range of different sites, from lowland to mountain streams. Laboratory processing of samples has kept the lab team busy as well. **Staff involved:** Bryony Alden, Ruth Goldsmith, Ben Ludgate, Deni Murray, Megha Sethi, Mike Wakelin, Melanie Vermeulen.

Oceana Gold – Macraes Flat and Waihi gold mines biomonitoring –

We undertake regular biological monitoring to fulfil resource consent requirements for Oceana Gold at a number of sites within the mine footprints. The programme requires biomass assessments of periphyton and macrophytes and population and diversity

analyses of stream macroinvertebrates and fish. **Staff involved:** Bryony Alden, Ruth Goldsmith, Ben Ludgate, Deni Murray, Greg Ryder, Mike Wakelin, Melanie Vermeulen.

Department of Conservation – Waituna Lagoon –

We are examining the current state and trends of the ecological health of Waituna Lagoon (Southland). The work will identify information gaps and help determine whether the ecosystem management guidelines for the lagoon, prepared in 2013, are fit for purpose. **Staff involved:** Deni Murray, Greg Ryder.

Trustpower – Mangorei Hydroelectric Power Scheme –

Trustpower has commenced a consenting process for the Hydroelectric Power Scheme located within the Waiwhakaiho River catchment in Taranaki. Ryder Environmental has provided an Assessment of Environmental Effects to address water quality and aquatic ecology aspects to support the consent application. **Staff involved:** Ruth Goldsmith, Greg Ryder, Mark Sanders. ■

TOP LEFT: Ben with a longfin eel (tuna) caught during an electric fishing survey of irrigation races near Pukeuri.

Photo © Ryder Environmental

TOP RIGHT: Melanie conducting a visual assessment of periphyton and sediment cover at The Neck, Lake Hawea, for ORC biomonitoring. Photo © Ryder Environmental

BOTTOM LEFT: Ruth and Mark electric fishing in the Waiwhakaiho River, Taranaki. Photo © Ryan Kane (Trustpower)

BOTTOM RIGHT: The Ryder Lab processing freshwater macroinvertebrate samples. Photo © Ryder Environmental





Koura
Photo © Cawthron Institute

John and Yvonne Stark established Stark Environmental Limited in June 2007 and have been offering specialist freshwater ecological research and consulting services (primarily concerned with macroinvertebrates, biotic indices, and biomonitoring) and processing macroinvertebrate samples for over 13 years. We have employed part-time staff to assist, but in the last couple of years we have managed on our own.

Sample processing dominates our activity these days and in the past 12 months we have processed a record number (940) for 14 different clients from throughout New Zealand and prepared nine consent biomonitoring reports.

John was the recipient of a SuperGold card last year, so we are considering our options for the future, although we have no immediate plans to retire, mainly because our two offspring are planning to buy houses in Wellington and require assistance from the bank of mum and dad! Gone are the days when you could buy a house for twice one's annual salary (like we did in late 1981).

We are extremely concerned about some of macroinvertebrate components of the recent NPS-FM. In our view, biomonitoring should be cost-effective but the new protocols are quantitative, more complex, and are likely to produce larger samples that could increase the cost of biomonitoring and put even more strain on the sample processing 'industry'. Spending more time and money collecting data and checking its quality will not improve river health. It takes management action based on biomonitoring results to do that. In our view, that's the weak link in the water management industry, not the nature and quality of environmental data (including macroinvertebrates). ■

Our ecology discipline has grown throughout 2020 and we now have resident ecologists in Nelson and Wellington who will be delivering projects in the upper South Island and lower North Island.

A wide range of projects throughout the past year have drawn on the expertise of our freshwater specialists in the areas of ecology, fluvial geomorphology, modelling, and engineering. Projects have ranged from monitoring, catchment management solutions, and land development, through to high level strategic policy and technical advice for our clients. With advances in remote viewing capabilities and affordability/accessibility of both aerial and submersible UAV's we are encouraging innovative thinking and problem solving outside of the traditional norms to address our client's needs. Several of our staff continue to be involved as technical specialists on the Fish Passage Advisory Group, Rivers Group, Biodiversity Group, and Water NZ.

Tonkin + Taylor continue to be involved across the transport, energy, land development, waste, and water sectors. Many upcoming projects have been influenced by the changing needs of New Zealand as a country, including diversification of transport and the future demands on electricity generation, housing, and water supply. Shifts in approach to 'whole of catchment' sediment and erosion management by TLA's in New Zealand and wider Australasia, has resulted in increased interest in our fluvial geomorphology offerings. Likewise, the release of the NPS-FM and NES-FW have seen a focus from both internal and external clients on freshwater matters within their projects, and we are excited to see where this takes us in the coming years.



View of from the top of the saddle along the proposed Manawatu Tararua Highway. Photo © T&T

KEY PROJECTS

Tasman District Council natural channel design guidelines – Tasman District Council identified a need to provide better guidance on what their expectations are in regards to stream diversions, and how to best achieve these expectations. **Selene Conn** and **Bryn Quilter** developed a 'vision guideline' for Natural Channel Design (NCD) to support the Nelson Tasman Land Development Manual. The Guideline is based on an extensive review of existing guidance.

The intent of the Natural Channel Design Guidelines is to create the required hydraulic conveyance of a drainage channel and floodway while maximising its potential ecological, cultural, amenity and/or recreational values, to achieve the best environmental and ecological outcome.

The natural channel design guidelines provide guidance to developers and their agents for the design of naturalised stream diversions, stream restoration and partial alterations within future developments and to aid resource consent applications. It is also to support Tasman District Council as a Unitary Authority to holistically protect, enhance and manage streams within urban developments.

Water quality and ecology advice to the Energy Sector – T+T freshwater scientists have been busy in the Energy Sector over the past year. Our clients in this sector include Genesis Energy, Mercury NZ, Northpower and Trustpower and project work ranges from consent compliance monitoring, ecological management plan development and implementation for renewable energy developments. We also continue to provide our clients with strategic advice on National and Regional Policy. Projects in this industry continue to prove both interesting and challenging with a diverse portfolio of projects underway throughout the country. Emphasis by central government on renewable energy projects means that this sector will continue to provide project opportunities for years to come.

Our work in the industry involves several members on T+T ecology and wider science teams. **Dean Miller, Peter Cochrane, Caleb Sjardin and Selene Conn** have been involved with providing high level technical advice and guidance to our energy industry clients. While **Steven Pratt, Georgia Cummings, Toni Shell, David Pickett, Kate Rogers** and **Tumanako Ritchie** continue to be very busy undertaking on the ground implementation and technical reporting on comprehensive ecological and environmental monitoring programmes for a variety of schemes and projects throughout the country.

Hamilton city stormwater and receiving environment monitoring and management

– T+T freshwater scientists from our Hamilton Office have continued to support Hamilton City Council with implementation of best practice stormwater management and receiving environment monitoring. **Dean Miller** and **Peter Cochrane** have assisted council in finalising a comprehensive update to its stormwater monitoring plan with on the ground implementation by **Steven Pratt** and **Toni Shell**. The basis of the monitoring plan is an adaptive and responsive approach to environmental data. The monitoring plan broadly encompasses lake and stream water quality, sediment quality, ecological health, stream and catchment erosion susceptibility and city expansion.

Dean and **Bryn Quilter** have contributed to a city-wide stormwater master plan to support improved stormwater management and outcomes in the longer term. This includes the development of a prioritised programme of projects from fish passage improvements to stormwater treatment. Hamilton's Mangakotukutuku catchment remains an area of focus with significant urban development commencing along with comprehensive restoration and mitigation and biodiversity management planning.

Specialist input to regulatory processes – We are continuing to provide input to the specialist component of regulatory resource consent processing for several Councils across New Zealand. With a change in the way offsetting is considered under the Resource Management Act (1991) and the release of the Guidance to Biodiversity Offsetting under the RMA (2018), and updates to the National Policy Statement on Freshwater Management (NPS-FM) and National Environmental Standards for Freshwater (NES-FW) we are increasingly providing input to quantifying ecological values and offset proposals. This has become more important as developments move into greenfield areas with the shift towards no net loss (or net gain), and the inclusion of regulations on fish passage, wetlands and river reclamation within the new 2020 NES-FW. **Josh Markham, Justine Quinn, Duncan Law, Liza Kabrle, Liz Curry** and **Patrick Lees** have been working in this space this year.

Christchurch City Council Lower Ōpāwaho/Heathcote fish monitoring – Bimonthly for the last 12 months T+T staff including **Patrick Lees, Scott Thomas** and **Ashleigh Johnston** have been monitoring the fish communities in the lower reaches of the Ōpāwaho/Heathcote River. The purpose of the monitoring is to assess any residual impacts of dredging on fishes and monitor any changes in fish communities over time.

The monitoring work was undertaken alongside the tuna/eel relocation work being completed by Instream Consulting Ltd, who are relocating both shortfin and longfin eel from active dredging areas. In collaboration with the relocation work T+T staff are sharing eel capture data with Instream so they can analyse recapture rates through PIT tags.

Preliminary results show the composition of the fish community changes (slightly and unsurprisingly) from being

dominated by giant bully and shortfin eel at the downstream sites to common bully and longfin eel at the upstream sites. What was good to see occur over the monitoring period were the high numbers of adult Īnaka and returning juvenile Īnaka being identified during the respective migratory periods.

Nelson City Council stormwater receiving environment survey methodology

– T+T freshwater scientists and geospatial specialists from our Christchurch Office continue to support Nelson City Council (NCC) to develop a Stormwater Receiving Environment Survey (SRES) methodology and geodatabase collection tool. **Patrick Lees, Selene Conn, Dean Miller, and Bryn Quilter** worked closely with our geospatial team to develop, trial, and finalise a comprehensive SRES methodology to assess Wadeable Watercourses within the NCC region.

The SRES collects meaningful data (engineering assets, biological and geomorphological stream state) to inform effective management of watercourse ecological health, erosion, stormwater infrastructure and stormwater conveyance. The SRES methodology was developed for the NCC due to a wider need for robust information about watercourses and stormwater receiving environments in the Nelson region.

The SRES methodology and geodatabase collection tool will become a core resource for the council to provide baseline information to guide the management of waterways and identify potential enhancement and maintenance opportunities within Nelson streams.

Te Ahu a Turanga Manawatu-Tararua Highway

– A large contingent of our team have been spending time in the Manawātū-Whanganui region over the past 18 months, working on the consenting and design of the Te Ahu a Turanga Manawātū-Tararua Highway. This has been an exciting project, working collaboratively with iwi project partners, DOC and QEII to address ecological concerns. We developed a comprehensive mitigation and offset package to address freshwater effects and the project is now moving into the construction phase.

This has been a whole team effort, but some contributions are particularly noteworthy. **Duncan Law** and **Kylie Park** have led the field work and design discussions with the Alliance project team. **Alicia Wong** and **Sam Heggie-Grace** have been in the field working in the freshwater and wetland space. **Justine Quinn** and **Josh Markham** prepared evidence and worked through expert conferencing to address ecological effects and offsetting for freshwater and wetlands respectively. **David Pickett** is leading the work on the ground now as we move into the first earthworks season. **Outputs:** www.nzta.govt.nz/projects/sh3-manawatu



TOP LEFT: Steven Pratt installing fyke net for fish survey within the lower Kaimai Ranges.

TOP RIGHT: Steven Pratt and Kate Rogers undertaking instream sample collection and logger servicing.

MIDDLE RIGHT: Longfin eel Kaimai Ranges. Photo © T&T

BOTTOM: Longfin eel Kaimai Ranges.

Northland water supply projects – T+T’s Ecology team have been working with **Dr Martin Neale** (Puhoi Stour Limited) to provide ecological advice to inform opportunity and constraints assessments, and assessments of ecological effects, for several proposed water supply reservoirs in Northland. Funded by the Provincial Growth Fund, these projects are to provide much needed water for a regularly drought-stricken region. Several members of our team have had input with this work, including our terrestrial colleagues who got quite excited about a surprise threatened bird at one of the more degraded sites. Leading the charge in the field have been **Alicia Wong** and **Sam Heggie Grace**, with support from **Mike Lake**. **Justine Quinn** and **Josh Markham** have been providing senior support and strategic advice on the project.

Lower Manawatū sediment study – The Lower Manawatū and Ōroua Rivers had been identified as having elevated sedimentation rates. This has flow effects for river management and flood risk, and our client was particularly

keen to understand the risk to the Manawatū Flood Scheme. Over the last decade numerous studies and investigations had been undertaken to understand sediment processes in the Manawatū and Ōroua Rivers. T+T was engaged to undertake a review of the sediment processes and geomorphic trends in both rivers, the potential effects of climate change on these processes, and a range of concepts to help manage the effects of sedimentation in the short, medium to long term

Selene Conn and **Bryn Quilter** lead the project, which included a desktop assessment of past and predicted future climate change effects on rainfall, temperature, stream flow, and sediment regime, to inform past and future potential river response. The resulting report identified 13 river types (based on geomorphic processes and river character) which had responded differently to historic changes in climate, and which will respond differently to different drivers of change in the future. Ten conceptual sediment reduction options were identified that could be applicable to the different river types. **Outputs:** A final report was prepared for HRC’s science and river teams, and Selene presented the findings to the HRC councillors. ■



Steven Pratt undertaking fish survey in larger river within the Kaimai Ranges. Photo © T&T



Middle Bush Stream

Photo © Angus McIntosh

NON-PROFIT ORGANISATIONS

Fish & Game New Zealand



KEY PROJECTS

West Coast Fish & Game Sports Fish Drift Diving Surveys – Monitor trout populations in key West Coast river fisheries by drift dive surveys to assess trends in distribution and abundance to establish long-term reliable datasets with a focus on rivers under threat from development and unsustainable fishing practices. Brown trout abundance and distribution was comparable to long-term trends across most catchments. Further work needs to be done to understand factors influencing trout abundance in the Mawheraiti and Upper Grey Rivers. **Staff involved:** Glen Newton, Baylee Kersten, Dean Kelly, Rhys Barrier, Lawson Davey, Jacob Lucas and Emily Moore. Collaborator: West Coast Regional Council. **Outputs:** <https://fishandgame.org.nz/westcoast/about/about-fish-and-game-council/council-downloads>

West Coast Fish & Game Lake Netting Surveys – Monitor trout populations in key West Coast lake fisheries by gillnetting to assess trends in size, condition, and abundance to establish long-term reliable datasets. Lakes Poerua and Brunner were surveyed using standardised procedures from previous surveys. Trout on Lake Brunner were smaller than 2011 (1kg average weight) but in greater abundance and better condition. Trout on Lake Poerua were larger than 2012 (1.7kg average) but in lower abundance although with similar condition. **Staff involved:** Glen Newton and Baylee Kersten. **Outputs:** <https://fishandgame.org.nz/westcoast/about/about-fish-and-game-council/council-downloads>

West Coast Fish & Game Sports Fish Spawning Survey – To monitor salmon spawning in key salmon fisheries with a focus on establishing long-term reliable datasets. Key tributaries at lakes Mapourika and Paringa and the Hokitika and Taramakau Rivers were periodically surveyed during the spawning season to ascertain peak spawning counts. After low spawning counts in 2019 counts improved this year with Lake Mapourika

slightly below average and Lake Paringa above average. Low numbers were recorded Taramakau and Hokitika Rivers.

Staff involved: Baylee Kersten and Glen Newton. **Outputs:** <https://fishandgame.org.nz/westcoast/about/about-fish-and-game-council/council-downloads>

West Coast Fish & Game Sports Fishery Research – The Mawheraiti River Project to assess Trout Recruitment has completed its first year. Nominated spawning research streams were electric fished three times between November and May. River flows and temperature were also obtained to establish how they influence recruitment. Several years of data will be required before any trends or relationship can be identified with certainty. The New River Research project had a sonde deployed in the New River and has raised questions regarding potential anthropogenic disturbance to the fishery. Next year the project will be expanded to carrying out surveys on the aquatic life in the New River. **Staff involved:** Project overseen by Baylee Kersten, with field and data collection assistance from Dean Kelly, Glen Newton with West Coast Regional Council. **Outputs:** <https://fishandgame.org.nz/dmsdocument/1714>

West Coast Fish & Game Back Country Fisheries Management – This project consisted of carrying out an angler usage survey in the Mokihinui catchment using trail cameras, drift dives and angler survey. Of the three stretches of river monitored, the most popular stretch only had an occupancy rate of 8%. Compliance was carried out in both the Karamea and the Mokihinui catchment, with two anglers found to be non-compliant in regards to holding backcountry endorsements and issued warnings. Anglers were surveyed and again the majority were largely satisfied with their backcountry experience. This year saw an increase of resident anglers in the West Coast backcountry, with more resident anglers than non-residents anglers holding West Coast Backcountry endorsements and completing our survey for the first time in four years. **Staff involved:** Project overseen by Baylee Kersten, with field and data collection assistance from Dean Kelly and Glen Newton. **Outputs:** <https://fishandgame.org.nz/dmsdocument/1679> ■

RECENT PUBLICATIONS

- Baillie BR, BJ Hicks, ID Hogg, MR van den Heuvel, MO Kimberley. 2019. Debris dams as habitat for aquatic invertebrates in forested headwater streams: a large-scale field experiment. *Marine and Freshwater Research* 70:734–744. DOI:10.1071/MF18216.
- Barbieri L, Kral ST, Bailey SCC, Frazier AE, Schmale DG *et al.* 2019. Small unmanned aircraft systems (sUAS) in atmospheric science: measurement intercomparison for LAPSE-RATE. *Sensors* 19(9):2179.
- Benson J, Hanlon R, Seifried TM, Baloh P, Powers C, Grothe H, Schmale DG. 2019. Microorganisms collected from the surface of freshwater lakes using a drone water sampling system (DOWSE). *Water* 11(1):157.
- Bieber P, Seifried TM, Burkart J, Gratzl J, Kasper-Giebl A, Schmale DG, Grothe H. 2020. A drone-based bioaerosol sampling system to monitor ice nucleation particles in the lower atmosphere. *Remote Sensing* 12(3):552.
- Blyth J, Nation T, Taylor G. 2020. Moawhitu wetland hydrological restoration: inundation scenarios, control structures and peak flow assessment. Report prepared for the Department of Conservation. Taylor Collaborations Limited. 31 p. <https://ftp.doc.govt.nz/public/file/6UTLc85JzkKq2ox-EYY0zg/collaborations-2020-moawhitu-wetland-hydrological-restoration.pdf>
- Boddy NC, Booker DJ, McIntosh AR. 2020. Heterogeneity in flow disturbance around river confluences influences spatial patterns in native and non-native species co-occurrence. *Biological Invasions*. DOI:10.1007/s10530-020-02334-1.
- Boddy NC, Fraley KM, Warburton HJ, Jellyman PG., Booker DJ, Kelly D, McIntosh AR. 2019. Big impacts from small abstractions: the effects of surface water abstraction on freshwater fish assemblages. *Aquatic Conservation: Marine and Freshwater Ecosystems* 30:159-172. DOI:10.1002/aqc.3232.
- Boffa Miskell Limited. 2020. Avon River Precinct aquatic ecology: Six-years' post-rehabilitation activities. Report prepared for Christchurch City Council, Christchurch, New Zealand.
- Burdon FJ, McIntosh AR, Harding JS. 2019. Mechanisms of trophic niche compression: evidence from landscape disturbance. *Journal of Animal Ecology* 89:730-744. DOI:10.1111/1365-2656.13142.
- Burge OR, Clarkson BR, Bodmin KA, Bartlam S, Robertson HA, Sukias JP, Tanner CC. 2020. Plant responses to nutrient addition and predictive ability of vegetation N:P ratio in an austral fen. *Freshwater Biology* 65(4): 646–656. DOI:10.1111/fwb.13452.
- Catlin AK, Collier, KJ, Duggan IC. 2019. Diet of juvenile *Galaxias maculatus* (Galaxiidae) during the upstream migration period in the lower Waikato River, New Zealand. *Marine and Freshwater Research*. DOI:10.1071/MF18305.
- Collier KJ, Pilditch CA, Lundquist, CJ. 2019. Mountains-to-the-sea conservation: An island perspective. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 8 pages. DOI:10.1002/aqc.3197.
- Collins KE, Febria CM, Devlin HS, Hogsden KL, Warburton HJ, Goeller BC, McIntosh AR, Harding JS. 2020. Trialling tools using hand-weeding, weed mat and artificial shading to control nuisance macrophyte growth at multiple scales in small agricultural waterways. *New Zealand Journal of Marine and Freshwater Research* 54(3): 512–526. DOI:10.1080/00288330.2020.1722185.
- David BO, Jarvis M, Özkundakci D, Collier KJ, Hicks AS, Reid M. 2019. To sea or not to sea? Multiple lines of evidence reveal the contribution of non-diadromous recruitment for supporting endemic fish populations within New Zealand's longest river. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 29(9), 1409-1423. doi:10.1002/aqc.3022.
- de la Higuera I, Kasun GK, Torrance EL, Pratt AA, Maluenda A, Colombet J, Bisseux M, Ravet V, Dayaram A, Stainton D, Kraberger S, Zawar-Reza P, Goldstien S, James V, Briskie J, White R, Taylor H, Gomez C, Ainley DG, Harding JS, Fontenele RS, Schreck J, Ribeiro SG, Oswald SA, Arnold J, Varsani A, Enault F, Stedman KM. 2020. Unveiling Crucivirus Diversity by Mining Metagenomic Data. *mBio* 11(5): e01410-20.
- Death RG, Nicholson C, Chakraborty M, Pohe SR. 2020. Ecological health of stream invertebrate communities in Northland. Can state of the environment data identify drought impacts? Unpublished report for the Northland Regional Council. 93 p.
- Department of Conservation. 2020. Biodiversity in Aotearoa – an overview of state, trends and pressures. Department of Conservation, Wellington. 165 p. <https://www.doc.govt.nz/globalassets/documents/conservation/biodiversity/anzbs-biodiversity-report.pdf>
- De Winton M. 2020. Vegetation status in Waituna Lagoon: Summer 2020. Report prepared for the Department of Conservation. NIWA, Hamilton. 19 p. <https://www.doc.govt.nz/globalassets/documents/conservation/land-and-freshwater/wetlands/waituna-lagoon-macrophyte-monitoring-2020.pdf>
- Dillon ML, Hawes I, Jungblut AD, MacKey TJ, Eisen JA, Doran PT, Sumner DY. 2020. Environmental control on the distribution of metabolic strategies of benthic microbial mats in Lake Fryxell, Antarctica. *PLoS ONE* 15(4). DOI:10.1371/journal.pone.0231053.
- Dillon ML, Hawes I, Jungblut AD, Mackey T, Eisen JA, Doran PT, Sumner DY. 2020. Energetic and environmental constraints on the community structure of benthic microbial mats in Lake Fryxell, Antarctica. *FEMS Microbiology Ecology* 96(2). DOI:10.1093/femsec/fiz207.

- Doehring K, Young RG, Robb C. 2020. Demonstrating efficacy of rural land management actions to improve water quality – How can we quantify what actions have been done? *Journal of Environmental Management* 270:110475. DOI:10.1016/j.jenvman.2020.110475.
- Drinan TJ, Grainger NPJ, Harding JS, Collier KJ, Smith BJ, Death RG, Makan T, Rolfe JR. 2020. An analysis of conservation status of New Zealand freshwater invertebrates: temporal changes, knowledge gaps, impediments, and management implication. *New Zealand Journal of Zoology* 1-16. DOI:10.1080/03014223.17780440.
- Duggan IC, Pearson AAC, Kusabs I. In Press. Effects of a native New Zealand freshwater mussel on zooplankton assemblages, including non-native *Daphnia*: a mesocosm experiment. *Marine and Freshwater Research*.
- Duggan IC, Özkundakci D, David BO. In Press. Long-term zooplankton composition data reveal impacts of invasions on community composition in the Waikato lakes, New Zealand. *Aquatic Ecology*.
- Dunn NR, O'Brien LK, BurrIDGE CP, Closs GP. 2020a. Morphological convergence and divergence in *Galaxias* fishes in lentic and lotic habitats. *Diversity* 12: 183. DOI:10.3390/d12050183 .
- Dunn NR, O'Brien LK, Closs GP. 2020b. Phenotypically induced intraspecific variation in the morphological development of wetland and stream *Galaxias gollumoides* McDowall and Chadderton. *Diversity* 12: 220. DOI:10.3390/d12060220.
- Fraley KM, Warburton HJ, Jellyman PG., Kelly D, McIntosh, AR. 2020 Do body mass and habitat factors predict trophic position in temperate stream fishes? *Freshwater Science*. DOI:10.1086/709131.
- Fraley KM, McHugh P, McIntosh AR. 2020. Influence of maternally-transferred nitrogen and carbon on stable isotope ratios in juvenile Chinook salmon. *North American Journal of Fisheries Management* 40:175-181. DOI:10.1002/nafm.10393.
- Garrett-Walker J, Collier KJ, Daniel A, Hicks BJ, Klee D. 2020. Design features of constructed floodplain ponds influence waterbird and fish communities in northern New Zealand. *Freshwater Biology*. DOI:10.1111/fwb.13602.
- Goeller BC, Febria CM, McKergow LA, Harding JS, Matheson FE, Tanner CC, Angus R. McIntosh AR 2020. Combining Tools from Edge-Of-Field to In-Stream to Attenuate Reactive Nitrogen Along Small Agricultural Waterways. *Water*. DOI:10.3390/w12020383.
- Grettenberger CL., Sumner, DY., Wall, K., Brown, CT., Eisen, JA., Mackey, TJ., Hawes I., Jospin, G., Jungblut, A. D. 2020. A phylogenetically novel cyanobacterium most closely related to *Gloeobacter*. *ISME Journal*. DOI:10.1038/s41396-020-0668-5.
- Harrison KR, Duggan IC. 2019. First record of the parasite *Transversotrema patialense* (Soparkar, 1924) within New Zealand, and its prevalence in *Melanoides tuberculata* (Müller, 1774) among captive and “wild” populations. *BioInvasions Records* 8:729-735.
- Herse, MR, Lyve POB, Scott N, McIntosh AR, Coats SC, Gormley AM, Tylisanakis JM. 2020. Engaging Indigenous Peoples and Local Communities in Environmental Management Could Alleviate Scale Mismatches in Social-Ecological Systems. *Bioscience* 70:699-707.
- Holmes R. 2019. Waituna Creek restoration trial: progress report. Prepared for the Department of Conservation. Cawthron Institute Report No. 3362. 16 p. <https://ftp.doc.govt.nz/public/file/-mVbCObHmE6Xz65kh9aRlw/waituna-creek-restoration-trial-progress-report-2019.pdf>
- Instream Consulting Limited. 2020. Fish passage barriers in Christchurch City waterways. Report prepared for Christchurch City Council, Christchurch, New Zealand.
- Instream Consulting Limited. 2020. Heathcote River, Linwood Canal, and Banks Peninsula aquatic ecology 2020. Report prepared for Christchurch City Council, Christchurch, New Zealand.
- Instream Consulting Limited. 2020. Kakahi (freshwater mussels) in Christchurch Waterways. Report prepared for Christchurch City Council, Christchurch, New Zealand.
- Instream Consulting Limited. 2020. Kakahi in Cashmere Stream: distribution and current state of the population. Report prepared for Christchurch City Council, Christchurch, New Zealand.
- Instream Consulting Limited. 2020. Number One Drain restoration and ecological response. Report prepared for Christchurch City Council, Christchurch, New Zealand.
- Jellyman PG, McIntosh AR. 2020. Disturbance-driven consumer assemblages determine fish communities and moderate top-down effects via bottom-up constraints. *Journal of Animal Ecology* 89:1175-1189. DOI:10.1111/1365-2656.13168 .
- Klemmer AJ, Galatowitsch ML, McIntosh AR. 2020. Cross-ecosystem bottlenecks alter reciprocal subsidies within meta-ecosystems. *Proceedings of the Royal Society B* 287: 20200550.
- Li F, Tonkin JD, Haase P. 2020. Local contribution to beta diversity is negatively linked with community-wide dispersal capacity in stream invertebrate communities. *Ecological Indicators* 108:105715.
- Larned S, Collier K, Howard-Williams C. 2020. Preface: land-use impacts on aquatic ecosystems – tribute to John Quinn. *New Zealand Journal of Marine and Freshwater Research* 54(3):305-307. DOI:10.1080/00288330.2020.1790395.
- Le Quesne KS, Özkundakci D, Duggan IC. 2020. Life on the farm: are zooplankton communities in natural ponds and constructed dams the same? *Marine and Freshwater Research*. DOI:10.1071/mf20030.
- Lee JE, Brook EJ, Bertler NAN, Buizert C, Baisden T, Blunier T, . . . Winstrup M. 2020. An 83 000-year-old ice core from Roosevelt Island, Ross Sea, Antarctica. *Climate of the Past* 16(5):1691-1713. DOI:10.5194/cp-16-1691-2020.
- Li M, Liu J, Tonkin JD, Shen J, Xiao N, Wang J. 2020. The effects of abiotic and biotic factors on taxonomic and phylogenetic diversity of stream epilithic bacteria around Qiandao Lake. *Aquatic Sciences*. DOI:10.1007/s00027.
- Marapara TR, Jackson BM, Hartley S, Maxwell D. 2020. Disentangling the factors that vary the impact of trees on flooding (a review). *Water and Environment Journal*. DOI:10.1111/wej.12647.
- Margetts, B. & Marshall, W. 2020. Surface water quality monitoring report for Christchurch City Waterways: January – December 2019. Christchurch City Council, Christchurch, New Zealand.
- Meijer, CG, Warburton, HJ, McIntosh, AR. Disentangling the multiple effects of stream drying and riparian canopy cover on the trophic ecology of a highly threatened fish. *Freshwater Biology*. DOI:10.1111/fwb.13620.
- Melchior M, Collier KJ, Clearwater SJ. 2019. First record of complex release strategies and morphometry of glochidia in sympatric *Echyridella* species (Bivalvia: Unionida: Hyriidae). *Hydrobiologia*. DOI:10.1007/s10750-019-03995-3

- Moore TP, Clearwater SJ, Duggan IC, Collier, K. J. 2020. Invasive macrophytes induce context-specific effects on oxygen, pH, and temperature in a hydropeaking reservoir. *River Research and Applications*. DOI:10.1002/rra.3674.
- Moore TP, Collier KJ, Duggan IC. 2019. Interactions between Unionida and non-native species: a global meta-analysis. *Aquatic Conservation: Marine and Freshwater Ecosystems* 29:1438-1451.
- Mouton TL, Tonkin JF, Stephenson F, Verburg P, Flourey M. In Press. Increasing climate driven taxonomic homogenisation but functional differentiation among stream macroinvertebrate assemblages. *Global Change Biology*.
- Pearson AAC, Duggan IC. 2019. *Echyridella menziesii* (Bivalvia: Hyriidae) as a predator of zooplankton of different sizes; are large non-indigenous *Daphnia* a potential food source? *New Zealand Journal of Marine and Freshwater Research* 53:327-337.
- Pearson AAC, Duggan IC. 2020. Dividing the algal soup: is there niche separation between native bivalves (*Echyridella menziesii*) and non-native *Daphnia pulex* in New Zealand? *New Zealand Journal of Marine and Freshwater Research* 54:45-59.
- Pingram MA, Collier KJ, Özkundakci D, Garrett-Walker J. 2020. Food web characteristics of fish communities across degraded lakes provide insights for management in multi-stressor environments. *Aquatic Ecology* 54(1):401-419. DOI:10.1007/s10452-020-09750-4.
- Pohe SR. 2019. Macroecology of New Zealand Ephemeroptera. Unpublished PhD thesis, University of Canterbury, Christchurch, New Zealand. 226 p.
- Pohe SR, Wade ML, Winterbourn MJ, Ball OJ-P. 2020. Invertebrate fauna of ephemeral streams on Hauturu-o-Toi/Little Barrier Island in northern New Zealand. *New Zealand Journal of Zoology* 47:53-70.
- Pohe SR, Smith BJ, Ball OJ-P. 2020. Towards determination of the conservation status of aquatic EPT insects: survey results from Westland-Brunner, Tasman-Motueka and the Canterbury high-country. Unpublished report for the Department of Conservation.
- Rayne A, Byrnes G, Collie-Robinson L, Hollows J, McIntosh A, Ramsden M, Rupene M, Tamati-Elliffe P, Thoms C, Steeves TE. 2020. Centring Indigenous knowledge systems to re-imagine conservation translocations. *People and Nature* 2:512-526.
- Rayner S, Clough TJ, Baisden T, Moir J. 2020. Can ruminant urine-N rate and plants affect nitrate leaching and its isotopic composition? *New Zealand Journal of Agricultural Research* 63(1):87-105. DOI:10.1080/00288233.2019.1648302.
- Rissmann CWF, Pearson LK, Beyer M, Couldrey MA, Lindsay JL, Martin AP, Baisden WT, Clough TJ, Horton TW, Webster-Brown JG. 2019. A hydrochemically guided landscape classification system for modelling spatial variation in multiple water quality indices: Process-attribute mapping. *Science of the Total Environment* 672:815-833. DOI:10.1016/j.scitotenv.2019.03.492.
- Roloson SD, Landsman SJ, Tana R, Hicks BJ, Carr JW, Whoriskey F, van den Heuvel MR. 2020. Otolith microchemistry and acoustic telemetry reveal anadromy in non-native rainbow trout (*Oncorhynchus mykiss*) in Prince Edward Island, Canada. *Canadian Journal of Fisheries and Aquatic Sciences* 77(7):1117-1130. Open access. DOI:10.1139/cjfas-2019-0229
- Schmale DG, Ault A, Saad A, Scott D, Westrick J. 2019. Perspectives on harmful algal blooms (HABs) and the cyberbiosecurity of freshwater systems. *Frontiers Bioengineering Biotechnology* 7:128.
- Sundar S, Heino J, de O. Roque JF, Simaika JP, Melo AS, Tonkin JD, Nogueira DG, Silva DP. 2020. Conservation of freshwater macroinvertebrate biodiversity in tropical regions. *Aquatic Conservation: Marine and Freshwater Ecosystems*. DOI:10.1002/aqc.3326.
- Sutherland DL, Howard-Williams C, Ralph P, Hawes I. 2020. Environmental drivers that influence microalgal species in meltwater pools on the McMurdo Ice Shelf, Antarctica. *Polar Biology* 43(5):467-482. DOI:10.1007/s00300-020-02649-8.
- Taura YM, Duggan IC. 2020. The relative effects of willow invasion, willow control and hydrology on wetland zooplankton assemblages. *Wetlands*, 11 pages. doi:10.1007/s13157-020-01359-5.
- Tempero GW, Hicks BJ, Ling N, Morgan D, Daniel AJ, Özkundakci D, David B. 2019. Fish community responses to invasive fish removal and installation of an exclusion barrier at Lake Ohinewai, Waikato. *New Zealand Journal of Marine and Freshwater Research* 53:397-415. https://doi.org/10.1080/00288330.2019.1579101.
- Tonkin JD, Olden JD, Merritt DM, Reynolds LV, Rogosch JS, Lytle DA. In press. Designing river flow regimes to support entire ecosystems. *Frontiers in Ecology and the Environment*.
- Van Looy K, Tonkin JD, Flourey M, Leigh C, Soininen J, Larsen S, Heino J, Poff NL, DeLong M, Jähnig SC, Datry T, Bonada N, Rosebery J, Jamoneau A, Ormerod SJ, Collier KJ, Wolter C. 2019. The three Rs of river ecosystem resilience: Resources, recruitment, and refugia. *River Research and Applications* 35(2):107-120. DOI:10.1002/rra.3396.
- von Schiller D, Datry T, Corti R, Foulquier A, Tockner K, ... McIntosh AR. and 76 others. 2019. Sediment respiration pulses in intermittent rivers and ephemeral streams. *Global Biogeochemical Cycles* 33:1251-1263. DOI:10.1029/2019GB006276.
- Wells NS, Clough TJ, Johnson-Beebout SE, Elberling B, Baisden WT. 2019. Effects of denitrification and transport on the isotopic composition of nitrate ($\delta^{18}\text{O}$, $\delta^{15}\text{N}$) in freshwater systems. *Science of the Total Environment* 651:2228-2234. DOI:10.1016/j.scitotenv.2018.10.065. ■



Upper Waimakariri River

Photo © Angus McIntosh

AWARDS



Honorary Membership NZFSS

Jon Harding

With great enthusiasm, the executive committee have nominated Jon Harding as an honorary member of the Society, recognising Jon's long career in freshwater science and his exceptional contribution to teaching and mentoring generations of freshwater scientists. Teaching has always been in Jon's blood it seems as he moved on from being a schoolteacher in Dannevirke to start his MSc at Canterbury University's Zoology Department in 1988.

Jon completed his master's with Mike Winterbourn in 1990 on "The effects of impoundment on three Westland River macroinvertebrate communities" and then went on to complete a PhD with Mike Winterbourn in 1994 looking at the lotic ecoregions of New Zealand.

Jon undertook a postdoc at Virginia (Tech) Polytechnic Institute and State University in Blacksburg Virginia with Fred Benfield on the ecological communities of forest streams in the American South West. From this work, Jon produced his most cited paper (with over 1,000 citations) "Harding, J. S., E. F. Benfield, P. V. Bolstad, G. S. Helfman, and E. B. D. Jones. 1998. Stream biodiversity: the ghost of land use past. *Proceedings of the National Academy of Sciences USA* 95:14843-14847."

Jon then worked at the Cawthron Institute in Nelson from 1999–2001 and subsequently started lecturing at the University of Canterbury in 2002. Over his career at the University of Canterbury Jon received the UC Teaching Award, Ako Aotearoa Tertiary Teaching Excellence Award, became the Dean of Postgraduate Research and received the 2018 University of Canterbury Teaching Medal. Jon is a past-president of the Society, SIL Trust Trustee and has had a wide-spread influence on current and future generations of freshwater scientists through his post-graduate supervision and mentoring. Jon, we thank and acknowledge your huge contribution to the Society, freshwater science and in shaping the careers of so many Society members in nominating you as an honorary NZFSS member. ■



Jon Harding on a NABS field trip.

BUDGET FOR THE YEAR ENDED 30 JUNE 2019

New Zealand Limnological Society Incorporated

Entity Information

"Who are we?", "Why do we exist?"

For the year ended
30 June 2019

Legal Name of Entity:	New Zealand Limnological Society Incorporated
Trading Name of Entity:	New Zealand Freshwater Sciences Society
Type of Entity and Legal Basis:	Not-for-profit organisation; incorporated society
Registration Number:	1008510

Entity's Purpose or Mission:

The Society's objective is to establish and maintain effective liaison between all parties interested in any aspect of freshwater and brackish water research. This is achieved by:

- (a) The establishment and maintenance of a register of all persons working in the appropriate fields in New Zealand, giving details of their current interests.
- (b) The holding of meetings and conferences to deliver scientific papers, and to discuss scientific topics.
- (c) Co-operation and affiliation with other scientific bodies when appropriate.
- (d) The production of a newsletter including information about the current interests of freshwater workers, and listing relevant new publications and other items of interest.
- (e) The distribution of the Newsletter to appropriate organisations in New Zealand and overseas.

Entity Structure:

Executive committee comprises of:

Immediate past President:

Marc Schallenberg (Resigned 12 December 2018)

President:

Kate McArthur (Appointed 12 December 2018)

Secretary-treasurer:

Amy Whitehead

Newsletter Editor:

Amanda Valois (Appointed 12 December 2018)

Elected officers:

Jenny Webster-Brown (Appointed 12 December 2018)

Phillip Jellyman

Elections for these positions are held every two years at the AGM.

Statement of Service Performance

"What did we do?", When did we do it?"

For the year ended
30 June 2019

Description of the Entity's Outcomes:

Continued to enable effective liaison between members on all aspects of fresh and brackish water research in New Zealand.

Description and Quantification (to the extent practicable) of the Entity's Outputs:	Actual 2019	Actual 2018
Newsletter delivered to members.	495	526
Pdf format	451	482
Hardcopy format	44	44

Annual conferences held	1	1
-------------------------	---	---

Additional Output Measures:

The following objectives were met:

- a) Register of membership updated as required
- b) The annual conference was held in Nelson in December 2018
- c) Maintained our position as a Constituent Organisation of the Royal Society of New Zealand
- d) The 2018 newsletter was produced by:
 - Newsletter Editor Natasha Petrove and
 - Assistant Newsletter Editor Marine Richardson
- e) The 2018 newsletter was distributed to members in either pdf or hardcopy format

Statement of Financial Performance

"How was it funded?" and "What did it cost?"

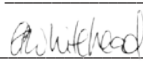
For the year ended
30 June 2019


	Notes	Actual 2019 €	Actual 2018 €
Revenue			
Donations, fundraising and other similar revenue	1	-	1,604
Fees, subscriptions and other revenue from members	1	16,209	15,347
Revenue from providing goods or services	1	1,092	1,945
Interest, dividends and other investment revenue	1	3,744	3,773
Conference revenue	1	327,698	215,587
Total Revenue		348,743	238,256
Expenses			
Costs related to providing goods or services	2	578	1,445
Grants and donations made	2	6,721	7,009
Other expenses	2	12,069	15,927
Conference expenses	2	281,160	209,486
Total Expenses		300,528	233,867
Surplus/(Deficit) for the Year		48,215	4,389

Statement of Financial Position
 "What the entity owns?" and "What the entity owes?"
 As at
 30 June 2019

	Notes	Actual 2019 \$	Actual 2018 \$
Assets			
Current Assets			
Cash and cash equivalents	3	34,397	41,663
Debtors and prepayments	3	72,916	13,186
Inventory	3	7,716	8,294
Investments	3	115,925	111,893
Other current assets	3	-	9,290
Total Current Assets		230,954	184,326
Total Assets		230,954	184,326
Liabilities			
Current Liabilities			
Creditors and accrued expenses	3	10,920	13,268
Other current liabilities	3	3,389	2,628
Total Current Liabilities		14,309	15,896
Total Liabilities		14,309	15,896
Total Assets less Total Liabilities (Net Assets)		216,645	168,430
Accumulated Funds			
Accumulated surpluses or (deficits)	4	216,645	168,430
Total Accumulated Funds		216,645	168,430

This performance report has been approved by the Committee, for and on behalf of New Zealand Limnological Society Incorporated:

Date: _____
 Signature: 
 Name: Amy Whitehead
 Position: Secretary/Treasurer

Date: _____
 Signature: 
 Name: Kate McArthur
 Position: President

Statement of Cash Flows
"How the entity has received and used cash"
For the year ended
30 June 2019

	Actual 2019 \$	Actual 2018 \$
Cash Flows from Operating Activities		
Cash was received from:		
Donations, fundraising and other similar receipts	-	1,604
Fees, subscriptions and other receipts from members	16,209	22,966
Receipts from providing goods or services	5,869	8,046
Interest, dividends and other investment receipts	4,070	3,575
Net GST	(1,956)	(6,354)
Cash was applied to:		
Payments to suppliers	25,669	27,343
Donations or grants paid	11,047	-
Net Cash Flows from Operating Activities	(12,524)	2,494
Cash flows from Investing and Financing Activities		
Cash was received from:		
Proceeds from loan	9,290	-
Cash was applied to:		
Payment of loan	-	9,290
Net Cash Flows from Investing and Financing Activities	9,290	(9,290)
Net Increase / (Decrease) in Cash	(3,234)	(6,796)
Opening Cash	153,556	160,352
Closing Cash	150,322	153,556
This is represented by:		
Bank Accounts and Cash	34,397	41,663
Investments	115,925	111,893
	150,322	153,556

Statement of Accounting Policies

"How did we do our accounting?"

For the year ended
30 June 2019

Basis of Preparation

New Zealand Limnological Society Incorporated has elected to apply PBE SFR-A (NFP) Public Benefit Entity Simple Format Reporting - Accrual (Not-For-Profit) on the basis that it does not have public accountability and has total annual expenses of equal to or less than \$2,000,000. All transactions in the Performance Report are reported using the accrual basis of accounting. The Performance Report is prepared under the assumption that the entity will continue to operate in the foreseeable future.

Goods and Services Tax (GST)

All amounts are recorded exclusive of GST, except for Debtors and Creditors which are stated inclusive of GST.

Income Tax

New Zealand Limnological Society Incorporated is wholly exempt from New Zealand Income tax having fully complied with all statutory conditions for these exemptions.

Bank Accounts and Cash

Bank accounts and cash in the Statement of Cash Flows comprise cash balances and bank balances (including short term deposits) with original maturities of 90 days or less.

Investments

All other term deposits with a maturity date of more than 90 days are classified as investments.

Inventory

Inventory is valued at the lower of cost and net realisable value. Inventory is sold on a first in first out basis

Receivables

Receivables are stated at their estimated realisable value. Bad debts are written off in the year in which they are identified

Revenue

Subscription Revenue

The subscription revenue is due from the members in July of each year to cover the period from July to June of the following year.

Subscription revenue is recognised in the year which the service is provided to members and unpaid subscriptions are recognised as a receivable at year end. Subscriptions paid in advance during the year are recognised as Income in Advance in the Statement of Financial Position.

Interest

Interest revenue is recognised as it is earned.

Conference Revenue

Conference Revenue is recognised on a gross basis, when the entity has primary responsibility for the conference, and has exposure to significant risk and reward.

Changes in Accounting Policies

There have been no changes in accounting policies during the financial year (last year - nil)

Notes to the Performance Report

For the year ended
30 June 2019

Note 1 : Analysis of Revenue

Revenue Item	Analysis	2019 \$	2018 \$
Donations and other similar revenue	Donations - For SIL Trust	-	4
	Donations - Student Prizes	-	1,600
	Total	-	1,604
Fees, subscriptions and other revenue from members	Subscriptions - Current	16,209	15,347
	Total	16,209	15,347
Revenue from providing goods or services	Sale book - Advances in Freshwater Science	978	1,762
	Sale book - Crustacea Identification Guide	114	183
	Total	1,092	1,945
Interest, dividends and other investment revenue	Interest Income	3,744	3,773
	Total	3,744	3,773
Conference revenue	Registration fee	236,730	176,206
	Sponsorship	90,968	39,381
	Total	327,698	215,587

Notes to the Performance Report

For the year ended
30 June 2019

Note 2 : Analysis of Expenses

Expense Item	Analysis	2019 \$	2018 \$
Costs related to providing goods	Cost of Goods Sold - Advances in Fresh Water Science	578	1,445
	Total	578	1,445
Grants and donations made	Awards - ECR Award	500	-
	Awards - Jolly Student Travel	800	1,100
	Awards - SIL Trust Conference Prizes	800	800
	Awards - Society Medal	36	-
	Donations - Gift to SIL Trust	4,585	5,109
	Total	6,721	7,009
Other expenses	Audit fees	3,100	4,983
	Bank Fees	40	266
	Consulting & Accounting	2,100	2,160
	General Expenses	72	-
	Membership fees - RSNZ	1,304	1,304
	Postage	124	125
	Printing - Newsletter	520	469
	Stripe fees	374	290
	Website	3,907	5,813
	Xero Fees	528	517
Total	12,069	15,927	
Conference Expenses	Venue Hire, Food, Accommodation and other expenses	222,087	145,839
	Conference Management Fees	59,073	63,647
	Total	281,160	209,486

Notes to the Performance Report

For the year ended
30 June 2019

Note 3 : Analysis of Assets and Liabilities

Asset Item	Analysis	2019 \$	2018 \$
Cash and cash equivalents	Non Profit Organisation A/C	34,397	41,663
	Total	34,397	41,663
Debtors and prepayments	Accounts Receivable	52,389	7,333
	Prepayments	20,000	5,000
	Interest Accrued	527	853
	Total	72,916	13,186
Inventory	Advances in Fresh Water Science Book	7,716	8,294
	Total	7,716	8,294
Investments	Term Deposit 07	60,879	59,188
	Term Deposit 08	55,046	52,705
	Total	115,925	111,893
Other current assets	Loan to SIL	-	9,290
	Total	-	9,290

Notes to the Performance Report

For the year ended
30 June 2019

Note 3 : Analysis of Assets and Liabilities

Liability Item	Analysis	2019 \$	2018 \$
Creditors and accrued expenses	Accounts Payable	6,034	2,859
	Accrued Expenses	4,586	5,000
	Donations Owed to SIL Trust	300	5,409
	Total	10,920	13,268
Other current liabilities	GST Payable	489	2,445
	Subscription in Advance	2,900	183
	Total	3,389	2,628

Notes to the Performance Report

For the year ended
30 June 2019

Note 4: Accumulated Funds

2019				
Description	Capital Contributed by Owners or Members	Accumulated Surpluses or Deficits	Reserves	Total
Opening Balance	-	168,430	-	168,430
Surplus/(Deficit)		48,215		48,215
Closing Balance	-	216,645	-	216,645

2018				
Description	Capital Contributed by Owners or Members	Accumulated Surpluses or Deficits	Reserves	Total
Opening Balance		164,041	-	164,041
Surplus/(Deficit)		4,389		4,389
Closing Balance	-	168,430	-	168,430

Note 5 : Commitments and Contingencies

Commitments

There are no commitments as at balance date (Last Year - nil)

Contingent Liabilities and Guarantees

There are no contingent liabilities or guarantees as at balance date (Last Year - nil)

Notes to the Performance Report

For the year ended
30 June 2019

Notes 6: Related Party Transactions

Related parties transactions during the financial year are:

Committee member subscriptions which are on the same terms as other members of the Society.

Payments of donation to the SIL Trust 1987 of \$4,585 (2018: \$5,109)

Loan to SIL Trust 1987 has been repaid during 2019 (2018: \$9,290)

In 1987, the New Zealand Limnological Society co-sponsored the 23rd Congress of the International Association of Theoretical and Applied Limnology (SIL).

In 2002, surplus funds (\$45,500) raised from this conference were put into a trust (called "S.I.L. – 1987 Trust Fund"), which was established specifically to "advance and promote education and research in the scientific field of Limnology for the benefit of New Zealand". Five Trustees agreed to act as S.I.L. – 1987 Trust Fund Trustees. To reach the aim of the Trust, three objectives were listed, and these are:

- to send young New Zealand scientists to an overseas conference;
- to bring prestigious scientists to New Zealand; and
- to recognise the best student paper delivered at the annual conference.

To enable the objectives to be met, a Trust Fund Awards Committee was also established, comprising one of the S.I.L. – 1987 Trust Fund Trustees, the President of the New Zealand Limnological Society, the Treasurer of the New Zealand Limnological Society, and two other members of the New Zealand Limnological Society elected during Society elections (held every two years). In each year, money is made available by the Trustees for purposes stated above, the Committee's tasks are to determine the winner of the Student Paper Award, invite and consider applications for travel and guest lecturer awards, and to recommend to the Trustees the number of awards to be made, the amount of each award, the recipient of each award, and other associated administrative tasks.

Note 7: Events After the Balance Date

The Society is aware that COVID-19 was declared a global health emergency on 31 January 2020 by the World Health Organisation. The New Zealand Government has declared a State of National Emergency on 25 March 2020 and this will limit the activities of our members and suppliers during this period. This is not expected to impact the financial viability of the Society and the Committee believes that the continued use of the Going Concern assumption remains appropriate.

The Society has provided seed funding of \$20,000 towards the INTECOL conference in October 2020 which may be affected. The conference committee is planning to meet to discuss potential impacts and to look at the need to make alternative arrangements.

At this point in time, it is not possible to further quantify the financial impact of this pandemic on the Society and its future operations. (Last Year Nil)

Note 8: Ability to Continue Operating

The entity will continue to operate for the foreseeable future.



Coloburiscus

Photo © Angus McIntosh

MINUTES OF THE 52ND ANNUAL GENERAL MEETING OF THE NEW ZEALAND LIMNOLOGICAL SOCIETY INC.

(Trading as New Zealand Freshwater Sciences Society)

Held at Waurn Ponds, Geelong Australia

Wednesday 4 December 2019

The Annual General Meeting commenced at 12:45 pm and was chaired by Kate McArthur, President.

Present: Kate McArthur (President) and 15 members.

1. Apologies

Natasha Petrove, Amy Whitehead, Angus McIntosh.

2. Minutes of the 51st AGM circulated

Matters arising from minutes: Dealt with under general business, no matters arising.

Motion: That the minutes be accepted as a true and correct record of the 51st AGM (Kate McArthur/ Kati Doehring– carried)

3. President's report [Kate McArthur]

Tēnā koutou,

It was a great privilege to take up the leadership of our Society at our 50th birthday in Whakatū Nelson in December last year and a particular honour, as the first woman President in 30 years, to follow in the footsteps of the pioneering women who founded and led the Society throughout its early years. We are a diverse, multi-disciplinary Society of more than 500 members with a critical role in shaping the future of freshwater in Aotearoa New Zealand. The coming national changes to freshwater management will make this no less of a challenge for us all.

Exec news

The Exec Team have been busy developing an annual operating budget so we can resolve our discussion with members on the spending of the Society's surplus funds – who knew spending our cash could be so difficult! Last year's conference also made a profit on top of our existing surplus, and we look forward to making some firm spending decisions early next year and getting funded projects underway. The exec decisions on annual spending included dedicated funding to ensure meaningful indigenous leadership and support for Te Wai Māori rōpū at future conferences, increased funding for student travel, and two post-graduate freshwater scholarships of \$7,500, one Māori and one open to all applicants which will be advertised soon through the Society's networks. We would appreciate members' support in spreading the word on these scholarships to any

prospective students entering honours or master's degree programmes. The scholarships are aimed at supporting more students into post-graduate degrees in freshwater science.

Action for Healthy Waterways

The government's Action for Healthy Waterways package hit the streets in mid-September this year. As expected, the policy package signalled a major change in freshwater management across multiple areas. The breadth and scope of the package covered a completely new national policy statement, broader consideration of Te mana o te Wai, ecosystem health, monitoring, limit setting, wetlands, streams, fish passage and farming, a new national environmental standard for freshwater and new stock exclusion regulations.

To their credit, the Ministry for the Environment engaged directly with the Society and two workshops were run with members in early October. Considerable feedback and advice on the package were provided by members at the workshops and throughout the submission period, and the task of collating our advice was enormous. I thank Hannah Rainforth, Rich Allibone, Marc and all the members who took the time to provide their feedback and expert advice for assisting with coordinating what I think was a very comprehensive submission. I had the opportunity to converse directly with Minister Parker on our submission recently at Invercargill Airport and he asked astute questions in relation to our advice. We will see what influence we have had when the final package is released early in 2020.

NZFSS Awards

With sadness we mourned the passing of Dr John Quinn late last year and we were grateful to Marc for presenting the 2018 NZFSS medal to John and his whanau at his home before he passed.

The Awards Committee had a very tough job of judging this year's medal award as the calibre of all nominees was, without exception, outstanding. We ask that unsuccessful nominations are re-submitted next year, as all the nominees were deserving of the Society's recognition.

Notwithstanding this, the Awards Committee are delighted to award the 2019 NZFSS medal to Dr Susie Wood for her outstanding contribution to freshwater science and management, and her leadership of women in science. Susie is the nation's foremost expert in toxic cyanobacteria, leading the global research community with a stellar research and publication record over her relatively short career thus far – congratulations Susie! We look forward to your award presentation at INTECOL next year.

The executive is also extremely pleased to recognise and acknowledge the mahi of Dr Don Jellyman in nominating him for an Honorary NZFSS membership for his lifetime contribution and commitment to freshwater sciences and the Society. Don's research encompasses a wide range of indigenous and introduced fish, although his passions are tuna (eels) and piharau/kanakana (lamprey). Don is a force in advancing our knowledge, and ensuring the viability, of these taonga. We will vote to confirm Don's nomination further on in the agenda.

Future conferences

We have committed to two more joint conferences in the coming years: INTERCOL in Christchurch in 2020 with the National Wetland Trust and a joint meeting in mid-2021 in Brisbane with AFSS and SFS (formerly the North American Benthological Society). Philippe will be updating us on INTECOL later in the agenda. Joanne and I met with Andy Leidolf, the Executive Director of SFS and the AFSS committee on Monday to beginning scoping the 2021 conference. We are looking for an additional

NZFSS member to make up the programme committee for Brisbane, please contact me with details if you are or know anyone who might be interested in taking on that role. We also need a student representative/s who will still be a student in mid-2021 to liaise with the student reps for AFSS and SFS to ensure the programme of activities for students meets the needs of all Societies.

We recognise that multiple joint conferences, with international travel are difficult for many members to attend (and don't do much for our carbon footprints). Following feedback from members and to maintain our networks and cohesion as a society, the exec is supporting specific NZFSS sessions at INTERCOL in 2020 an additional NZFSS symposium at home in late 2021. We are looking for volunteers to organise and host that meeting in the North Island in 2021.

Closing message

On behalf of the Executive Committee I would like to express our gratitude to Marc Schallenberg and acknowledge his mahi on behalf of the Society over his four-year term as President. Joining the Committee this year is Jenny Webster-Brown, with Marc staying on as immediate past-president and Phil Jellyman and Amy Whitehead (without whom I would be completely lost) continuing to provide their skills and knowledge to the Exec Team. We thank David Hamilton for his exec work, Natasha Petrove for her superb editorship of previous newsletters and Amanda Valois for taking on the role and doing a great job of pulling together this year's newsletter. Joanne Clapcott has joined Ian Kusabs and Yvonne Taura to lead Te Wai Māori rōpū. We also welcome Issie Barrett as our student rep and thank Emma Moffat and Tom Moore for their representation of student members.

I'd also like to particularly acknowledge the mahi of Te Wai Māori rōpū who have built and sustain the Society's network of experts and practitioners in indigenous science and mātauranga. The vision of Te Wai Māori rōpū is the successful participation of Māori in freshwater sciences, management and research where Māori principles, values and interests are identified and valued within the Society. Te Wai Māori is now an integral part of our Society as a result of the continued effort of its members. The celebration and sharing of indigenous knowledges of Australian first nations and tangata whenua o Aotearoa has been a vital aspect of this year's conference in Geelong which I hope we will build on in the upcoming INTECOL and Brisbane conferences in the coming years. We thank the home nations of the Australian continent for their welcome and wonderful hospitality during our time here. I would like to particularly thank Brett Cockram for taking on the role of cultural liaison between NZFSS and AFSS for this conference.

As always, the Society runs on the energy and commitment of its members. I'm excited to see what we have all been up to over the last year in our newsletter, which will be released in the coming days, and I look forward to what the next year will bring for our Society.

Ngā mihi nui kia koutou,



Kate McArthur

I move from the Chair that this report be accepted. (Kate McArthur/Juliette Milne– *carried*)

4. Secretary-Treasurer's report [from Amy Whitehead, presented by Kate McArthur]

Finances

The accounts for the 2018-2019 financial year are still with the auditors Crowe Horwath in Blenheim. Amy will send out the final financial statements to all members once they are finalised (as part of the constitution, the audited financial statements should be presented to members). Therefore, this represents the draft financial report for the 2018-2019 financial year.

Our total assets as at 30 June 2019 were \$150,388, including two Term Deposits (\$115,925). As of 30 November 2019, we have \$215,847 in assets due to the payment of the Nelson conference profit this financial year.

Revenue earned for the 2019 financial year came primarily from the 2018 Nelson conference (\$51,694), subscription income (\$18,505), repayment of a loan to the SIL Trust (\$9,290) and interest earned from our term deposits and current account (\$3218).

Main expenditure items for the 2018-2019 financial year included conference seed funding for INTECOL Wetlands (\$20,000), website upgrade (\$3,907), student awards (\$2,600), accounting and audit fees (\$2,444), RSNZ membership fees (\$1,304), hardcopy newsletter and postage expenses (\$644), and admin fees (\$878).

The Society made a **net surplus of \$42,347** for the year ended 30 June 2019. This compares to a surplus of \$4,390 for the 2017-2018 financial year.

The main reason for this difference was that conference income for the 2018-2019 financial year was significantly higher than 2017-2018 (\$51,694 vs \$7,088). This conference income was unexpected and resulted due to lower costs, higher attendance and greater sponsorship than anticipated.

Table 1. Income and expenses for the 2018 – 2019 financial year

Profit and Loss
New Zealand Limnological Society Incorporated
1 July 2018 to 30 June 2019

30 Jun 19

Income

Conference Income	\$327,853.50
Donations - Student Prizes	\$800.00
Interest Income	\$3,217.54
Sales - Book - Advances in NZ Freshwater Science	\$196.00
Sales - Book - Crustacea Identification Guide	\$114.15
Subscriptions - Current	\$16,368.00
Subscriptions - In Advance	\$2,137.30
Loan to SIL	\$9,290.00
Total Income	\$40,129.62

Total Income **\$359,976.49**

Gross Profit **\$359,976.49**

Less Operating Expenses

Awards - Best Student Paper	\$500.00
Awards - Jolly Student Travel	\$800.00
Awards – NZFSS ECR Award	\$500.00
Awards - SIL Trust Conference Prizes	\$800.00
Donations - Gift to SIL Trust	\$4,585.00
Audit fees	\$1,904.00
Awards - Society Medal	\$35.50
Stripe Fees	\$307.18
Bank Fees	\$130.00
Xero Fees	\$440.69
Consulting & Accounting	\$540.00
General Expenses	\$71.60
Membership fees - RSNZ	\$1,304.00
Postage	\$123.84
Printing - Newsletter	\$520.34
Website	\$3,906.52
Venue Hire, Food, Accommodation and other expenses	\$234,331.46
Conference Management fees	\$46,828.00
Conference Seed Fund	\$20,000.00

Total Operating Expenses **\$317,628.13**

Net Profit **\$42,348.36**

Membership

We currently have 523 members, with a slight increase since last year (Figure 1, **Error! Not a valid bookmark self-reference.**). This is despite a clean-up of the membership database when we transitioned to the new online membership system. We have included a new membership category – *Corporate Member* – in the online database that allows organisations to request a single invoice for all members at the waged rate of \$55 per person. Please contact Amy Whitehead (info@freshwater.science.org.nz) if you are interested in setting this up for your organisation.

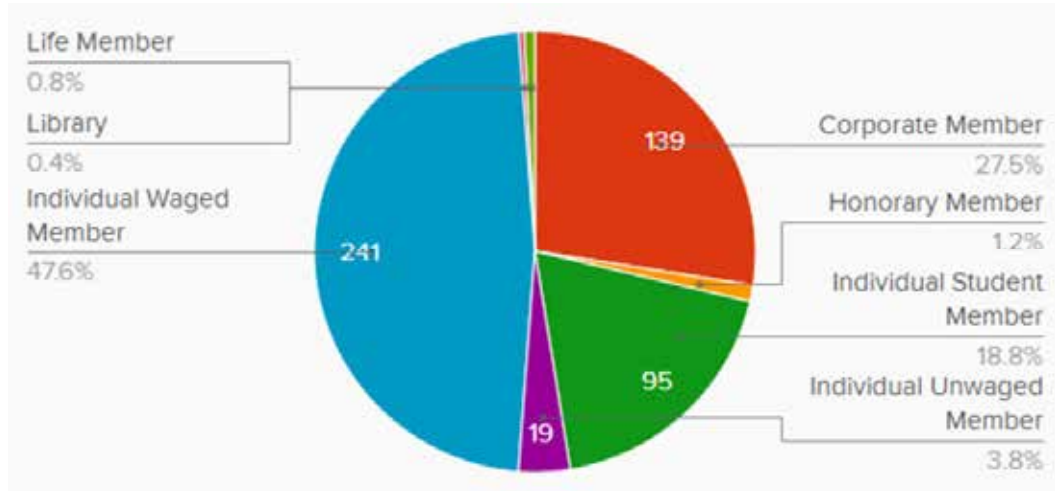


Figure 1. Breakdown of NZFSS members by membership type as of 30 November 2019.

Table 2. Membership numbers by type over the past five years. 2016 and 2017 include members who are more than six years in arrears that need to be removed from the database.

Member type	2019	2018	2017	2016	2015
Waged	380	361	371*	384*	337
Unwaged / Student	114	105	124*	122*	113
Honorary	9	9	9	9	9
Life	4	4	4	4	4
Other (Societies)	5	5	5	5	5
Corporate (Libraries)	11	11	11	11	11
TOTAL	523	495	526	535	479

The transition to the new online membership system appears to have gone relatively smoothly, with invoices and payment reminders now generated automatically. Many thanks to those who are up-to-date with their membership payments. However, there are currently 149 members who are in arrears for this financial year (Figure 2). This number includes members who we have lost contact with, or who may have moved away from freshwater science and have not resigned from the Society, or who are active in the Society but keep forgetting to pay their subs. Members who are still in arrears at 30 June 2020 will be considered non-financial and removed from the membership database as per Section 6.a of the Constitution. If you are unsure of your membership status, please login to the NZFSS website and make sure to update your contact details while you are there.

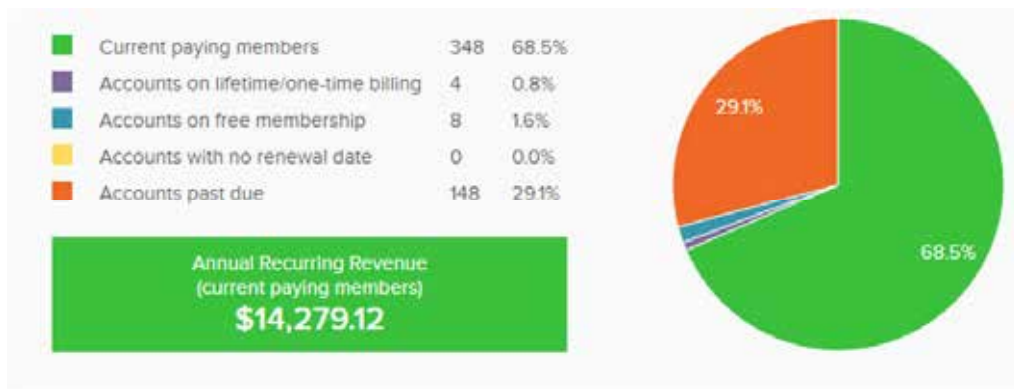


Figure 2. Financial status of members on 30 November 2019.

Motion from the Chair: That the Society accounts for 2018-2019 be accepted (Kate McArthur / Roger Young *carried*)

Motion from the Chair: That the Auditor for the next financial year be Crowe Horwath NZ Ltd., Blenheim. (Kate McArthur / Sophie Allen – *carried*)

5. SIL 1987 Trust Fund report

SIL 1987 Trust		Financial Statement 17th October 2019						
	Account number	Maturity	Interest	Amount				
TOTAL ASSETS at FY ending 30th September 2018								
30/09/2018	AMP (AT)	NZ Bonds Fund	3335382	\$70,282				
11/10/2018	AMP Int. Equity Trust	1633996		\$21,595				
29/11/2018	BNZ Ready Money	02 0343 0048 153 000		\$26,238				
30/09/2018	BNZ Term deposit #2	9348153-01007	11/09/2019	3.85%	\$48			
30/09/2018	BNZ Term deposit #3	9348153-01008	6/10/2019	3.85%	\$10,000			
30/09/2018	BNZ Term deposit #4	9348153-01009	30/09/2019	3.25%	\$7,000			
TOTAL ASSETS at FY ending 30th September 2019				\$69,728	change			
31/03/2019	AMP (AT)	NZ Fixed Interest Trust	3335382	\$22,413	\$818			
31/03/2019	AMP Int. Equity Trust	1633996		\$24,202	-\$2,036			
17/10/2019	BNZ Ready Money	02 0343 0048 153 000	6/10/2021	2.65%	\$374			
30/09/2019	BNZ Term deposit #3	9348153-01008	15/04/2020	2.80%	\$7,539			
30/09/2019	BNZ Term deposit #5	0009316362-00010	16/02/2020	2.75%	\$5,000			
30/09/2019	BNZ Term deposit #6	0009316362-00011	16/02/2020	2.75%	\$4,000			
Net increase in assets				-\$6,554	-\$1,219			
Donations								
increase in assets								
Interest etc								
Fees								
Awards								
%								
Available for 2020								
				\$0,446	\$1,186	Donations/increase in assets+interest+fees+awards		
Income/expenditure								
1/04/2019		maturing #4		deposits		prizes		
1/04/2019		Interest #4		\$5,000		Total		
11/09/2019		Interest #2		\$120		payments		
11/09/2019		maturing #2		\$770				
11/09/2019		Interest #3		\$10,000				
11/09/2019		Coxon	2019 awards					
9/04/2019		Gea	2019 awards					
2/09/2019		Kuczynski	2019 awards					
26/03/2019		Thoms	2019 awards					
11/03/2019		Barbosa	2019 awards					
29/11/2018		NZFWSS	2019 awards					
28/03/2018		Charities Commission	levy					
monthly		Overdraft fee						
18/09/2019		to TD #5						
18/09/2019		to TD #6						
NETT				\$20,999	-\$18,879	\$1,479	-\$9,819	-\$60
Treasurer		17/10/2019						

Motion from the Chair: That the SIL 1987 Trust Fund report for 2018-2019 be accepted (Kate McArthur / Chris Tanner – carried)

6. Te Wai Māori Rōpū

Ian Kusabs presented a summary of Te Wai Māori – Ngā mahi o te Rōpū Māori

- Busy year
- Working with executive on kaitiaki attending conferences, scholarships
- Prof Tom Roa, University of Waikato, kaumātua for the rōpū
- Scholarship name - He Manawa o Whenua – recognising unseen potential of Māori student
- Thanks to Yvonne Taura for her administration support for the rōpū
- Updated terms of reference
- Joanne now on the rōpū exec team
- Thanks to Brett Cockeram for his role on the organising committee for this year's conference
- Twitter account 630 followers – very active
- Sky Halford attending the conference – funded by conference costs transferred from Joanne to Sky
- Donation to students who created cultural design for this year's conference logo
- Future conferences – need substantial lead in time for cultural logos etc.
- 70 members in the rōpū.

7. General Business

Kate McArthur circulated briefing notes to members prior to the AGM for members to consider prior to the meeting. The notes were then discussed.

A. NZFSS medal winner and honorary membership vote

Kate McArthur announced the NZFSS medal award for Dr Susie Wood (as discussed in the President's report) for her outstanding contribution to freshwater science and leadership of women in science.

Kate raised the nomination by the executive of Dr Don Jellyman as an honorary member of the Society and called for a vote from members to confirm an honorary membership for Don.

Motion from the Chair: That Dr Don Jellyman be confirmed as an honorary member of the Society.

All in favour: All

Against: none

Motion carried: Kate to notify Don on behalf of the Society of his honorary membership.

B. Constitutional changes and Code of Professional Standards and Ethics - update

Kate referred to the briefing notes provided to members with the agenda. Discussion of constitutional changes to streamline the way the Society does business and the adoption of the Royal Society of New Zealand code of professional standards and ethics for members has been ongoing for some time. Legal ramifications of adopting the code of professional standards and ethics and any issues associated with disciplinary actions has been explored. Voting will occur in

2020 as discussed in the briefing notes. Kate noted a strong preference for including the code in the Society's constitution as it provides protection of and professional guidelines for members.

C. Discussion on splitting Secretary/Treasurer and membership roles into two or more distinct positions (constitutional change)

Kate noted that further changes are required to the constitution in order to ensure the Society's executive can function effectively and that the workload is sustainable. We are seeking feedback on the separation of the Treasurer/Secretary role into two roles on the Executive as the combined task (along with managing memberships) has become too onerous for one person to undertake.

The executive will explore some options for this, including having a paid, part-time position to fulfil one of the roles, as many other Societies do (including Hydrological Society) and will bring some options to the membership for final voting on the constitutional changes in early 2020.

Discussed membership being paid as part of conference attendance. Noted that next two years are joint conferences so limited ability to deal with this in the short term.

Motion from the Chair: That the Secretary /Treasurer position is split into two roles and the executive will explore options for external assistance in providing these functions for the Society for voting in constitutional change in 2020 (moved *Kate McArthur / Joanne Clapcott, carried*).

D. Annual operating budget, executive spending and plan for spending surplus funds - update

Kate noted, as discussed in the President's report and briefing notes, the executive decisions on spending over the last year. She also noted that the scholarships were in fact \$7,500 each, a correction from the briefing notes. The annual operating budget is outlined on page 6 of the briefing notes.

Useful options for discussion include: 1) having a contestable annual fund, within set criteria consistent with the types of projects discussed and supported to date (with a fund management committee) for application by project leads; and/or 2) to make the scholarships this year enduring while there are surplus Society funds available. A further option was discussed to release surplus funds to ensure good participation of members at the Brisbane 2021 joint conference, which presents a major international opportunity for members.

E. Future conferences 2020 INTECOL Wetlands Christchurch and 2021 joint NZFSS/AFSS/SFS Brisbane

Philippe – INTECOL update

- Conference organiser contracted.

- Support from Tourism NZ – advertising material prepared plus sending people to various events to promote the conference
- Amy Whitehead representing the Society on the committee.
- The rūpū has been contacted to provide support and input for the conference – two local people can help Channell Thoms and Levi Collier-Robinson.
- Scientific committee established – Tim Davie chairing, Chris Tanner involved
- Call for Symposia – great response – 30 ideas put forward.
- Theme – traditional knowledge and wetland science.
- Venue – still being built but ahead of schedule.

NZFSS/AFSS/SFS Brisbane 2021 update:

Kate noted as discussed in the President’s report that an initial scoping meeting occurred on Monday with AFSS and SFS representatives on the joint conference in Brisbane in May 2021. There are NZFSS representatives on the local organising committee (Joanne Clapcott) and on the programmes committee (Angus McIntosh and Kevin Simon). We are seeking one further NZFSS rep on the programmes committee and a student rep/liaison.

8. Any other business?

None.

The meeting closed at 1:40 pm.

ABOUT THE NEW ZEALAND FRESHWATER SCIENCES SOCIETY

The New Zealand Freshwater Sciences Society (NZFSS) began as the New Zealand Limnological Society (Limsoc) founded in 1968. It adopted a new trading name in 2005 to reflect the broad interests of current and new members whose interests span freshwater science, education, conservation and management. The society aims to:

“establish effective liaison between all persons interested in any aspect of fresh and brackish water research in New Zealand, and to encourage and promote these interests”

The society achieves this by:

- holding workshops and annual conferences,
- co-operating with other scientific bodies (see links to related sites),
- producing one newsletter per year,
- maintaining a membership register,
- communication through emailing list and public forum for members,
- listing members' interests,
- listing relevant publications.

Constitution

1. The Name of the Society shall be the New Zealand Limnological Society Incorporated.

2. Objectives: To establish effective liaison between all persons interested in any aspect of fresh and brackish water research in New Zealand, and to encourage and promote these interests.

3. Means of Attaining Objectives:

- a) The establishment and maintenance of a register of all persons working in the appropriate fields in New Zealand, giving details of their current interests.
- b) The holding of meetings and conferences to deliver scientific papers, and to discuss scientific topics.
- c) Co-operation and affiliation with other scientific bodies when appropriate.
- d) The production of a newsletter including information about the current interests of freshwater workers, and listing relevant new publications and other items of interest.
- e) The distribution of the Newsletter to appropriate organisations in New Zealand and overseas.

4. Membership:

- a) **The members** of the Society shall be:
 1. Ordinary members who shall be persons admitted

to membership by the committee, and whose annual subscription as fixed from time to time shall be accepted by the Committee.

2. Unwaged Members who shall be any full-time student of a secondary or tertiary educational institution, and who shall pay such annual subscription as shall be fixed from time to time.
3. Honorary Members who may be elected at a general meeting on the recommendation of the Committee.
4. Life Members who shall be persons admitted to membership by the committee, and whose lifetime subscription shall be paid in advance as a single fee as fixed from time to time.

- b) Newly elected members shall be **notified** by the Secretary of their election and sent a copy of the constitution.
- c) Any member may **resign** by giving notice in writing to the Secretary, and paying all subscriptions due.
- d) Any member shall notify the Secretary in writing of a **change of address**.
- e) The Committee shall have the power to **cancel membership** in the case of conduct considered prejudicial to the Society.
- f) All members are entitled to receive the Society's **Newsletter** free of charge.

5. Executive and Meetings:

- a) There shall be an **Executive Committee** consisting of the President, the immediate Past President (ex officio), the Secretary-Treasurer, the Editor, and two (2) other members,
- b) The Committee shall implement the Society's general business, and a simple majority shall decide all questions at Committee Meetings. If voting is equal, a motion is lost. A quorum at a Committee Meeting shall be three (3).
- c) The officers shall be **elected** every two years, either at a General Meeting or by postal ballot as the existing Committee determine. The postal ballot shall be held before the end of the financial year, and if a General Meeting is not held, the committee shall have the power to scrutinize and count the votes, and declare the results.
- d) The newly elected officers shall take office one (1) month after their election.
- e) **Candidates** for positions as officers shall be nominated at the General Meeting, or in writing signed by two other members, received by the Secretary before the

time of such meetings, or by the 31st of August if a meeting is not held. Every candidate shall signify personally, or in writing his or her acceptance of nomination. The Committee shall have the power to co-opt members of the Society to fill any casual vacancies on the Committee.

- f) The Executive Committee may summon a **General Meeting** or a General Meeting shall be summoned on receipt of a request signed by no fewer than ten (10) members entitled to vote. General Meetings shall be summoned by notice in writing, specifying the business to be considered, and notices shall be posted not less than fourteen (14) days prior to the proposed date.
- g) At all General Meetings, ten (10) members entitled to vote shall constitute a **quorum**, and a simple majority shall carry a motion. Voting shall be on the voices, or by show of hands or by ballot at the discretion of the chairman, provided that, if any member so demand, voting shall be by ballot. The Chairman shall have a deliberative and a casting vote.
- h) **Votes of members:** Each Member shall have one (1) vote at a General Meeting, and each Affiliated Body shall have the right to appoint a delegate who shall have one vote at a General Meeting.

6. Finance:

- a) **Annual Subscription:** shall be due on 1st July in each year and the amount shall be fixed at a General Meeting. Members whose subscriptions are not paid by the succeeding 30th of June shall be unfinancial and shall be liable to forfeit all benefits of membership. The financial year shall conclude on the 30th of June.
- b) **The funds** of the Society shall be controlled by the Executive Committee and shall be banked in the name of the Society. Cheques and bills shall be signed by any one of the President or Secretary-Treasurer, and must be approved in writing by other members of the Executive Committee. The Society shall not have the power to borrow money.
- c) Any income, benefit or advantage shall be applied to the **charitable purposes** of the Society as described in Sections 2 and 3 above.
- d) No member of the Society, or any person associated with a member, shall participate in or materially influence any decision made by the Society in respect of the payment to or on behalf of that member or associated person of any income, benefit or advantage whatsoever.
- e) Any such income paid shall be reasonable and relative to that which would be paid in an arm's length transaction (being the open market value).
- f) The provisions and effect of clauses 6(c), 6(d) and 6(e) shall not be removed from this document and shall be included and implied into any document replacing this document.
- g) **Payment of accounts** must first be approved by the Executive Committee. This may be done at a meeting or by mail, and items may be approved in advance for one financial year.

- h) **An Annual Report and Financial Statement** shall be prepared and posted to members. The Financial Statement shall be audited by a person appointed at the previous General Meeting.

7. Organisation:

- a) The Secretary-Treasurer shall keep (i) a **Minute Book** containing full minutes of all meetings, and (ii) a **Register** with the names, addresses, professional interests and date of joining of all members.
- b) **Affiliated Bodies:** Incorporated or unincorporated bodies, and other organisations approved by the Committee, may become affiliated with the Society on acceptance by the Committee, and on payment of such annual subscription as may be fixed from time to time.
- c) **Changes in the Constitution** may be made only on a two-thirds majority of the votes polled, and this vote shall be conducted by letter.
- d) No addition to or alteration or recession of the rules shall be approved if it affects the **charitable objects**, the **personal benefit clauses**, or the **winding up clause**, except as specified under clause 7(g) below.
- e) **The Common Seal** of the Society shall be in the custody of the Secretary, who shall in pursuance of a resolution of the Committee to that effect, affix the same to all instruments requiring the same.
- f) The Society shall not be wound up except on a two-thirds majority of a postal vote, but shall be dissolved in the event of the membership being fewer than five (5) persons. In the event of **dissolution** of the Society, its assets shall become the property of the Royal Society of New Zealand which shall dispose of the assets in accordance with the aims of the Society.
- g) The provisions and effects of this clause 7(f) shall not be removed from this document and shall be included and implied into any document replacing this document, except that another organisation, which must be an **Inland Revenue Department approved charitable organisation**, may be named in place of the Royal Society of New Zealand.

Membership

Membership is open to anyone with an interest in freshwater sciences, management and education in New Zealand and internationally. Members are entitled to attend the annual Society conference and associated workshops on topical issues, and to receive an annual newsletter detailing recent work at research institutions, members' addresses and interests, and recent publications. The Society administers grants for conference travel and visits by overseas scientists through the SIL Trust Fund. The Society also makes submissions to government bodies on behalf of members.

The Society currently has over 350 members coming from a wide range of backgrounds, including research institutes, regional and district councils, government environmental and conservation organisations, universities and consultancies. Members' freshwater interests include:

- native freshwater fish,
- sports fishery management,

- aquatic invertebrate ecology,
- zooplankton and phytoplankton taxonomy and ecology,
- macrophytes and periphyton ecology,
- lakes, rivers and wetlands,
- water quality management,
- aquatic biosecurity,
- human perceptions of water,
- conservation and restoration of freshwater ecosystems,
- resource management,
- science education.

To become a member, please fill out the membership application form and post or email this form to the Society Secretary-Treasurer.

Executive & Meetings

See page 3.

History of NZFSS

New Zealand Freshwater Sciences Society was founded in 1968 by a group of freshwater scientists interested in maintaining links in their field. It was also a time of increasing public interest in the management of freshwaters with lake weed and eutrophication issues in several areas, the newly passed Water and Soil Conservation Act 1967 and the first national environmental campaign to 'Save Manapouri' questioning further hydroelectric power development. Society membership remained relatively small during the 1970s, with annual conferences held throughout the country attended by about 30 members to discuss research and provide opportunities to visit areas and collect samples.

By the late 1970s and early 1980s, New Zealand was considering various options for future freshwater management during the 'think big' era which led to an increase in freshwater investigations and reviews of freshwater policy as well as research opportunities. This time was characterised by the management issues including development of the MCI and national debates about 'wild and scenic' rivers. A highlight for the Society at the end of the period was the highly successful running of the SIL conference in 1988 in Hamilton, the first of these to be held in the southern hemisphere.

By the late 1980s environmental and tertiary education reviews were affecting the context for education, research and management. This culminated in the reorganisation of water management through the Resource Management Act 1991, with the associated demise of considerable central government funding, the National Water and Soil Conservation Authority, DSIR and Water Quality Centre, environmental government departments, catchment boards and Acclimatisation Societies and their replacement with the Ministry for the Environment, NIWA, Department of Conservation, regional councils and Fish & Game councils, respectively.

The 1990s saw the decentralisation of freshwater management and a growing proportion of society membership made up of local and central government officers and policy

makers, as well as significant increases in under- and post-graduate student numbers with expanding Universities. Society membership expanded steadily through this period. The importance of freshwater as an economic and environmental resource has remained high, with considerable expansion of water use and concerns about environmental degradation. Water management has become more sophisticated through regional plans and more complex requirements on water users through resource consent processes.

Over the last 10 years the economic value of water has increased in proportion with its perceived scarcity, with increasing concerns expressed about maintenance of water quality with increasing intensification of land use. Development of complex modelling of, for example, effects of river flow changes on biota, pollutant transport, landuse effects on water, has challenged freshwater scientists to provide answers to complex technical issues. Society numbers have continued to steadily grow, with more emphasis on liaison, education and policy and better links with other societies, especially with the Australian Society of Limnology with which the Society has joint conferences every four years since the first joint meeting at Wairakei in 1999. About a quarter of Society members are students, with about a third practising scientists in research institutions or Universities, a third working for regional or central government and the remainder in consultancy, other education or advocacy.

Honorary & Past Members

See page 3. ■

NEW ZEALAND
Freshwater Sciences Society
MEMBERSHIP APPLICATION



How do I Join?

Sign up online freshwater.science.org.nz/become-a-member – or print/pull out this page, fill in and post to:
Amy Whitehead, NZFSS Secretary-Treasurer, c/- NIWA, PO Box 8602, Riccarton, Christchurch 8440
or email to: amy.whitehead@niwa.co.nz.

DETAILS:

Title..... First Name..... Middle Initial/s..... Last Name.....

Postal Address.....

Email.....

Telephone: (main)..... (alternate).....

Membership Type: (select one) Waged Student Unwaged

Brief list of your professional interests:.....

PERMISSIONS: (Please select your preferred option for the following and sign to authorise)

I agree to the NZ Freshwater Sciences Society **publishing my membership details:**

Yes No Signature.....

I give permission for my **email address to be added to the NZFSS email mailing group:**

Yes No Signature.....

The default format for sending the NZFSS newsletters is a PDF via email. Opt in here if you need a hardcopy posted to you:

Please send me a hardcopy Signature.....

PAYMENT: (Please select appropriate boxes)

Waged/Corporate \$55 per annum Unwaged/Student \$15 per annum Life Membership \$1375

Donation to the SIL Trust* (optional) \$4

Total Amount \$.....

Payment by Direct Credit (preferred method) – Acct: BNZ 02–0700–0354213–00 (include your name in the Reference/Details field)
Date paid.....

Payment by Credit Card (please tick one) Visa Mastercard
Name on Card..... Card Number.....
Card Expiry Date..... Signature of Cardholder.....

Payment by Cheque – Make payable to “NZ Freshwater Sciences Society”

Please send completed form to: NZFSS Secretary-Treasurer (details at the top of this form).

* The SIL 1987 Trust supports overseas travel awards for beginning NZ scientists and guest lecturer visits to NZ by eminent international freshwater scientists.
See www.freshwater.science.org.nz for more details.



NEW ZEALAND
Freshwater Sciences Society

www.freshwater.science.org.nz

.....

Find us on:
facebook 

ISSN 1178-6906 (online)

© 2019, New Zealand Freshwater Sciences Society