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NEW ZEALAND **Freshwater Sciences Society** NEWSLETTER -

www.freshwater.science.org.nz













MAIN COVER PHOTO: Echyridella Menziesii in purpose-woven kete from Parangarahu. See article on page 22. Photo © Linton Miller

#### COVER LOWER PHOTOS:

LEFT: Measuring a massive eel rescued from St Albans Creek. See article on page 13. Photo © EOS Ecology

2<sup>nd</sup> FROM LEFT: Mike Hickford showing people īnanga at World Fish Migration Day 2018. See article on page 24. Photo © Sjaan Bowie

 $2^{nd}$  FROM RIGHT: Getting up close with the locals in Oman. See article on page 46. Photo  $\mbox{$^{\odot}$ Greg Ryder}$ 

RIGHT: Ō Tū Wharekai, July 2018 Photo © Tom Drinan

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S*tenoperla* golden morph

Photo © Angus McIntosh

## 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 2018 subscription is \$55.00 per annum; or \$15 for students, the unwaged, or retired persons. Committee members for 2018 are:

#### President

Dr. Marc Schallenberg marc.schallenberg@otago.ac.nz

#### Immediate Past President

Prof. David Hamilton d.hamilton@waikato.ac.nz

#### Secretary-Treasurer

Amy Whitehead amy.whitehead@niwa.co.nz

#### Newsletter Editor

Natasha Petrove npetrove@doc.govt.nz

#### Assistant Newsletter Editor

Marine Richarson marine.richarson@gmail.com

#### **Elected Committee Members**

Kate McArthur kate@thecatalystgroup.co.nz Dr. Phil Jellyman phillip.jellyman@niwa.co.nz

#### Māori Representatives

Ian Kusabs ian@kusabs.co.nz Yvonne Taura TauraY@landcareresearch.co.nz

Brett Cockeram Brett.Cockeram@gw.govt.nz

#### **Student Representatives**

Emma Moffett moffettemma@gmail.com Tom Moore tpm13@students.waikato.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

#### **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

## EDITORIAL



Kia ora koutou,

2018 marks the 50<sup>th</sup> year since the founding of NZFSS – then the New Zealand Limnological Society. At our conference this year, we'll be celebrating this anniversary, and in writing the editorial, I thought it fitting to take a trip back through the newsletter archives. I found topics just as relevant today as they were back then, and many familiar names. The newsletters clearly highlight the varied work of members, and the diverse

contributions that both the Society and members have made to freshwater science throughout the years.

Going right back to the beginning, the Society was formed to provide 'a common mooting ground for freshwater workers in New Zealand, and to encourage and promote the exchange of news and views'. It seems there was great enthusiasm and support for the creation of the Society, to the extent that the proposers were even surprised. From this time, at least one newsletter has been produced almost every year, with (in the words of Ann Chapman in the first editorial) the 'hope that this will lead to a much greater knowledge of freshwater activities in the country and to an increasing degree of cooperation between workers.'

Knowledge sharing began immediately, with the first two newsletters in 1968 containing a combination of research notes and a list of papers published – content that has remained constant throughout all editions. Also included were requests for samples (harpacticoid and cyclopoid copepods), reports from trips overseas (Vida Stout and Geoff Fish both gave accounts of the International Congress of Limnology, held in Jerusalem, and their travels afterwards), and a summary about the first annual conference (held at Auckland University, and including an all-day excursion to the lower Waikato basin, presentation of papers, and displays of aquatic plants, equipment and photomicrographs of zooplankton). The active voice that the Society has had in freshwater matters since founding is highlighted in the 1978 newsletter, which included copies of the submissions made by the Society that year—on the 'Wild and Scenic Rivers' discussion paper, a report by the Committee on Water Quality Control on 'Water Classification', and the environmental impact report for 'Te Marua water storage proposals'.

Photo © @shannan\_crow

The 1988 newsletter contained an outline about the establishment of the SIL Trust fund. This fund provides grants to facilitate international sharing of scientific knowledge, and arose from surplus funds returned by the 1987 SIL Congress in Hamilton. In 1997\*, the newsletter summarised discussions on 'where to from here' for the Society, as we neared our 30<sup>th</sup> anniversary. These included building the profile of the Society, the form of the newsletter and planning for future conferences. Other articles ranged from the fragmented knowledge about New Zealand freshwater amphipods, to the revamping of the Limsoc homepage and website development, the 8<sup>th</sup> International Rotifer Symposium, and a new freshwater teaching resource (Streamsense) in development.

In 2008, the Society's honorary life members shared their reflections of early highlights from their own research and memories about the Society, in honour of the Society's 40<sup>th</sup> year. I encourage you all to have a read through these reflections, and to dip in to the newsletter archives on the NZFSS website (http://freshwater.science.org.nz/index.php/ publications/newsletters – though soon to be migrated to our new website).

On to 2018, thanks to all who have contributed to this year's newsletter. I hope you all enjoy reading about what everyone's been up to as much as I have.

Finally, a big thanks to Marine Richarson, assistant newsletter editor, who has done a fabulous job of collating and chasing up contributions, all while writing up her PhD. And to Bronwyn Gay from EOS Ecology (newsletter layout and design), for all their work in making the newsletter look amazing once again.

Ngā mihi nui, nā

Natasha Petrove NEWSLETTER EDITOR

\* In perusing past newsletters, I noted that we have a few gaps in our website archive – if you have copies of past newsletters, please check if any are from missing years and let us know so that they can be scanned and added to the archive.

## PRESIDENT'S PIECE



I'd like to begin my message by thanking and congratulating our newsletter team (Natasha Petrove, Marine Richarson and EOS Ecology) for producing yet another excellent newsletter for our Society. Along with our annual conference, the

annual newsletter is our way of summing up who and what the New Zealand Freshwater Sciences Society is all about. This newsletter shows that we are indeed an active and productive lot and that we will have much to celebrate when conference time rolls around in December. So thanks team for putting together another great newsletter.

This year has seen some important changes in the freshwater 'landscape'. We have a new, coalition government and new Ministers (David Parker – Environment, Eugenie Sage – Conservation, and Damien O'Connor – Agriculture), who will steer policies related to freshwaters in some different directions. The previous government's collaborative vehicle for generating freshwater policy, The Land and Water Forum, has gone into abeyance after having done much work and proposing many amendments and new policies related to freshwaters. The new government is trying a new approach of appointing expert advisory groups, with the aim of rapidly improving water quality and freshwater ecosystem health. Its main approach will be by way of new regulations on land and water use. The Government's stated goals are to stop further degradation and loss, reverse past damage, and address water allocation issues. The freshwater agenda was recently set out in the document: Essential Freshwater: Healthy Water, Fairly Allocated (www.mfe.govt.nz/ fresh-water/essential-freshwater-agenda).

At the same time, the government has committed to engage with Māori to develop a new approach to the Crown/Māori relationship for freshwater. The outline for this process can be found in the document: Shared Interests in Freshwater: A New Approach to the Crown/Māori Relationship for Freshwater (www.mfe.govt.nz/sites/default/files/media/Fresh%20water/ shared-interests.pdf).

These new initiatives involve different advisory groups, including a Science and Technical Advisory Group of which a few of our members are participants. These initiatives are challenging but exciting opportunities to translate our freshwater technical knowledge into policy to improve the condition of freshwater ecosystems and the well-being of all those who depend on them (i.e., everyone). Many members of NZFSS have been working with central government ministries, regional and district councils, iwi, industry and community groups to make sure decision makers are well informed about freshwater matters so that they may make good decisions.

One thing that has really struck me this year is how many people seem to be aware of freshwater issues. Perhaps it was the election campaign, which had a strong focus on the environment and water quality, that heightened public awareness, but I am often amazed by how many strangers I meet who express a passion and concern about freshwaters and freshwater issues. This tells me that people are interested and receptive of the work that we do as well as the knowledge that we gain and share. Many of us have been in the media this year, sharing our freshwater information and ideas, and this helps raise the profile of freshwater science and the NZFSS. So, I thank the members of NZFSS who have spoken on radio and TV, and to newspapers and magazines, and I thank those who make use of the wide array of social media to engage with the public on freshwater issues. You have done a great service.

#### CONGRATULATIONS ARE DUE:

Two of our members deserve special congratulations for their achievements that have been recognised this year:

Carolyn Burns (University of Otago) was awarded the Thomson Medal by the Royal Society for her outstanding leadership and service to environmental science and conservation. Well done, Carolyn!

Russell Death (Massey University) was awarded the NZFSS Medal for his services to advancing freshwater science – congratulations Russell! We look forward to your plenary talk at the NZFSS conference.

#### NZFSS ACTIVITIES IN THE PAST YEAR

It has been a quiet year for NZFSS in terms of submissions on policy. However, the central government's Essential Freshwater strategy has signalled that there will be an update to the National Policy Statement for Freshwater Management, a new National Environmental Standard for Freshwater Management will be developed, and amendments to the Resource Management Act will be made, all in the coming year. The Exec will be keen to get your feedback to help craft submissions on these policies as they are sent out for consultation.

This year, the Exec has been focused on major administrative restructuring of the NZFSS. This has involved developing a new website, integrating a new membership management system via the website, and integrating a discussion forum into the website, to allow efficient consultation with the membership between AGMs. These upgrades to the way the Society functions will increase efficiency and allow us to get more work done on behalf of the Society.

#### UPCOMING CONFERENCES & OPPORTUNITIES TO JOIN FORCES

Organising for our 50<sup>th</sup> anniversary conference in December in Nelson has been progressing well. This conference will be our own, without any other societies joining up with us. The Exec has also been busy organising upcoming conferences and some exciting opportunities to join other conferences have come up. In 2019, it will be our turn to travel to Australia for a joint conference with the Australian Freshwater Sciences Society (formerly the Australian Society for Limnology, ASL) in Geelong, Victoria. In 2020 we will have the opportunity to join forces with INTECOL (the International Association for Ecology), which will be holding a major wetlands conference in Christchurch. Then, in 2021 the Society for Freshwater Science (formerly the North American Benthological Society, NABS) will be holding its conference in Brisbane. We have been invited to join all of these conferences. No final decision has been made on the 2020 or 2021 conferences, so please share your thoughts about these opportunities at our AGM in December.

#### CLOSING MESSAGE

The NZFSS runs on the energy and talents of its Executive. So, I would like to specifically thank the core Exec team for their work and assistance this year: David Hamilton, Phil Jellyman, Kate McArthur, Natasha Petrove and of course our omniscient chief organiser and keeper of accounts, Amy Whitehead. I'd also like to thank Ian Kusabs, Yvonne Taura and Brett Cockeram (Te Rōpu), Emma Moffett (student representative), Richard Allibone (helper with submissions), Lisa Carlin (website manager), Sophie Allen (community outreach), and Marine Richarson (assistant newsletter collator and editor).

If members have any thoughts or comments for me and/or the Exec, feel free to send those to us.

Best regards and I hope to see you at our  $50^{\rm th}$  anniversary conference in Nelson in December,



Marc Schallenberg PRESIDENT, NEW ZEALAND FRESHWATER SCIENCES SOCIETY

Limsoc conference in Taupō 1982
– can you spot some familiar faces?

2. Vida Stout, Mike Winterbourn, Colin McLay and Trevor Crosby – bonus points if you can tell us where or when!

3. 1987 SIL conference in Hamilton.

4. Ruapehu eruption that happened during the 1982 conference in Taupō.

NZFSS over the years



NEW ZEALAND LIMNOLOGICAL SOCIETY CONFERENCE - TAUPO, 1982

Back row:	J. Gibb, M. Timperley, B. Coffey, S. Wood, A. Viner, C. Mitchell, R. Wells, E. Mhite, R. McColl, T. Stephens, W. Vant, D. Jellyman, M. Gibbs, R. Edwards, J. Boubée
3rd row:	C. Richmond, M. Downes, M. James, P. Gillespie, V. Wilkinson, J. Stark, P. Claman, V. Stout, B. Biggs, P. Henriques, P. Mylechreest, J. Quinn, J. Davles, E. Cudby, W. Donovan, I. Vida]
2nd row:	L. Whiteside, Y. Stark, S. Davis, A. Chapman, M. Fransen, S. Porter, C. Burns, R. Vigor-Brown, L. Harper, A-M. Schwarz, M. Butler, F. Eccles, M. Harper, K. Law, J. Edwards, L. Ryan
Front row:	S. Pickmere, P. Lawless, G. Payne, P. Todd, R. McLay, P. Tortell, D. Forsyth







Simon Stewart and Warrick Powrie collecting water samples from 150 m depth at the long-term monitoring 'Site A' in Lake Taupō, April 2015. Water samples were analysed for dissolved nutrient stable isotopes to characterise nitrogen cycling processes.

noto © Chester Boye

# INVITED ARTICLES & OPINION PIECES



## Ngā Mahi o te Ropū Māori

#### By Ian Kusabs, Yvonne Taura & Brett Cockram

#### Mō wai, mōu māori mā - Water for all

#### Tēnā koutou katoa,

I te tuatahi, e kore e mutu ngā mihi ki a tātou te iwi Māori, ngā kairangahau Māori hoki e ngana tonu nei kia anga whakamua ēnei mahi puta noa i te motu whānui.

Kātahi te tau tōnui ko tēnei mō tātou o Te Rōpū Māori. I kaha tātou ki te whai i ngā huarahi kia puta mai i ngā hua mō tātou te iwi Māori, ngā kairangahau, me ngā tauira i roto i ngā mahi mō ngā wai māori.

Firstly, we would like to acknowledge all of the efforts that our Māori researchers and Māori communities continue to carry out throughout Aotearoa.

Well it's been a busy, but productive, past 12 months for the Rōpū Māori. This year, we've made significant progress in realising our potential as a network for Māori freshwater scientists, researchers, and students, including:

- Development of a terms of reference (ToR) that clearly defines the purpose and structures of the röpū. We are indebted to Associate Professors Hēmi Whaanga and Tom Roa from the University of Waikato, as well as Joanne Clapcott and Erica Williams for their contributions. The vision of the NZFSS Röpū 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://gallery.mailchimp.com/b96d0103d59682c6de14ae8ec/files/85400e77-a5b5-45e4-83bd-f94c30fabd8d/NZFSS\_Terms\_of\_Reference\_Ro\_pu\_M%C4%81ori\_Updated\_April\_2018.pdf).
- Increased our social media profile via Twitter (~500 followers).
- Produced regular newsletters and sent numerous emails to rõpü members.
- Increased our membership to more than 50 members.
- Networked with indigenous researchers in the USA, Hawaii and Australia.

Furthermore, over the past few months, the representatives have been liaising with the NZFSS Conference Committee regarding the annual conference to be held in Nelson this December. We are also in discussions with the NZFSS Executive, on the benefits (and possible funding) of kaitiaki attendance at annual conferences.

A highlight of the year was the NZ Journal of Marine and Freshwater Research special issue on Mātauranga Māori shaping marine and freshwater futures (issue 52/4). Many of our members contributed to this exciting kaupapa as either editors or authors. The issue, spearheaded by Associate Editor (and rōpū member) Joanne Clapcott and a team of guest editors collated papers on how Māori knowledge, resources and people advance our understanding of aquatic science. The special issue showcases recent examples of how mātauranga Māori is shaping aquatic research and decision-making. There is an enormous potential for the use of mātauranga Māori to enhance our understanding of aquatic ecosystems, underpin culturally appropriate restoration approaches, and provide a more holistic and integrated perspective for research, monitoring, planning, and policy and resource development. See page 12 for further details.

We would like to congratulate rōpū members, Drs Tara McAllister, Ani Murchie and Simon Stewart on completing their PhDs. We wish you all the best in your future scientific careers .

Finally, thanks to all of those who have supported and assisted the Rōpū Māori this year.

Me mihi hoki ki a koutou i akiaki, i tautoko mai i a tātou o Te Rōpū Māori i tēnei tau.

#### nā Ian Kusabs, ko Yvonne Taura rātou ko Brett Cockeram MĀORI REPRESENTATIVES, NEW ZEALAND FRESHWATER SCIENCES SOCIETY

For any Māori freshwater scientists, researchers or students who would like to join the NZFSS Māori rōpū, please email māori.fwss@gmail.com



#### Dr. Tara Mc Allister Te Aitanga a Mahaki

Tara is currently a research fellow at Te Pūnaha Matatini (University of Auckland) and an ecologist at Mahaanui Kurataiao Ltd. She recently completed her PhD in freshwater ecology at the University of Canterbury, titled: 'Phormidium accrual cycles in Canterbury rivers: the effects of nutrients and flow'.

Photo supplied by Tara McAllister



#### Dr. Ani Kainamu-Murchie Ngāpuhi, Ngāti Kahu ki Whangaroa

Ani is currently a Post-doc fellow within Te Kūwaha – the National Māori Research Centre at NIWA (National Institute of Water Atmospheric Research). She recently completed her PhD in environmental science at the Ngāi Tahu Research Centre and the University of Canterbury, titled: 'The ecological and sociocultural values of estuarine shellfisheries in Hawai'i and Aotearoa New Zealand'.

Photo supplied by Ani Kainamu-Murchie



Dr Simon Stewart Ngāpuhi, Waikato

Simon is currently holding a shared position between the University of Waikato and the Cawthron Institute as a freshwater ecologist. He recently completed his PhD in freshwater ecology at the University of Waikato, titled: 'Seasonal and spatial patterns in nitrogen cycling and food web interactions in Lake Taupō New Zealand'.

Photo supplied by Simon Stewart

#### 10

#### Northern Arizona University and the American Indian Science and Engineering Society

#### By Ian Kusabs

In June this year, Ian Kusabs hosted Ann Marie Chischilly from the Diné (Navajo) Nation/Tribe from Arizona. Ann Marie is the Executive Director of the Institute for Tribal Environmental Professionals (ITEP) at Northern Arizona University. ITEP assists all 573 tribes in the USA with their environmental issues, primarily building capacity through trainings, educational outreach, technical assistance and policy development (http://www7.nau.edu/itep/main/ Home/). ITEP currently have student exchange programmes with the University of Tasmania and University of Melbourne. Hopefully, in the near future we can include New Zealand in this exchange programme as well. From this connection with ITEP, Ian Kusabs was recently featured in an article on indigenous knowledge in Winds of Change - the magazine of the American Indian Science and Engineering Society. The article can be viewed in detail at https://read.nxtbook. com/aises/winds\_of\_change/fall\_2018/refocusing\_on\_ indigenous\_know.html



tan Kusaba deproping whata-welu goundes of brazinen ferm) in a small loss reor Rotorus. New Zustand in John Country: of the sex stands

#### Refocusing on Indigenous Knowledge

Cultures open to learning find mutual benefits In Drive Vision Kini

#### **Examining Kākahi and Kōura with the 'Te Arawa Wai Warriors'** By Ian Duggan

In May, Ian Kusabs, myself, and post-graduate students Anita Pearson, Tom Moore and Laura Francis, spent the day with the 'Te Arawa Wai Warriors' – a group of enthusiastic 12 to 15 year old Te Arawa students who are learning to become protectors of the Te Arawa lakes and of other waters in their rohe. We aimed to help the students become familiar with kākahi and kōura, and shared our knowledge of the threats to these species.

Our day started at Hamurana, Lake Rotorua, where we retrieved whakaweku, previously set by Ian K. Although we didn't catch any kōura, the students gained experience with the method, and counted toi toi (common bullies) and invertebrates collected. Meanwhile, other students donned waders and successfully hunted for kākahi with their hands in the sediments of the lake.

Returning to Te Takinga Marae, the students were shown how to make their own whakaweku, learned about the life cycle of kākahi and kõura, examined zooplankton down microscopes, and 'sampled' (ate!) some kõura. For many of the students, despite the importance of these species to Te Arawa, it was their first experience seeing and handling these species.

The day was facilitated by the Te Arawa Lakes Trust, and was part of our Biological Heritage National Science challenge work on biosecurity threats to freshwater taonga invertebrates.



RIGHT: The students examining zooplankton down microscopes.

BELOW: Te Arawa Wai Warriors hunting for kākahi.

Photos supplied by Ian Duggan



### New Zealand Journal of Marine and Freshwater Research Special Issue: Mātauranga Māori Shaping Marine & Freshwater Futures

#### By Joanne Clapcott

In December 2018, a collection of articles that capture the rich and diverse knowledge and experiences associated with how mātauranga Māori is shaping marine and freshwater futures will be published as a special issue in NZJMFR. The special issue was edited by Joanne Clapcott, Jamie Ataria, Chris Hepburn, Dan Hikuroa, Anne-Marie Jackson, Erica Williams and Rauru Kirikiri. It contains an editorial introduction as well as 15 invited articles:

- Whakamanahia te mātauranga o te Māori: empowering Māori knowledge to support Aotearoa's aquatic biological heritage (Jamie Ataria and colleagues)
- Māori oral traditions record and convey indigenous knowledge of marine and freshwater resources (Hēmi Whaanga and colleagues)
- Enabling mātauranga-informed management of the Kaipara Harbour, Aotearoa New Zealand (Maria Hepi and colleagues)
- Indigenous and local peoples' values of estuarine shellfisheries: Moving towards holistic-based catchment Management (Ani Kainamu-Murchie and colleagues)
- Fishing for the cultural value of kahawai (*Arripis trutta*) at the Mōtū River, New Zealand (Kimberley Maxwell and colleagues)
- Murihiku Cultural Water Classification System: Enduring partnerships between people, disciplines and knowledge systems (Jane Kitson and colleagues)
- East Otago Taiāpure: Sharing the underlying philosophies 26 years on (Anne-Marie Jackson and colleagues)

- Using Māori knowledge to assist understandings and management of shellfish populations in Aotearoa New Zealand (Kura Paul-Burke and colleagues)
- Mātauranga Māori driving innovation in the New Zealand scampi fishery (Sean Ogilvie and colleagues)
- Evaluation of a traditional Māori harvesting method for sampling kōura (freshwater crayfish, *Paranephrops planifrons*) and toi toi (bully, *Gobiomorphus* spp.) populations in two New Zealand streams (Ian Kusabs and colleagues)
- Relationships between Māori values and streamflow: tools for incorporating cultural values into freshwater management decisions (Shannan Crow and colleagues)
- Classifying mauri of wai in the Matahuru Awa in North Waikato (Aareka Hopkins)
- Severed at the head: Towards revitalising the Mauri of Te Awa a te Atua (Dan Hikuroa and colleagues)
- Tuākana/Teina Water Warriors Project: A collaborative learning model integrating mātauranga Māori and science (Phyllis Callahan and colleagues)

The special issue will be open access for two months following publication. Download articles from here: www.tandfonline. com/toc/tnzm20/current. The launch of the special issue will coincide with a special session at the 50<sup>th</sup> meeting of NZFSS in Nelson.



### Fish Rescues from Construction Sites

#### By Siobhán Culhane – EOS Ecology

Over the years we have rescued thousands of fish from construction sites that could have otherwise died or been injured. Since the introduction of the joint Environment Canterbury-Christchurch City Council 'Fish Salvage Guidelines for Work in Waterways' in October 2017, Canterbury contractors undertaking works that disturb the wetted channel now have a set of protocols to follow. If the works are likely to negatively impact fish within a project involving a waterway, then fish removal and relocation is required to be carried out prior to commencement.

Construction works within waterways vary, so the fish removal approach has to be customised to the type of site, the fish present, and the construction activity. Whilst electrofishing is our most common method of fish removal, challenging conditions such as high salinity, deep water, long culverts, and dredging works have often meant we employ a range of alternative fish removal methods, including trapping (e.g., Gee minnow traps and fyke nets), hand netting by spotlight, seine/drag netting and even electrofishing sloppy sediment that has been removed from a river. For example, at a lower river site with high salinity and a range of both freshwater and estuarine fish species, a combination of trapping and drag netting was used to effectively remove these fish. At another site, fish removal was required from within a 220 m long culvert, a job we could undertake as we have staff trained in confined space entry. We have also been to sites where fish removal efforts have morphed into a recovery of kākahi/freshwater mussels by hand. We have found it enjoyable and satisfying working with various contractors to develop effective methods of fish removal tailored to their specific site, the fish likely to be present, and their construction schedule.

Looking at the 12 months from 1 October 2017, we have rescued a total of 9,671 fish and waikōura (freshwater crayfish) from construction sites within Canterbury. Of these, 793 fish (in order of abundance: īnanga, giant bully, longfin eel, bluegill bully, waikōura and lamprey) had an 'At Risk' or 'Threatened' conservation status. The most recent 2017 Conservation Status of New Zealand Freshwater Fish report indicates a staggering 74% of our native freshwater fish have either an 'At Risk' or 'Threatened' conservation status. The removal of such species from harm's way further emphasises the worth of fish rescue work.



TOP LEFT: Thousands of yellow eye mullet rescued via drag netting. TOP MIDDLE: Giant and not-so-giant giant bullies rescued before site dewatering. TOP RIGHT: Electrofishing section to be dewatered. BOTTOM: Siobhán measuring a massive eel from St Albans Creek.

Photos © EOS Ecology

### Conservation (Freshwater Indigenous Fish) Amendment Bill: What it Means for Scientific Work

#### By Paula Warren – Senior Policy Advisor, Department of Conservation

DOC manages most aspects of freshwater fish, although the Fisheries Act and MPI also have key roles. Most of DOC's powers derive from the Conservation Act 1987 (the Act) and the Freshwater Fisheries Regulations 1983 (FFR).

The Conservation Amendment Bill (the Bill) is a short statute, largely designed to adjust and extend the existing toolbox for managing freshwater fish. It has generated a surprising amount of public concern, mostly because of misunderstandings of what it will mean for sports fish and whitebaiting. This article does not deal with those issues (email pwarren@doc.govt.nz if you want more information).

The fisheries management controls in the Act affect a lot of fisheries science work. For example, the controls on electric fishing sit within the Act, as do controls on transfer of aquatic life. But in many cases DOC isn't enforcing provisions that, if strictly enforced, would have major effects on fisheries research activities (e.g., the Act says that any disturbance of a spawning ground is an offence). Nor have we actively used some of the provisions to help research work.

This article gives a basic summary of how the Bill and intended regulation reform work next year could affect the work of freshwater fish scientists.

#### FISH TAKE

The Bill moves the basic rules about when you can fish without a specific permission from regulations to the Act. Killing a fish for anything other than for food will require an authorisation, so any take for scientific purposes will need to be authorised, unless the fish is fairly rapidly returned unharmed to the same place. That may restrict some fishing that currently doesn't need a permission, but we have included an authorisation process that should be able to deliver rapid approvals for low risk activities.

We have had complaints from some fisheries scientists about the difficulties of getting authorisations for scientific work. We are going to look at whether we want to make it easier to issue generic authorisations for a particular type of take, or to make particular types of take permitted by passing a regulation. We would love your feedback on what sorts of common activities should be allowed without an individual needing approval to carry out the activity.

#### ELECTRIC FISHING

This is controlled under the Act and some regulations. The Bill revokes the regulations, as they are no longer needed. The process on the ground will be unaffected by that.

#### **ROTENONE USE**

The Bill clarifies who in DOC can use hazardous substances (and electric fishing machines) for fishing without needing an authorisation. Other than that, there is no change.

#### CLOSING AREAS TO FISHING

We currently have four ways to do this: closed seasons (section 26ZP), restrictions on fishing (section 26ZL), regulations (e.g., the whitebait regulations close some areas), and faunistic reserves (a mechanism created under FFR regulation 68 that permanently close an area to all fishing of all species). The Bill makes minor changes to section 26ZP to make it more useful.

These provisions haven't been used much. With more experimental management work, re-introductions, and research, there is potentially a case for using them more actively to ensure that management and research projects are not affected by fishing. Comments on whether you need to have closures for your work would be useful to aid our thinking about that.

#### SPAWNING SITES

The Act has a blanket prohibition on any disturbance, damage or destruction of spawning grounds. This hasn't been actively enforced, but there is strong community interest in better protecting spawning sites. The existing provisions are a problem, as they don't allow for any authorisation, they apply even if no-one knows the spawning ground is there, and 'disturbance' would include restoration plantings, possibly spawning surveys, etc.

The Bill does two things. It allows authorisation of damage in limited circumstances. And it allows for regulations that will solve some of the above issues. We are looking also at how to further adjust the Bill to deal with the issue of not knowing where all our spawning grounds are.

As we start actively implementing the law, we'll be looking to the scientific community for help in things like defining where spawning grounds are, defining what activities would damage them, defining what activities would be good for spawning and should therefore be automatically allowed (and encouraged), defining spawning seasons, etc.

#### FISH TRANSFERS

Section 26ZM controls the movement of fish between waterbodies. There are also old regulations, and the Bill is proposing to revoke those as they aren't being used. The Bill also makes a minor change to 26ZM to resolve a legal issue. A key piece of work we need to do at some point is to define movements that aren't an issue and remove unnecessary restrictions on them – e.g., movement of fish over dams, rescuing fish, and re-introduction of fish that were historically present. That will require more information on what movements are a risk.

#### FISH PASSAGE

The Bill does not change the current rules, but does ensure that we can review the existing regulations. A review of the regulations has started, and we will be consulting on changes next year. A key aim in the review will be to ensure that the limited mitigation resource is well targeted and effectively used, and that new structures are optimal.

There is increasing science on what creates a barrier to movement of fish and how to mitigate that, but there has been very little work on other species such as non-flighted invertebrates.

#### ACTIVITIES THAT KILL FISH

The Act already manages some of these, notably contaminants. The Bill would allow regulations to be promulgated to control others, such as dewatering of drains, drainage pumps, etc. The intention is to do that where there is clear industry best practice that needs to be enforced.

Research will be critical to identify activities that are a problem, and solutions to these. For example, screening water intakes is an obvious need, but standard rules are difficult to design given the variation between intake structures, waterbodies and fish. There is even a risk that some types of screens can encourage fish to enter intakes.

#### NOXIOUS FISH

The Bill creates a regulation-making power to allow us to review the noxious fish regulations. Work done so far has raised some basic questions about how we can best manage noxious fish, particularly species such as gambusia and koi carp that are well established in some places but not yet through their full potential geographic range.

#### NATIVE FISH AND SPORTS FISH

The submissions and public debate about the Bill have highlighted the fact that there are significant uncertainties about the interactions between different fish species, and how best to manage those. A key question DOC wants to answer is how we can improve habitat so native fish can cope with the presence of trout (e.g., by having refuges). But we will also need science to identify the rare native species and specific habitats where keeping sports fish out will be critical. We have not had too much difficulty in the past getting fish and game council agreement to sports fish exclusion or eradication in specific cases, where we have good science to justify our choices.

If you have any questions about the Bill, or suggestions on what we need to achieve in future reform of fisheries management, contact Paula at pwarren@doc.govt.nz.



## STUDENT NEWS



Emma Moffett

#### Hi NZFSS students,

It is almost conference time! This year's student function will be held on Tuesday 11<sup>th</sup> December at DeVille café and is open to all students, postdoctoral researchers, and early career researchers attending the conference The student event is a great opportunity to informally meet your peers, who may be your co-workers of tomorrow, with a drink and some food provided.

Those of us presenting work at the conference this year will receive feedback on our presentations post-conference. I hope that getting this feedback will be constructive and will help us to improve our presentations and posters. Hopefully you will also find this helpful. If you have any feedback let the NZFSS committee know.

Finally, I am looking for someone to replace me as a NZFSS student representative. If you are keen on advocating for your fellow students please get in touch. I will also be asking for volunteers at the student function.

I am looking forward to catching up with all of you soon,

Emma Moffett STUDENT REPRESENTATIVE NZFSS COMMITTEE

E-mail: Emma Moffett - emma.moffett@auckland.ac.nz

## **CRITTER OF THE YEAR 2018**

#### By Karen Shearer

### Philanisus – the Caddis with a Little Salt in its Diet

Hi entomological enthusiasts! This year I'm going to put the spotlight on one of my favourite aquatic insect groups – the caddisflies. Now, as every fly-fisher knows, caddisflies are common around streams and rivers, and are a favoured food of trout and other freshwater fish. But while most of New Zealand's 250 plus caddisfly species live near freshwater, I'm going to tell you about a very unusual wee beastie. A radical, that after experiencing evolution in the new and exciting realms of freshwater and land decided to up sticks and relocate closer to its ancestral home. A salty little number known as (drum roll) *Philanisus* – the marine caddisfly!

Why talk about a marine animal in the NZFSS newsletter? Well, it features in the New Zealand freshwater taxonomists bible 'Guide to Aquatic Insects of New Zealand'...Need. I. Say. More! As a Master's student at Canterbury University, it was one of the first aquatic insects I identified with confidence **and** correctly – arguably a bit of a no-brainer given the habitat giveaway. But the clincher for me is that it has a really, really interesting life history. We'll get to that.

As a member of the world's only marine caddisfly family, Chathamiidae, *Philanisus* is found throughout New Zealand living in the intertidal regions of the seashore. They can be found in rock pools usually in association with the red alga *Corillina* – a genus of red seaweeds with hard, abrasive calcareous skeletons. The first time I saw *Philanisus* was during my Master's, when my best friend, who was studying eelgrass on the rocky shores of the Kaikoura Coast, brought in a live specimen that was beetling happily around in an eelgrass sample. We both marvelled at how cute it was, and the loveliness of the beautiful case it had built for itself out of coralline algae. Then, as you do after making a new friend, we cemented the relationship with our favourite tipple, ethanol.

Now for some fun facts - Philanisus females lay their eggs into the coelomic cavity of the common intertidal cushion starfish Patiriella. Didn't see that coming, did you! The relationship appears to be commensal, with the starfish acting as a mobile nursery maid for the caddisfly eggs while they develop. Although adults may be found year-round in light traps, oviposition occurs mainly from spring through to autumn. The eggs hatch inside the starfish after 17–18 days. The newly hatched caddis larvae exit the starfish (most likely through papular pores or the stomach wall) and take up residence in rock pools, growing to around 6.5 mm long before pupating. The larvae seem to have a huge affinity for red algae – they feed on detritus and red algae, construct their cases primarily from red algae (interspersed with seagrass, shell and sand), and pupate - you guessed it - while attached to red alga.

So why did this amazing animal spurn the freshwater scene and return to its evolutionary roots? A question I don't have the answer for, nor does it keep me awake at night folks, but certainly one for us to ponder over as you make your first cup of coffee (or herbal tea) for the day. But for now, it's hats off to *Philanisus*, our salt-loving caddisfly with a flair for red seaweed and the ethics of a cuckoo.



#### Reference material used in article was sourced from:

- Leader JP. 1976. Marine caddisflies (Trichoptera: Philanisidae). In: Cheng L, editor. Marine Insects. Amsterdam: North Holland Publishing Co.; p.291–302.
- Smith BF, Storey RG. 2018. Egg characteristics and oviposition behaviour of the aquatic insect orders Ephemeroptera, Plecoptera and Trichoptera in New Zealand: a review. New Zealand Journal of Zoology. 45(4):287–325.
- Winterbourn MJ, Anderson NH. 1980. The life history of *Philanisus* plebeius Walker (Trichoptera: Chathamiidae), a caddisfly whose eggs were found in a starfish. Ecological Entomology. 5(3):293–304.

https://teara.govt.nz/en/insects-overview/page-2

Athena Irvine (Zealandia) and Micheline Evans (GWRC) identifying the rarer species of kākahi in Lake Wairarapa

## **RESEARCH NEWS**



## UNIVERSITIES

### University of Canterbury Freshwater Ecology Research Group (FERG)



The Freshwater Ecology Research Group has experienced a mass exodus of students this year, with many having completed their theses and moved on to new positions. Nixie Boddy handed in her PhD in June, titled 'Riverscape heterogeneity controls on spatial patterns in fish assemblages' and is now working at DOC as a Freshwater Technical Advisor in Christchurch. Brandon Goeller finished his PhD thesis and is now working with the NIWA Aquatic Pollution group in Hamilton researching the selection, siting, and scaling of edge-of-field contaminant mitigation tools for waterway rehabilitation in agriculturally-impacted catchments. Kevin Fraley also finished his PhD thesis and is working as a post-doc at the University of Alaska Fairbanks. Finally, Simon Coats finished his MSc thesis on Canterbury mudfish GIS modelling, and Katie Collins has recently submitted her PhD thesis. Meanwhile, **Catherine Febria** will be leaving FERG later this year to pursue a research position in Canada. Holding the fort includes Kristy Hogsden, who has been busy with science communication and developing handouts for the CAREX project; Chris Meijer, who finished his MSc on Canterbury mudfish food-webs and is working as a research assistant within the group; Richard White, who has been wrapping up work on manuscripts and conducting a meta-analysis of stable isotope data; and the usual suspects of Angus McIntosh, Jon Harding and Helen Warburton. Meanwhile, Issie Barrett has just completed her one-year PhD confirmation for her research conducting stream channel experiments on the impacts of different stressors for the Biological Heritage Science Challenge.

#### **CAREX (Canterbury Waterway Rehabilitation**

**Experiment)** - Freshwater Ecology Research Group, University of Canterbury - Te Whare Wānanga o Waitaha - the Canterbury Waterway Rehabilitation Experiment (CAREX) wraps up in 2018 after a decade of funding from the Mackenzie Charitable Trust. It's been an exciting time of solutions-focused research on agricultural stream restoration and we end the program with fantastic successes, including resources for decision-makers, strong partnerships across the country (DOC-Fonterra Living Water Partnership, Biological Heritage National Science Challenge & DairyNZ), and having launched new opportunities for our students and staff. Brandon Goeller completed his PhD on bioreactors and nitrogen management at the farm-scale, and has joined NIWA Hamilton as a Surface water quality specialist. Katie Collins published her first PhD thesis chapter, and has joined DOC and the Living Water Partnership after submitting her PhD in November. Catherine Febria completed her Fellowship with IPBES and role as CAREX Director & Scientist. She is returning to Canada to take up a new role as Canada Research Chair in Freshwater Restoration Ecology at the University of Windsor's Great Lakes Institute for Environmental Research. Research staff Hayley Devlin and Dr Kristy Hogsden will continue onto new and ongoing projects within FERG. Outputs: Collins et al. 2018 (https://doi.org/10.1080/002883 30.2018.1487454), Datry et al. 2018 (https://doi.org/10.1038/ s41561-018-0134-4), Hosen et al. 2017 (https://doi. org/10.3389/fmicb.2017.01452), O'Brien et al. 2017 (https:// doi.org/10.1002/ecs2.2018) and UN IPBES 2018.



Catherine Febria & Katie Collins monitor the Silverstream CAREX research site and farm, 3 years after multiple riparian and restoration tools were implemented. See CAREX's figshare page for resources and information. Reigniting healthy resilience: using functional traits to achieve stream restoration, Biological Heritage National

Science Challenge – members of the team undertook research linking stream restoration, resistance, resilience and functional traits as part of the Biological Heritage National Science Challenge. The team, co-led by Catherine Febria and Helen Warburton, together with Kristy Hogsden, Elizabeth Graham (NIWA), Angus McIntosh, Jon Harding and PhD student Issie Barrett engaged in a range of research activities in the past year including a multi-trophic level freshwater traits workshop at last year's NZFSS conference, the launch of a stream-channel experiment as part of Issie's PhD, literature synthesis, and conceptual framework to disentangle resistance and resilience in stream restoration. In the year ahead, the group is continuing to build the framework for an open traits database for NZ, testing concepts and mechanisms experimentally, while also engaging in outreach with tamariki, rangatahi, schools, industry and communities about overcoming barriers to stream restoration and in particular developing additional tools to help achieve full food web & ecosystem recovery. **Outputs:** Issie's research blog – tinyurl. com/stressforsuccess



The multi-channel stream experiment constructed by Issie Barrett at Cass to examine the effects of different stressors on community assembly for the Biological Heritage Science Challenge project.

### University of Otago Lake & Evolutionary Ecology Groups



**New:** Simone Langhans (Visiting Researcher), Motia Ara (PhD student), Lena Schallenberg (MSc), Nichola Salmond (MSc)

The lakes (and estuaries) group has been branching out a bit in the past year, starting new genetic work on picocyanobacteria and *Daphnia*, working with communities on decision support systems to inform management, and working on the science underpinning limit setting in a large intertidal estuary. While we are exploring these new directions, we are also continuing to work intensively on the lake snow problem plaguing our southern Great Lakes, lake restoration via foodweb manipulation (Lake Hayes), freshwater resistance and resilience to eutrophication, climate change impact in Antarctic meltwater ponds, and palaeolimnology. Pelagic food web controls on phytoplankton and the influence of perch in eutrophication -Sami Khan (PhD student) and Helen Trotter (MSc student) have been studying the trophic linkages between fish, Daphnia and phytoplankton in two eutrophic Otago lakes. Their work is driven by an interest in the potential to employ classical biomanipulation techniques to mediate phytoplankton biomass and to thereby increase ecological resistance and resilience to eutrophication. This work is supported by the Friends of Lake Hayes and a subcontract from the MBIE Programme called the Health and Resilience of NZ Lakes and Estuaries, held by the Waikato University. **Outputs:** Khan 2017 (www.lernz.co.nz/uploads/case-study-of-lakehayes-as-an-attempt-for-biomanipulation.pdf), Schallenberg & Schallenberg 2017 (https://yoursay.orc.govt.nz/38718/ documents/85976) and www.odt.co.nz/regions/queenstown/ can-we-save-lake-hayes.

Nuisance polysaccharide production (lake snow) by Lindavia intermedia – Lindavia intermedia is an invasive diatom that has become the dominant alga in some of our oligotrophic lakes. Unfortunately, Lindavia can produce copious amounts of polysaccharide threads, which facilitate the formation of sticky nuisance macroaggregates, also known as lake snow or lake snot. Together with Phil Novis (Landcare Research) and other collaborators from New Zealand and overseas, we are developing methods of sampling, detection, and quantification of lake snow, and studying the historical dynamics of Lindavia as inferred from lake sediment cores, and the ecological effects of *Lindavia* on lake food webs. Our lake snow research is funded by an MBIE Smart Ideas grant (on which Phil is the PI) and by the Otago Regional Council. Outputs: Novis et al. 2017 (https://doi.or g/10.1080/0028825X.2017.1377263), Schallenberg & Novis 2018, https://royalsociety.org.nz/research/too-much-snowfor-wanaka-and-not-the-alpine-kind/ and www.odt.co.nz/ regions/central-otago/lasers-may-be-used-study-lake-snow.

#### Spatial and temporal variability of picocyanobacteria in oligotrophic and eutrophic lakes - Lena Schallenberg (MSc student) is

using epifluorescence microscopy and *e*DNA metabarcoding to study picocyanobacterial diversity and spatio-temporal dynamics in eutrophic (Lake Ellesmere/Te Waihora, Tomahawk Lagoon and Lake Hayes) and oligotrophic lakes (lakes Wanaka and Wakatipu). Picocyanobacteria form the base of the microbial foodweb and are abundant in many of our lakes, however, very little is known about their diversity, function and potential response to our changing freshwater environment. This work is supervised by **Carolyn Burns** (University of Otago) and **Susie Wood** (Cawthron Institute).

#### Safeguarding Biodiversity and Ecosystem seRvices by integrating CULTURAL values in freshwater management (SABER CULTURAL)

- Dr Simone Langhans (Marie Curie Fellow funded by the European Commission) uses a well-known participatory decision support framework (i.e., Multi-Criteria Decision Analysis; MCDA) to tackle two major challenges in freshwater ecosystem-based management: (1) including cultural values that build a conceptual link between natural resources/ biodiversity and local knowledge, besides traditionally considered ecological and socio-economic ones, and (2) accounting for uncertainty. MCDA is (i) transparent, (ii) allows for the whole range of stakeholder values to be quantified and accounted for, (iii) can be used to robustly test outcomes of different management scenarios, and (iv) can ultimately be used to prioritise cost-effective management actions with collective buy in. Simone works with the community in Wanaka (Central Otago) and Blueskin Bay (Dunedin) to tackle different parts of SABER CULTURAL. Outputs: One paper in prep (Langhans et al. (accepted)) and a podcast (Thyr et al. 2018, https://soundcloud.com/ingridthyr/sets/a-lake-at-a-crossroads).

The use of stressor-response relationships for freshwater management - this is a project funded under the Our Land and Water National Science Challenge as part of the Land Use Suitability Programme. This work aims to develop a national spatial tool that indicates land use capability, but is constrained by contaminant limits set to safeguard receiving environments. The work we are doing specifically involves accounting for ecological resistance and resilience in receiving environments to help manage land use within boundaries to safeguard aquatic ecosystems. We are working with Scott Larned (NIWA), Ton Snelder (Land, Water, People) and Richard McDowell (AgResearch). Outputs: Larned & Schallenberg 2017 (www.eds.org.nz/ assets/EDS%20Conferences/2017%20Conference/0900%20 Dr%20Scott%20Larnedv1.pdf), Larned & Schallenberg 2018 (https://doi.org/10.1080/00288330.2018.1524388), McDowell et al. 2018 (https://doi.org/10.1002/ecs2.2482) and Schallenberg et al. 2017 (https://doi.org/10.1080/00288330.2 016.1267651).

## Detecting evidence of ecological resistance and resilience in lake time series datasets -

this project uses the theory of stressor-response relationships to attempt to identify historical tipping points in lake ecosystem state. The tipping points occur where resistance and resilience are overwhelmed and regime shifts occur. Stressor-response relationships are examined to confirm that rapid temporal changes in response variables are due to small changes in stressors. Datasets analysed include palaeolimnological data as well as time series of water quality and LakeSPI measurements. This project is co-funded under (1) the MBIE-funded Lakes380 programme (Marcus Vandergoes and Susie Wood, co-PIs), (2) the MBIE-funded Health and resilience of NZ lakes and Estuaries Programme (Kevin Collier and Troy Baisden, Co-PIs), and (3) the Our Land and Water programme on Land Use Suitability (headed by Scott Larned). Outputs: Larned & Schallenberg 2018 (https://doi.org/10.1080/00288330.2018.1524388).

Causes and Consequences of Intraspecific Variation – Travis Ingram and his research group are addressing a number of questions related to intraspecific variation in freshwater species. Marine Richarson completed her final mesocosm experiment and is writing up her thesis on individual specialisation in common bullies. Visiting intern Grégoire Saboret compared niche use of adult bullies to their larval habitat inferred from otolith microchemistry. Motia Ara has arrived to start a PhD looking at ecological, morphological and genetic variation within New Zealand smelts. Outputs: Travis presented part of this work at the 2017 SEEM Meeting in Queenstown and the 2018 ASN Meeting in Asilomar, CA. Two publications have been coauthored with undergraduate research assistants (Ingram & Bennington 2018, Ingram & Burns 2018).

## Victoria University of Wellington



**Amber McEwan** started her PhD at VUW this year, focussing on translocation ecology of two species of NZ freshwater mussel. The project got off to a great start, with the translocation of *Echyridella menziesii* and *E. aucklandica* into Roto Mahanga (the upper lake) at Zealandia, from lakes Kohangapiripiri and Wairarapa respectively. The work was a collaborative effort, involving local iwi, community members, and multiple partner organisations. After spending some time in quarantine, all the kākahi were PIT-tagged and delivered to their new habitats. The first monitoring event is planned for September 2018.

See the below for more information:

- VUW article: www.victoria.ac.nz/news/2018/08/turningthe-tide-on-mussel-conservation
- Māori TV coverage: www.maoritelevision.com/news/ national/kakahi-cleaning-waterways
- One News coverage: www.dropbox.com/s/tcpi6oj3opcjpv7/ One%20news%20ScreenRecording\_07-22-2018%2020-24-46%20-%20Copy.mov?dl=0
- RNZ coverage (Our Changing World): www.radionz. co.nz/national/programmes/ourchangingworld/ audio/2018656022/mussels-on-the-move
- Newspaper coverage: https://times-age.co.nz/lending-alittle-mussel-to-conservation-plan/ and www.stuff.co.nz/ environment/105923904/rare-kkahi-fresh-water-musselsreleased-in-wellington



Collecting kākahi in July is cold!

Photo © Owen Spearpoint



Joe Potangaroa collecting kākahi in Lake Wairarapa. Photo © Pete Monk



ABOVE: E. aucklandica in purpose-woven kete from Wairarapa. RIGHT: sign on the transport vehicle. Photo © Pete Monk

## GOVERNMENT ORGANISATIONS & CROWN RESEARCH INSTITUTES

### Department of Conservation



New: Nixie Boddy and Katie Collins

This last year has been a busy and exciting one for freshwater conservation. This has been helped by having a new Minister, who is passionate about freshwater conservation science, as seen in her launch of the Fish Passage Guidelines and introduction of the Conservation (Indigenous Fisheries) Amendment Bill to the house. In addition, we have a new Aquatic Director, **Lian Butcher**, who has a strong freshwater background from her work at MfE and Greater Wellington. We welcomed **Nixie Boddy** and **Katie Collins** to the team, who are filling in for **Nicki Atkinson** (currently seconded to the DOC-Fonterra Living Water programme) and **Natasha Grainger** (who has taken on the manager role while **Rosemary Miller** has stepped back into a team role to back fill **Anna Paltridge** while she is on maternity leave!).

A few of the things that have been keeping us busy include:

- Continuing to progress DOC's ambitious stretch goal of seeing more freshwater catchments restored. We have identified new places that DOC can see itself working alongside other partners to restore, as well as continuing work at existing sites through the Arawai Kākāriki and Living Water programmes.
- We have commenced work reviewing all the possible avenues for improving whitebait populations through the establishment of a working group. This followed on from a collation of information on migratory galaxiids (Goodman 2018).
- Publishing the latest assessment of the conservation status of freshwater fishes (Dunn *et al.* 2018).
- Reassessing the conservation status of freshwater invertebrates. The new assessment is due out in early December.

#### NZ Fish Passage Advisory Group (NZFPAG)

- the NZFPAG continues to go from strength to strength, and is now known as a key group improving fish passage management in New Zealand. In the last year we have focussed on supporting the completion and launching the national fish passage guidelines for structures up to 4 metres. We have recently taken the time to undertake a review of our Terms of Reference, next 12 month plan and our membership (see doc.govt.nz/fishpassage), and are currently focusing on promoting the implementations of the guidelines, producing key summaries and resources, continuing to improve our communications, and finalising a summary of key fish passage research needs. We have published two further lessons learnt factsheets that summarise how passage over a dam can be improved and how establishing rock ramps can enable passage past weirs (www.doc.govt.nz/nature/habitats/ freshwater/fish-passage-management/how-you-can-help/), developed a whitebait activity sheet for children to help World Fish Migration Day celebrations (www.doc.govt.nz/nature/ habitats/freshwater/fish-passage-management/resources/), and continued to publish our regular newsletter with lots of key information and updates (see www.doc.govt.nz/nature/habitats/ freshwater/fish-passage-management/advisory-group/).

New Zealand now has National Fish Passage Guidelines for structures up to 4 m! – On 18 April, World Fish Migration Day celebrations began with the New Zealand Fish Passage Advisory Group hosting an event at the Ministry of the Environment in Wellington to launch the 'NZ Fish Passage Guidelines for structures up to 4m'. The Minister of Conservation, Eugenie Sage, launched the document to over 100 ecologists, engineers and others from 50 organisations representing regional councils, Fish and Game, DOC, the Ministry for the Environment, contractors, iwi and several others involved in fish passage management in New Zealand.

DOC and regional councils have specific responsibilities to manage fish passage in our waterways under the Freshwater Fisheries Regulations 1983 and the Resource Management Act 1991 (RMA). Under the Freshwater Fisheries Regulations, culverts and fords may not impede fish passage unless that impediment has been approved or exempted by DOC, and new dams and diversion structures in any natural waterway may require a fish passage facility.



We hope that the guidelines will be the start of a more consistent national approach to fish passage and instream structure management in New Zealand, better compliance with DOC's fish passage responsibilities under the Freshwater Fisheries Regulations, and improved habitat for our freshwater fish.

In the coming months, NZFPAG hope to produce some summaries of the key information, and provide further opportunities to get an overview of the guidelines and how it can best be used. For further general information see doc. govt.nz/fishpassage. **Outputs:** Franklin *et al.* 2018 (www. niwa.co.nz/freshwater-and-estuaries/research-projects/newzealand-fish-passage-guidelines).

#### World Fish Migration Day 2018 celebrated -

with 569 events in 63 countries and over 60 million people reached we can safely say that this year's World Fish Migration Day was a huge success. To read about the reach, ambitions and impact of World Fish Migration Day 2018 – check out www.worldfishmigrationday.com/downloads/?lang=6&id=7.

New Zealand officially opened the event for the world at our national guidelines launch, where we gave everyone a giant kōkopu chocolate fish to celebrate. Five events were held throughout New Zealand in Wellington, Christchurch, Hamilton, Bay of Plenty and Motueka.

In Christchurch, well over 700 hundred people helped to celebrate World Fish Migration Day at Margaret Mahy playground. Staff from DOC, Fish & Game, Environment Canterbury, EOS Ecology, Working Waters Trust, Canterbury University, Kiwi Conservation Club, and Avon-Ōtākaro Network joined forces to create this family friendly event. Lots of freshwater experts were on hand to show people our fabulous freshwater fish, what is special about them, how we can help them, and how they need to move within our rivers, and to and from the sea. Kids got to try out the giant inanga board game, complete the World Fish Migration Day challenge, try the new whitebait activity sheet, make t-shirt bags, and try to get the fish up the fish pass in the water play area. **Outputs:** this amazing video was made of our Christchurch event: www.facebook.com/FishandGameNZ/ videos/1961347847270439/

#### Resource Management (National Environmental Standards for Plantation Forestry) Regulations 2017 - the National

Environmental Standards for Plantation Forestry (NES-PF) provide nationally consistent regulations to manage the environmental effects of forestry. An objective of the NES-PF is to maintain or improve the environmental outcomes associated with plantation forestry activities. The Fish Spawning Indicator was developed by MPI – led by Elizabeth Heeg and assisted by Nicholas Dunn (DOC), Shannan Crow (NIWA) and Richard Allibone (Water Ways Consulting Ltd) to assess the risk of forestry activities on spawning locations and times of 33 freshwater fish with high conservation status' or high sensitivities to disturbance. **Outputs:** the Regulations (www.legislation.govt.nz/regulation/public/2017/0174/ latest/DLM7373517.html?search=ts\_act%40bill%40regul ation%40deemedreg\_forestry\_resel\_25\_a&p=1), summary and guidance material about the NES-PF (www.mpi.govt.nz/ growing-and-harvesting/forestry/national-environmentalstandards-for-plantation-forestry/), and the fish spawning indicator GIS tool (http://data-mpi.opendata.arcgis.com/ datasets?q=nes&sort=name).

## NIWA



#### New Zealand Water Model—Hydrology

– NZWaM-Hydro is a partnership of NIWA (lead), GNS Science, Manaaki Whenua – Landcare Research, and the regional councils of Southland, Horizons and Gisborne over the period 2016–2022. The key aim of the NZWaM-Hydro is to enable prediction of hydrological processes and transport from national to sub-catchment scale (relevant scales for the National Policy Statement for Freshwater Management). NZWaM-Hydro will combine surface-water and groundwater models with a water-age model to provide hydrological tracers and water-source information. The project will also build a geospatial database to organise and harmonise data, and provide transferable, scalable and cost-effective applications. As a result, the ability of NZWaM-Hydro to predict how climate, land-use and other environmental changes will affect aquatic ecosystems and water-resources available for use by businesses and communities will be greatly enhanced. The improved accuracy of the model's river-flow simulations will enable communities to develop sustainable use of the resource as well as to better prepare for potential floods and droughts. Over the period 2016–2018, NZWaM investigation is focused on developing the project hydro-geofabric, which provides a framework to further develop capability in process understanding, and measurement across spatial and temporal scales. Outputs: Yang et al. 2017.





Key components and deliverables of the NZWaM-Hydro project.

**Groundwater ecosystems: functions, values, impacts and management** – a report for Horizons Regional Council, funded by Envirolink and entitled 'Groundwater ecosystems: functions, values, impacts and management', summarised the current state of knowledge on groundwater ecosystems in New Zealand. This included chapters on what lives in groundwater, how the ecosystems function, the services and values they provide, Māori values, beliefs and practices associated with groundwater ecosystems, and threats they face, as well as the current regulatory context. The report is available at: www.envirolink.govt.nz/ assets/Uploads/1838-HZLC143, Groundwater-Ecosystems-Functions-values-impacts-and-management.pdf

New tools to define ecologically friendly streetlighting solutions – funding from the MBIE Endeavour Smart Idea fund has allowed the initiation of a 3 year project investigating the implications of current national conversion of streetlights to light emitting diodes (LEDs). This conversion will save millions of dollars per year in energy costs, but the ecological implications of the increased blue light emitted by LEDs compared to most older streetlighting types is unknown. This project will (1) develop a UAV-mounted spectrophotometer that will allow fine-scale light intensity and spectral mapping, (2) develop interactive visualisations of different streetlighting scenarios at a cityscale, and (3) use experimental manipulations of operational streetlights to investigate impacts of the LED conversion on flying aquatic insects and on night sky visibility.

What's in our groundwater? – NIWA's Biological Heritage National Science Challenge project, in collaboration with University of Waikato and ESR, seeks to define the scales of microbial and invertebrate biodiversity in alluvial aquifers in two islands, three regions and several aquifers. Results so far indicate cryptic speciation (DNA bar-coding vs morphological identifications) and a higher diversity than expected for invertebrates. Novel methods for sampling in situ biofilm bacterial populations yielded markedly (>20 times) higher densities and high diversities. More comprehensive analyses of all data over the coming months promise to provide new insights into this neglected ecosystem.

#### Land and water interactions and long term ecological research at Whatawhata/ Te Rauputiputi hill country farm - NIWA and

collaborators have been studying land-water interactions at Tainui owned Whatawhata/Te Rauputiputi hill country farm since the early 1990's, with approximately 100 publications and theses produced. NIWA has been monitoring streams (flow, water quality, habitat, biota) since 1995 and responses to 2001 land use/management changes in the Mangaotama sub-catchment (monthly water quality sampling by Kerry Costley, NIWA), which provides a platform for researchers. Three catchment outlets and a weather station are part of NIWA's hydrometric network. Current studies include: (1) **Andrew Hughes** and **John Quinn** (NIWA) on the impact of pine forest establishment in a previously grazed pasture



TOP: *Phreatoicus typicus*, a 20 mm long isopod from Canterbury's groundwater. Photo © Nelson Boustead/NIWA BOTTOM: NIWA's Simon Howard and Graham Fenwick decant a stygofauna catch. Photo © NIWA

catchment, including the impact of forestry management activities (e.g., planting, thinning and harvest) on stream water quality and the impact of forest establishment on stream hydrology; (2) Manawa Huirama (Waikato University MSc student) and Andrew Hughes using sediment fingerprinting to determine the importance of stream bank erosion as a source of catchment sediment; (3) Richard Storey and Brian Smith (NIWA) on the effects of stream turbidity/suspended solids on adult insect oviposition; (4) Rebecca Stott (NIWA) and Elaine Moriarty (ESR) on land use effects on *E. coli* and *Campylobacter* in headwater streams; (5) Marina Hape (Ngati Māhanga, studying Kaitiakitanga Putaiao at Te Wananga o Raukawa; NIWA intern supervised by Richard Storey and Andrew Hughes) on volunteer methods for monitoring water clarity and E. coli; (6) Riki Parata and Johlene Kelly (MSc/EnvSc students), supervised by Kevin Collier (Waikato University) and Sue Clearwater, (NIWA) are investigating habitat use by koura and links with riparian restoration; (7) Vanessa Barbosa (Waikato University PhD student) is working with Elizabeth Graham (NIWA) on dispersal of aquatic insects to restored sites; (8) Rob Davies-Colley, Ron Ovenden and Kerry Costley (NIWA) on riparian vegetation change and channel morphology dynamics; and (9) Brian Smith continues to lead twice yearly stream habitat and biota monitoring at eight sites with contrasting land and riparian management. **Outputs:** Hughes *et al.* 2017, Hughes & Quinn 2014, Hughes & Quinn 2017 and Hughes & Quinn (submitted).



Fish-eye lens photos in 2018 of representative locations at paired pasture sites with riparian planting in 2001 and the unplanted pasture control.

Photos © Kerry Costley

Estuary Trophic Index (ETI) - the NIWA Estuary Trophic Index (ETI) Team (John Zeldis, David Plew, Bruce Dudley and Amy Whitehead) has created tools to assess ecological health of all New Zealand's estuaries. This work is in high demand from local and central government and industry, because of the threats posed by nutrient enrichment to many New Zealand estuaries and need to effectively manage these threats. The ETI tools were created in 2016–17 in an Envirolink contract. In 2017–18, the ETI generated ten client contracts with regional councils, central government (MfE) and the irrigation industry. The team provided the first NZ-wide survey of estuary eutrophication susceptibility for MfE, assessing 400 estuaries in both current and pristine states (the latter using pre-human land-cover). In other MfE work, the team produced the first compilation of estuarine water quality state and trends monitoring by all regional councils. This drove further council engagements, including detailed eutrophication susceptibility assessments for seven Environment Canterbury and Otago Regional Council estuaries, contributing to SOE and water-management assessments. The team members span hydrodynamics, hydrology, freshwater and marine ecology groups, indicating its synergy of disciplines. **Outputs:** the online ETI Tools Apps are freely available online with supporting documentation at: https://shiny.niwa.co.nz/Estuaries-Screening-Tool-1/. A paper (Plew et al. 2018) was also recently published.

#### Instream nutrient attenuation in a gravel-

**bed river** – we investigated nutrient-periphyton interactions and nutrient attenuation loading along an 80 km reach of the gravel-bed Tukituki River during summers of 2011–2017, and before and after a sewage treatment upgrade in 2015 to reduce phosphorus loading, using reach-scale measurements and in situ chambers. The research (and leaders) involves: N and P attenuation drivers at reach-scale (**Kit Rutherford**, John Quinn), chamber scale (John Quinn) and diurnally (**Craig DePree**); nutrient attenuation modelling (Kit Rutherford); role of sediment/water column interactions in P dynamics (**Bob Wilcock**, **Rich McDowell** (AgResearch)), ecosystem metabolism (**Roger Young** (Cawthron)), denitrification (Bob Wilcock), isotope and sewage marker tracing (**Sherry Schiff** (Waterloo University, Canada)) and insect emergence (John Quinn, Brian Smith, **Elizabeth Graham**). **Outputs:** A video/talk overviewing several aspects of the research is available (www.limnology.ro/wrw2018/ John\_Quinn.html) and a conference proceeding paper will be available shortly (Quinn *et al.* 2018). Several journal papers are in preparation.

## Oviposition habitat and effects on aquatic insect community structure - Richard Storey

and **Brian Smith** investigated the effect of turbidity on the navigation abilities of aquatic insects as they make their oviposition flights over streams. Aquatic insects recognise water bodies by the pattern of polarised light reflected from their surface, but light reflected from turbid water is known to be less polarised. Mayflies and caddisflies flying over a second-order rural stream showed no preference for clear vs. turbid water, suggesting that turbidity does not affect their navigation abilities.

#### Resources and support for volunteer

**freshwater monitoring** – NIWA is continuing to develop tools and assistance to support volunteer stream monitoring. Through 2018, landowners, community groups, iwi, hapū and schools user-tested the updated Stream Health Monitoring and Assessment Kit (SHMAK). We aim to make SHMAK available by the end of 2018, and launch the website (www.nzwatercitizens.co.nz) for data input, analysis and sharing around the same time. The National Advisory Group for Freshwater Citizen Science has been meeting regularly to build collaboration for volunteer training, support, access to monitoring tools and ongoing development. Members of the Advisory Group include Whitebait Connection, NZ Landcare Trust, Greater Wellington Regional Council, Wellington City Council, Environment Southland, Auckland Council,



TOP: Volunteers measuring dissolved phosphate, one of the new tests available in SHMAK. BOTTOM: Volunteers trying out the new SHMAK invertebrate ID guide.

Photos © Richard Storev

MfE, DOC, Beef&LambNZ and DairyNZ. The work is being hosted by NIWA's SSIF-funded project 'Riparian Restoration Investments & Outcomes: a Citizen Science Approach', led by **Richard Storey** with **Amanda Valois, Kate Davies, Brian Smith, Rob Davies-Colley, Rebecca Stott, Cathy Kilroy** and **Darcel Rickard. Outputs:** SHMAK and accompanying manual available from NIWA Instrument Systems (Chch) by the end of 2018. Website www.nzwatercitizens.co.nz live from end of 2018. National Riparian Restoration Database website https:// riparian.niwa.co.nz for community groups, farmers, etc., to enter details of their riparian fencing and planting projects.

#### Global climate change effects of lakes -

continuous monitoring data recorded by the Taupō buoy and other data are being used to study how our lakes are affected by climate and by climate change, and to compare climate effects on lakes in New Zealand and across the world. **Led by:** Piet Verburg. **Outputs:** Leach *et al.* 2017 (https://doi. org/10.1002/1no.10656), Woolway *et al.* 2017 (https://doi. org/10.1002/2017GL073941), Woolway *et al.* 2018a (https:// doi.org/10.1175/2018BAMSStateoftheClimate.1), Woolway *et al.* 2018b (https://doi.org/10.1002/lno.10950).

#### Lake Horowhenua sediment nutrient legacy -

Lake Horowhenua (Manawatū–Whanganui Region), a shallow dune lake (300 ha), has a long history of eutrophication. The lake also shows an extreme contrast in the seasonality of nitrogen and phosphorus concentrations in the water column, with extremely high phosphorus concentrations in summer by internal loading, while in winter nitrogen is high and phosphorus concentrations are negligible. These nutrient cycles are strongly linked to growth cycles of macrophytes and cyanobacteria. NIWA studies the nutrients accumulated in the sediment and the interactions with nutrient concentrations in the water column. Sediment cores were collected in many locations to determine phosphorus contents and the sediment's capacity to release phosphorus, its origin in the catchment, and a record of the nutrient accumulation during the past century. The project involves collaboration with personnel of Horizons Regional Council, The Horowhenua Lake Trust, Massey University and Cawthron. NIWA staff involved: Piet Verburg, Anathea Albert, Max Gibbs, Greg Olsen, Mary de Winton. **Outputs:** Verburg et al. (in review with NZJMFR).

#### Trace metal nutrient limitation of phytoplankton growth in the Taupō Volcanic Zone -

Several trace metals are essential micronutrients for eukaryotic algae and cyanobacteria, and cyanobacteria also require trace metals to synthesise enzymes involved in nitrogen fixation. The soils in the Taupō Volcanic Zone, which stretches from Mount Tongariro to the Bay of Plenty, are unique, with very low concentrations of certain trace metals. In this Smart Idea Endeavour Fund project, NIWA examines concentrations of trace metals in lakes in the Taupō Volcanic Zone (Lake Taupō and Bay of Plenty Region lakes), and whether these elements limit growth by phytoplankton. The effect of low trace metal concentrations on rates of nitrogen fixation by cyanobacteria is examined as well. **Staff involved:** Piet Verburg, Karl Safi and PhD student Markus Dengg, supervised by Claudine Stirling (Otago University) and Piet Verburg.



Markus Dengg examines concentrations of trace metals in a lake in the Taupō Volcanic Zone.



Shortfin eel otolith from Te Waihora showing annual rings. The ring patterns are being coupled with environmental data to investigate the effects of climate change on eel populations in Aotearoa.

Photo © Eimear Egan/NIWA

#### Eel growth rates and climate change - Eimear

**Egan** is completing her postdoctoral research with the Freshwater Ecology team at NIWA. This research aims to investigate the effects of climate change on longfin and shortfin eels in Aotearoa. A chronology of annual growth rates is being derived from otoliths collected from the 1970s to present. The most extensive chronology generated so far spans over 50 years for Te Waihora shortfin eel populations. Statistical methods called crossdating (traditionally used by tree ring scientists) and mixed effect models are being applied to investigate the effects of multi-decadal environmental variation on eel growth. This research was presented in April 2018 at the 6<sup>th</sup> International Otolith Symposium held in Taiwan and a manuscript is underway. Key contact: eimear. egan@niwa.co.nz Larval origins and migration pathways of longfin and shortfin eels – NIWA's freshwater, marine and Māori scientists are banding together to research the larval origins and migration pathways of longfin and shortfin eels. Eimear Egan, Brittany Graham, Erica Williams and Shan Crow have recently been awarded almost \$1 million NZD (2018–2021) through the MBIE Smart Ideas funding stream. They will be using otolith microstructure and chemistry, together with compound specific isotopes of amino acids and fatty acid analysis to examine the largely unknown marine life of New Zealand's tuna/eels. The marine core of eel otoliths collected over the decades will also be examined to disentangle temporal variation in marine life histories. Key contact: eimear.egan@niwa.co.nz



NIWA Postdoctoral researcher Eimear Egan and Department of Conservation biodiversity ranger Allanah Purdie searching for glass eels at the Ashley River mouth.

Photo © Simon Hayes/NIWA



## **COUNCILS & UNITARY AUTHORITIES**

## Christchurch City Council



New: James Dare

Belinda Margetts has been supported this year in her Waterways Ecologist role by Greg Burrell (Instream Consulting Limited) as a part-time consultant, to help with the busy workload. The Council now has a strategic priority for improving waterways which has helped give impetus to appropriate management and enhancement of Christchurch and Banks Peninsula waterways. Work has been focussed on ensuring effects on waterways are mitigated for large Council projects (such as waterway dredging, bank stabilisation and cycleway projects), undertaking waterway restoration projects in conjunction with community groups, carrying out detailed state of environment monitoring, advising on resource consent applications, working collaboratively with external organisations (such as helping with NIWA's fish barrier assessment app), and advising and liaising with stakeholders. We have also been undertaking research to inform our dayto-day practices, such as ensuring fish passage at tide gates, understanding the effects of bank cutting on īnanga spawning sites, and gaining a better understanding of the health of our waterways.



Kākahi and lamprey from Styx River. Photos © Greg Burrell

#### **Comprehensive Stormwater Network**

**Discharge Consent** - Application for a City-Wide (including Banks Peninsula) stormwater discharge consent. This work involved blending science with policy, involving the assessment of potential effects and how these will be mitigated, and a detailed work programme to address several detailed consent conditions. It also involved practical application of receiving environment standards and testing of this framework on a large scale. Proposed conditions include detailed investigations (e.g., to further understand the effects of stormwater and when you would expect to see a response in the receiving environment due to reduced contaminant loads) and a very detailed monitoring programme, including monitoring of mana whenua values.

#### Salvage and monitoring of freshwater mussels in the Styx River in relation to river

**dredging** – Confirmation of a large population of kākahi (freshwater mussels) in the Styx River by **Greg Burrell** and **Duncan Gray** prompted the Council to conduct a major salvage operation prior to river dredging. NIWA divers, aided by consultants Aquatic Ecology Ltd, were very effective at quickly collecting and relocating kākahi, with over 17,000 mussels moved over three days! Divers are also being used to monitor recovery of kākahi populations after removal from the dredged location. This information can be used to better understand ecological effects for any future dredging proposals.

#### Tracking lamprey to inform design of an

**urban waterway** – In 2015, an aquatic survey by Aquatic Ecology Ltd for the Council revealed lamprey (kanakana/ piharau), a threatened species, living in high numbers in Canal Reserve Drain in the Styx River catchment. High numbers of juveniles indicated that spawning was occurring in this timber-lined drain, which is in major need of repair. Therefore, Council, along with DOC and Environment Canterbury, are supporting efforts by NIWA to monitor migrant adult lamprey using both PIT tags and radio tags and tracking. By tracking the adult fish, we hope to better understand what habitat they are spawning in. This information will be used to help inform the design of the drain lining replacement and enhancement.

## Greater Wellington Regional Council



Greater Wellington Regional Council had reason to celebrate in November, when we were presented with the Goek Ling Phang Memorial Award by the New Zealand Institute of Planning. The award is given to a group that has made a significant contribution to the Wellington region through a project. It recognises the huge effort by the Ruamāhanga Whaitua Committee, community and project team in the development of the Ruamāhanga Whaitua Implementation Programme.



The Ruamāhanga Whaitua Implementation Programme 2018. Photo © Jen Olsen `Drift-Migrate-Navigate – Tuna tryptich'.

## Whaitua Committees help deliver recommendations for freshwater

**management** – GWRC's response to the National Policy Statement for Freshwater Management (NPS-FM) has been to divide their region into five whaitua (Ruamāhanga, Te Awarua-o-Porirua, Wellington Harbour/Hutt Valley, Kāpiti Coast and Wairarapa Coast). In each whaitua a community committee is established and will be responsible for delivering a Whaitua Implementation Programme (WIP). The WIP provides recommendations on the future of land and water management and will become a chapter in GWRC's Natural Resources Plan. The Ruamāhanga WIP was accepted by Council in August, Te Awarua-o-Porirua WIP is in the final stages, and the Wellington Harbour/Hutt Valley Whaitua Committee has just been established.

**Freshwater Accounting** – In order to give effect to the NPS-FM freshwater accounting requirements, GWRC have initiated a project to identify what freshwater accounting

is, what the barriers to implementation are, and what opportunities exist. The project aims to engage a range of internal and external stakeholders. The key output from the project will be a freshwater accounting implementation frame work and business case.

## A new approach to recreational water quality monitoring for the Wellington region – GWRC

coordinates the region's recreational water quality monitoring programme, which is communicated to the public on our website under the 'Is it safe to swim?' campaign. We are in the process of re-designing the region's recreational water quality monitoring programme, with cooperation and support from territorial authorities, Wellington Water and Regional Public Health. One of the primary changes is implementing risk-based messaging updated on a daily basis for human health. The microbial risk component will combine historical microbial grades, update and forecasted rain while the toxic algae component will have a sentinel network with targeted monitoring at high risk sites. The risk-based framework allows us to report the highest risk category for the public represented as a 'traffic light' colour code, i.e., green (safe for swimming), amber (caution advised) or red (unsuitable for swimming).

#### Ecological monitoring of the region's rivers

**and lakes** – Nineteen river and stream sites across the region, and seven sites across six lakes were surveyed as part of the regional river and lakes ecological monitoring. Many of the surveys were undertaken in areas where information on fish community health has previously been very limited. A total of 9,519 fish representing 19 different species were caught across all of the sites surveyed. Data from the monitoring will be used to better inform us about the region's ecological health and to report against the ecological objectives in the proposed Natural Resources Plan (pNRP).



Dwarf galaxias, an endemic fish species considered 'At Risk, Declining' under the NZ Threat Classification System, has a large population in the Wainuiomata River, Wellington Region.

**Urban stream biodiversity** – GWRC and EOS Ecology have begun an urban stream biodiversity monitoring project to identify and monitor the biodiversity values of Wellington City's urban streams, both piped and free-flowing. Monitoring is being conducted in two stages: stage one focusses on habitat condition, macroinvertebrate community health and fish populations, while stage two will design a long-term monitoring programme to provide information on biodiversity state and trends. The results of these surveys will provide baseline information on the ecological health of urban streams within Wellington City, and inform the design of a long-term monitoring network, informing adaptive management of these streams and assisting in protecting them into the future.

Retaining streams through subdivision

design alternatives - Piping and reclamation of streams, particularly headwater streams, is a significant issue in the Wellington Region. Hundreds of metres of stream channel are lost each year, mainly due to urban development. However, there was strong reaction to GWRC's recommended changes to the policy framework in the proposed Natural Resources Plan that reclamation of the bed of a lake or river is to be avoided. Developers and some territorial authorities considered that this policy would unduly hinder urban development, with a requirement to retain streams in Wellington's steep topography reducing the potential housing yield to uneconomic levels. To evaluate these concerns, GWRC commissioned a study by Morphum Environmental Ltd, McIndoe Urban and Wraight + Associates to identify what effect requiring stream retention would have on housing yield and urban form in typically steep parts of the Wellington Region. They found that even in Wellington's steep hill terrain, subdivision design led by stream retention can result in equal, if not better housing yield, with significant additional benefits, not only for ecology and natural character, but for overall urban form and social outcomes, such as recreation, amenity, liveability and sense of place. See Clarke et al. 2018 (http://pnrp.gw.govt.nz/assets/Uploads/ HS5-ROR-Beds-of-Lakes-and-Rivers-Appendix-E-Stream-Retention-Report-13-July-2018.pdf) for more detail.

Potential aerial survey system to quantify

**toxic cyanobacteria cover** – A recently submitted Envirolink Tools proposal hopes to get funding to develop an aerial surveying system and software analysis tool to quantify the cover of toxic cyanobacteria. If funded, the collaboration between NIWA and GWRC will see a survey system designed that will provide data for the mandatory periphyton biomass attribute and the potential benthic cyanobacteria attribute (under development) of the NPS-FM. An associated software tool will be developed for analysis of aerial imagery and assessment of toxic cyanobacteria cover. The proposed aerial survey system and associated open source cyanobacteria aerial mapping software (C.A.M.S.) tool will offer regional and unitary council staff a more effective and robust way to quantify *Phormidium* cover and biomass in rivers commonly used for recreational purposes across New Zealand.

**Passive sampling devices at work** – GWRC is also championing the Envirolink Tools project 'Developing low cost monitoring tools for monitoring stormwater', a project headed by NIWA scientist Dr Jenni Gadd. The aim is to increase the uptake of low-cost reliable passive sampling devices by regulators that enable improved monitoring of urban waters and collection of more robust water quality data. The project is in the second phase of trialling selected passive samplers across various locations, sampling the first flush of urban streams for measurements of contaminants including metals, nutrients and suspended sediments. A field trial of the samplers at three streams in the Porirua catchment looks promising.



Nalgene stormwater bottles and DGT plates deployed just prior to rain at the lower reaches of the Mitchell Stream in the Porirua catchment.

Photo © Claire Conwell

Water quality assurance programme – GWRC have been collaborating with NIWA to pilot a national quality assurance programme for water quality in the Wellington region. Field staff from the two agencies have met on-site in the field at selected 'quality assurance' river monitoring sites to measure field variables side-by-side and collect paired water samples for laboratory measurements. The quality assurance programme has been running since October 2015 and has found field measurements generally have better reproducibility than laboratory-based measurements.

**Citizen Science** – Our freshwater citizen science work began after a community expressed concerns about the state of their local stream. The programme is growing slowly, currently providing tools, training (through Mountains to Sea Wellington) and support for community groups wishing to monitor the water quality of their local stream. Further, a collaborative Envirolink application between NIWA, GWRC, Northland Regional Council, Nelson City Council and Auckland Council secured a grant to 'advance support tools for freshwater citizen science'. Filming of a series of short (~2 min) instructional videos focused on the Stream Health Monitoring and Assessment Kit (SHMAK) has been completed. The suite of videos should be ready for public use early 2019.



The next generation looks on as Friends of Waiwhetu undertake stream health monitoring and assessment training with Mountains to Sea Wellington and GWRC

Photo © Sheryl Miller

## Waikato Regional Council



New: Matthew Barson and Aroha Salu

Bruno David has been working on various fish related projects; Mike Lake has been co-ordinating research into the impacts of flood pumps on migrating eels and monitoring of the impacts of river works; Deniz Ozkundakci and Paula **Reeves** have been working on various lake related projects, including a survey of data deficient lakes around the Taupō catchment; Michael Pingram and Alicia Catlin have begun implementing a monitoring programme for assessing the ecosystem health of non-wadeable rivers; Eloise Ryan has been working on a number of projects, including faecal source tracking and emerging contaminant studies, as well as assisting on several large environmental prosecutions; Alicia Catlin has coordinated the REMS SOE monitoring programme, freshwater mussel surveys, and new monitoring of large river sites; **Josh Smith** has coordinated the SOE freshwater fish monitoring programme; Asaeli Tulagi has coordinated the region's water quality monitoring programmes; and **Bill Vant** continues his work on water quality in the region.

#### WRC Freshwater Fish State of Environment

(SOE) monitoring programme – 70 sites were surveyed between December 2017 and early April 2018. Of these, 14 sites were fished via the netting methodology (i.e., 6 fyke nets/12 minnow traps) and 56 sites via electrofishing. This year's field monitoring team consisted of **Josh Smith**, **Matthew Barson** (student) and **Nicky Kerr** (student), with support from **Bruno David** and **Alicia Catlin**. We are currently collating and analysing the data collected via the freshwater fish data capture system. For a copy of the latest version of the data capture system, please contact Josh (josh. smith@waikatoregion.govt.nz).

Regional Ecological Monitoring of Streams (REMS) Programme – Around 140 sites were surveyed between January and the end of March 2018. At each site, ecological habitat assessments were undertaken and invertebrate samples collected using standardised methodologies. This year's field monitoring team consisted of Alicia Catlin and Tammy Valler (student), with support from Mark Hamer, Michael Pingram, Josh Smith, Nathan Singleton and Aroha Salu. We are currently collating and analysing the data collected for the 2018 season. For any information about this programme please contact Alicia (Alicia.Catlin@waikatoregion.govt.nz). Outputs: Latest round of REMS report is currently in preparation. **Freshwater mussel surveys 2018** – For the past four years WRC has undertaken a freshwater mussel markrecapture survey on Ohautira Stream, Raglan. This year, over 200 mussels of both species (*Echyridella menziesii* and *E. aucklandica*) were tagged, and 186 mussels were recaptured from previous years. In addition, multiple sites have been surveyed throughout the Waikato region over the last five years and a standardised mussel methodology has been written (see linked technical report). A SOE report based on these surveys is also currently in prep. This year's monitoring team consisted of **Alicia Catlin**, **Aroha Salu** (student), **Mark Hamer** and **Michael Pingram**. **Outputs:** Catlin *et al*. 2017 (https://waikatoregion.govt.nz/services/publications/ technical-reports/2016/tr201623/).

#### SOE Freshwater Quality Monitoring

Programmes - In 2018, after nearly 30 years, WRC implemented the largest redesign of our freshwater quality monitoring programmes. The last redesign was implemented in 1989. A restructure of these longstanding programmes was undertaken in response to the adoption of the Healthy Rivers Implementation Plan and NPS-FM amendments. River and stream sites increased from 110 to 122. Ten of the new sites are in the Waikato and Waipa catchments, and two in Hauraki, which were from NIWA's National River Water Quality Network sites. All sites in the redesigned programmes will be sampled monthly, starting September 2018. Lakes monitoring changed from bimonthly sampling to monthly, starting July 2018. The restructure required two new staff members, however, sampling methods largely remain the same. Two SOE reports based on the legacy programmes are currently in prep. This year's monitoring team consisted of Asaeli Tulagi, Chris McKinnon, Matthew Barson, Aroha Salu, Alicia Catlin, Claire Kotze and Mark Hamer. Outputs: Tulagi 2017 (www.waikatoregion.govt.nz/services/ publications/technical-reports/2017-technical-reports/ tr201714/) and Tulagi 2018 (www.waikatoregion.govt.nz/ services/publications/technical-reports/2017-technicalreports/tr201733/).

Large river monitoring 2018 – A large river monitoring network consisting of 40 sites has been developed across the Waikato region on large non-wadeable rivers. Cotton strips and continuous DO loggers are being deployed for one week to assess ecological health in these otherwise hard to monitor systems. This year, 19 sites were monitored, with the rest to be monitored in 2019. This year's monitoring team consisted of Alicia Catlin, Michael Pingram, Mark Hamer and Aroha Salu.
Potential sources of faecal contaminants in four Coromandel catchments – To identify

potential faecal contamination issues in popular recreationally utilised swimming areas, an initial water quality snapshot survey of 18 coastal stream mouths was conducted. Based on the results of the snapshot, four catchments were selected for further investigation to gain a more comprehensive understanding of where in the catchment faecal contamination may have come from. The sources of these contaminants are rarely derived within the coastal areas themselves. In most cases, we need to identify diffuse sources in the catchment that are flushed into estuaries via streams and rivers following rainfall or during flooding of low-lying land caused by spring tides. With the use of faecal source tracking, we carried out event-based sampling to quantify contamination levels during dry and wet weather, and during spring and neap tides at the stream mouths. These types of investigations help us to build a better understanding of catchment-specific sources of contamination which can ultimately inform robust, science-driven management responses, including appropriate catchment management practices. For any information about this project please contact **Eloise Ryan** (Eloise.Ryan@waikatoregion.govt.nz). Outputs: Wilson et al. 2017 (www.waikatoregion.govt.nz/ services/publications/technical-reports/2017-technicalreports/tr201725/).

Improving fish passage at pump stations

- Various research and investigative projects aimed at supporting the development of a strategy for improving fish survival and passage at pump stations in New Zealand. This work has been a collaborative effort between **Mike Lake** (ICM) and **Bruno David** (SAS). **Jacques Boubée** of Vaipuhi Freshwater Consulting Ltd was contracted to undertake an assessment of the performance of new fish friendly pump, and was assisted by **Amy Yasutake-Watson** (student). **Outputs:** Boubée 2017, Boubée (in press) and Pine (2018).

#### Dealing with high frequency monitoring

**data** – WRC currently operates four solar-powered highfrequency meteorology and water quality monitoring buoys in lakes Waahi, Whangape, Waikare and Ngaroto. These buoys generate large data streams that require careful considerations with regards to assuring data quality and accuracy. Consequently, interpreting these measurements requires in-depth knowledge about lake processes and sitespecific relationships for each parameter measured. To ensure that the lake management decisions are based on accurate and reliable data, protocols have been established that deliver quality controlled data in near real time to the relevant people. Mark Hamer and Deniz Ozkundakci have worked with Limnotrack Ltd to develop maintenance schedules and SOPs for the buoys, as well as a  $\ensuremath{\mathsf{QA/QC}}$  tool with several algorithms that screen and correct several aspects of the buoy data. WRC has also worked with Streamlined Environmental Ltd to calibrate/ground-truth the buoy data over the last year. This data will now allow WRC to better understand the strengths and shortcomings of the buoy data. **Outputs:** Various internal documents available on request. Technical report on sensor calibration is currently under review.



A beautiful big giant kõkopu, caught using electrofishing in Paparahia Stream.

Photo © Josh Smith



Undertaking mussel surveys in Waitakaruru Stream – Echyridella menziesii (top) and Echyridella aucklandica (bottom) captured from the same stream.

Photo © Alicia Catlin



A buoy set up with cotton strips and a D-opto logger as part of our large river monitoring of ecological health.

Photo © Alicia Catlin

## **RESEARCH & CONSULTANCY COMPANIES**

## Aquanet Consulting Ltd



New: Dr Michael Greer, Lovisa Ekelund and Alex Egan (Massey Masters student)

As always, the last twelve months have seen the Aquanet Team kept very busy, undertaking a wide array of projects, including project management, field studies, technical reports, peer review, and involvement in Hearings as expert witnesses. We welcomed Dr **Michael Greer** and **Lovisa Ekelund** to the team in March, and fare-welled **Amy Feck** in May after five years with us. We are in the process of recruiting a new Freshwater Scientist for our Palmerston North or Wellington office.

**Olivier Ausseil** continues to be engaged as Project Manager or technical expert on numerous projects for water and wastewater treatment plants around the lower North Island. He is also involved in the Gisborne Regional Freshwater Plan (Waipaoa Catchment Plan), and has assisted the Five Waikato River Iwi in their submissions to the Waikato 'Healthy Rivers' Freshwater Plan.

Michael Greer has worked on a number of projects with Greater Wellington, Environment Canterbury and Otago Regional Councils. He is involved in the proposed Natural Resources Plan Hearings for the Wellington Region, and has been working on a pilot study looking at how LiDAR can be used to map 'drains' in agricultural landscapes.

**Fiona Death** continues to undertake fieldwork, compliance monitoring and reporting for many projects, along with Lovisa. **Lucy Cramp** and **Alex Egan** have both been helping with macroinvertebrate processing and fieldwork in between completing their Masters'.

#### Palmerston North Wastewater Best Practicable Option (BPO) Project – Water quality and Periphyton modelling of the Manawatu River in Palmerston North -

Palmerston North City Council have started a comprehensive programme to review options for the treatment and reuse/ disposal of the city's wastewater. Aquanet have been engaged to model water quality and periphyton growth in this reach of the Manawatu River to support the assessment of the potential effects of various options. **Outputs:** this work is ongoing, and a presentation will be given at the 2018 NZFSS conference. Whaitua Te Whanganui-a-Tara report – river and stream water quality in the Wellington and Hutt catchments – This report, led by Michael Greer, summarises the current state and trends of the waterways in the whaitua in terms of water quality and ecology. The report is not only intended to inform the Whaitua Committee of current state, but also of the key drivers of ecosystem health in the whaitua and any knowledge gaps, so that that these can be managed appropriately through the Whaitua Implementation Programme (WIP). **Outputs:** Whaitua Te Whanganui-a-Tara River and stream water quality and ecology. Aquanet Consulting report prepared for Greater Wellington Regional Council, October 2018.

James Line Stormwater Discharge - Palmerston North City Council were granted resource consents in August 2017 to enable the widening and upgrade of James Line. The works on James Line are still ongoing, however, the site for works is adjacent to an oxbow lake at the bottom of an old Manawatu River terrace. Horizons Regional Council have identified this oxbow as a threatened habitat in the One Plan, although they recognise that the area is heavily modified and degraded. As a result of the upgrade to James Line, increased volumes of stormwater, additional to those already discharging from the wider catchment, will enter the oxbow lake. Aquanet were tasked with addressing consent conditions relating to the timing of sediment sampling, macroinvertebrate monitoring and analysis of results. **Outputs:** Stormwater Discharge to James Line Oxbow Lake: Ecological Monitoring 2017–2018. June 2018.

Some of the other reports we have produced this year include:

- Hunterville Waste Water Treatment Plant Discharge Permit N.105833 Annual Report 2018, June 2018.
- Taihape Waste Water Treatment Plant Discharge Permit N.105518 Annual Report 2018, June 2018.
- Bulls Wastewater Discharge to the Rangitikei River: Annual Ecological Monitoring, 2018. August 2018.



Old oxbow of the Manawatu River at James Line, October 2018.



Sampling at James Line, October 2018. Photos © Aquanet Consulting Ltd

## Boffa Miskell



2018 has been another busy year for Boffa Miskell's everexpanding ecology team. We've worked on a wide variety of interesting and exciting projects, from the Far North to Invercargill, and many places in between.

We continue to provide ecological advice to a wide range of clients, including councils, government agencies, engineering consultancies and private developers. We've been working closely with construction crews on infrastructure projects, and some of our staff have been spending a lot of time salvaging fish from waterways prior to construction works. Our team has been carrying out long-term monitoring of waterways for resource consents and to monitor rehabilitation success; and working closely with iwi, rūnanga and DOC on wetland restoration programmes.

Here's a bit of a taste of what some of our team have been up to...

#### Creation of streams in Wellington's Transmission Gully - Vaughan Keesing, Jeremy

Garrett-Walker and the rest of our Wellington team continue to be heavily involved in Transmission Gully. As part of the road construction, at least 6 km of two regionally significant streams have been diverted. The TG team has been building new waterways down the Te Puka and Horokiri catchments. These new streams need to have high quality aquatic habitat, be fully forested, and support diverse indigenous fish and macroinvertebrate communities. The streams must also meet NZTA standards, including resisting a 1-in-100-year flood, which requires massive armouring. Access tracks for maintenance are also required. Our team continues to work closely with the design and construction team to meet these engineering requirements, while still achieving good ecological objectives. Vaughan, Jeremy, and the wider project team regularly monitor the new waterways to test the ecological outcomes.

Kaikoura Earthquake Recovery – for the last 18 months, Tanya Blakely has been the Project Freshwater Ecologist for the North Canterbury Infrastructure and Transport Recovery team. Tanya has been providing ecological advice to the design team and construction crews, both on and off site, for the road and rail rebuild works. Together with the NCTIR Environmental team, over 3,000 fish were salvaged during river diversions, culvert installations and road and rail work.

#### Long-term monitoring for the Christchurch City Council – Tanya Blakely and Katie Noakes

continue to assist the Christchurch City Council with a variety of work. Most recently, we worked with **Belinda Margetts** (CCC) to carry out another round of surveying of the Avon River Precinct rehabilitation sites. Three years on there are signs of ecological gains because of rehabilitation works in the Avon River Precinct sites: bluegill bullies are now present at all rehabilitation sites, lamprey were found at a number of sites, and a torrentfish was captured at one of the sites. Previously, bluegill bullies had only been recorded at a few sites within the Avon River, and torrentfish and lamprey are only rarely encountered in the catchment. A report of the survey and findings can be found at: www.ccc.govt.nz/ environment/water/waterways/waterway-monitoring

#### **Tauriko for Tomorrow in Tauranga** – Tauriko West, on the edge of Tauranga City, is set to become one of Tauranga's next urban growth areas. This predominantly agricultural area contains a network of what most people might consider 'farm drains'. In fact, this network is home to an array of native fish fauna, including several At Risk: Declining species. The challenge is to create an urban area while balancing geotechnical, landscape, ecological, stormwater and flooding components. **Kieran Miller** has been working with Tauranga City Council, Bay of Plenty Regional Council, land developers and engineers to achieve a desirable outcome for all parties.

#### Ravenswood Development, Northern Canterbury - Vaughan Keesing and Tanya Blakely

assisted the design and construction crew to divert 1.2 km of Taranaki Stream and create a new stream channel, including meanders, coarse substrate base, submerged logs and boulders, and riparian planting. Before the stream was diverted into the new channel, **Katie Noakes** trapped and transferred over 1,700 fish, including shortfin and longfin eels, inanga, common bullies, and brown trout.

#### Ruakura Inland Port Development - our

Hamilton team has been heavily involved in fish salvage operations related to the Ruakura Inland Port development to the east of Hamilton City. Following consultation with Boffa Miskell's Te Hihiri cultural advisory team, our ecologists worked together with Waikato-Tainui on salvage operations for longfin and shortfin eels, and black mudfish.



TOP: Ruakura Fish Salvage – Ecologists and iwi are working together on fish salvage to minimise the environmental impact of the Ruakura Inland Port development.

BOTTOM LEFT: Tauriko – Small streams and 'farm drains' in undeveloped rural areas are home to a remarkable number of freshwater fish, including several threatened species.

BOTTOM MIDDLE & RIGHT: Transmission Gully – In Wellington's Transmission Gully, newly-created stream diversions need to satisfy engineering requirements and achieve ecological outcomes.

Photos © Boffa Miskell



In 2018, Cawthron's freshwater teams and colleagues have continued to work across a range of project areas.

Under **Roger Young**'s oversight, one focus of Cawthronled research has been ensuring that the right things are measured when it comes to the health of New Zealand's rivers, lakes and streams. **Kati Doehring** and **Eric Goodwin** have been immersed in LAWA (Land, Air, Water Aotearoa) state & trend analysis, while **Joanne Clapcott** and **Annika Wagenhoff** included a large MfE sediment project in their workloads. **Susie Wood** and co. have furthered their research into cyanobacterial toxin production and bloom formation in NZ rivers, while **Robin Holmes** has found time to continue his PhD on restoring fish habitat in addition to publishing and submitting several papers.

**Jim Sinner** has been helping Hawkes Bay Regional Council distil learnings from the six-year TANK (Tutaekuri, Ahuriri, Ngaruroro and Karamu catchments) collaborative planning process, and wrote a report for MfE on establishing effective water management groups (www.mfe.govt.nz/publications/ fresh-water/water-management-groups-preliminary-guidance).

Dave Kelly and new team member Simon Stewart have been testing the use of constructed lake-structures for their ability to provide habitat functions for native fish, while Sean Waters has been busy assessing legacy nutrients in the sediments of various lakes around the country and has now begun the field sampling campaign for the MBIE-funded Lakes 380 project.

John Hayes has continued advancing the science of ecological flow assessment, with research themes on trout, as a model drift-feeder, flow dependency of drift transport capacity of rivers, and the influence of flow variability (low and high flows) on native fish and trout. **Rasmus Gabrielsson** has been providing evidence on flow requirements and allocation limits for Fish and Game, has contributed to Salmon research under Cawthron's MBIE project, and assisted Contact Energy with advice on fishery mitigation options.

Further information is available on the Cawthron website, with our freshwater news stories at: www.cawthron.org.nz/ coastal-freshwater/news

**Freshwater Ecosystem Health** – 'What is a healthy freshwater ecosystem?' The aim of this research was to provide the public and central and regional governments with a synthesis of science on freshwater ecosystem health, what ecosystem indicators are available, and what they can tell us about ecosystem health. The motivation for the research was to contribute to a more solid science foundation for informing environmentally sustainable freshwater management. Two parallel research streams have included a multi-institutional project, funded by MfE, which has resulted in the development of a framework to monitor and report on the biophysical components of ecosystem health. **Outputs:** A report to MfE (Clapcott *et al.* 2018), and a recent report, funded by the Cawthron Foundation, that presents a review of the science of ecosystem health in rivers (Young *et al.* 2018: www.cawthron. org.nz/media\_new/publications/pdf/2018\_10/Cawthron\_-\_ Healthy\_River\_Report\_-\_PRINT\_003.pdf), and accompanying video (https://vimeo.com/292855565).

#### Development of stream ecosystem health bottom-line thresholds for fine sediment - A

key outcome of a large NIWA-led multi-institutional project, funded by MfE, was the development of ecosystem health bottom-line thresholds for fine sediment in New Zealand streams and rivers for inclusion in the National Policy Statement for Freshwater Management (NPS-FM). Project team members from Cawthron were **Joanne Clapcott** (project oversight), **Annika Wagenhoff** (threshold analyses), **Eric Goodwin** and **Hayden Rabel** (who provided statistical help), and **James Mackman** (literature analysis). The NIWA team included **Craig Depree** (project manager) and **Doug Booker**, **Paul Franklin** and **Chris Hickey** (threshold analyses), with further input from **Fleur Matheson**, **James Shelley**, **Martin Unwin** and **Sanjay Wadhwa**.

Toxic Algae in Rivers - Experimental field work and data analysis to further knowledge on the variables that regulate cyanobacterial toxin production and bloom formation of Microcoleus autumnalis (previously Phormidium autumnale) in New Zealand rivers. Highlights from the past year include using a new qPCR assay to measure toxic Microcoleus autumnalis cells and determine toxin quotas in samples, acute toxicity work on anatoxin congeners abundant in NZ Microcoleus, progress towards site-specific modelling of Microcoleus blooms, a Catalyst Seeding exchange with USA researchers on benthic cyanobacteria, and MfE-funded work towards updating the Interim Guidelines for Cyanobacteria in Recreational Freshwaters. Staff Involved: Susie Wood, Jonathan Puddick, Javier Atalah, Eric Goodwin, Laura Biessy and Georgia Thomson-Laing (Cawthron), with Ian Hawes (Waikato), Tara McAllister (Canterbury), Laura Kelly, Ken Ryan (Victoria), Penny Truman (Massey Wellington), Sarah Finch (AgResearch), Graham McBride, Karl Safi (NIWA) and Kim Handley (Auckland). **Outputs:** Several scientific manuscripts and eight technical reports for regional councils and MfE.

Blooming Buddies: Explaining the coexistence of toxic and non-toxic strains in algal blooms – Marsden-funded research on the sequestration of microcystins (a common cyanotoxin) by non-toxic cyanobacteria and its ecological implications in bloom-forming cyanobacteria. Highlights to-date include the demonstration that toxin uptake in non-toxic cyanobacteria is more widespread than previously shown, and two MSc students from Victoria University starting on the project. **Staff Involved:** Jonathan Puddick, Laura Biessy, Veronica Beuzenberg, Susie Wood and Kirsty Smith (Cawthron), with Rossella Nicolai, Jenna Mumford, Ken Ryan (Victoria) and David Hamilton (Griffith University, Brisbane).

LAWA (Land, Air, Water Aotearoa) – has had an annual re-fresh of freshwater module (rivers, lakes, macroinvertebrates, recreational water quality). Cawthron led the state and trend analyses for 2018, which took **Kati Doehring** and **Eric Goodwin** 3.5 months full time. **Outputs:** LAWA website www.lawa.org.nz.

Sustainable Water Allocation - Cawthron's contribution to this NIWA core-funded programme, led by Murry Hicks, included: (1) a review of the rationale for assessing fish flow requirements, (2) improving the drift foraging model in a net rate of energy intake model for salmonids, (3) developing mechanistic drift-feeding bioenergetics habitat suitability curves for drift feeding salmonids to support traditional hydraulic-habitat modelling (this and the previous work stream involved international collaboration funded by Cawthron), and (4) publication of papers on: (a) relationships between invertebrate drift concentration and flow, and modelling them based on sediment transport theory, and (b) reference condition study of temporal variation in abundance of native fish in the Rainy River and the influence of natural flow variation and juvenile brown trout. **Outputs**: Published papers: Hayes et al. 2018a (https://doi.org/10.1139/cjfas-2018-0033), Hayes et al. 2018c (https://doi.org/10.1139/cjfas-2017-0340) and Hayes 2018d.

#### Complementing hydraulic habitat modelling with drift transport and drift-feeding trout bioenergetics modelling - Recently, Cawthron,

in collaboration with NIWA Christchurch, have worked toward more comprehensive ecological flow assessment by complementing hydraulic-habitat modelling with drift transport and drift-feeding trout net rate of energy intake (NREI) modelling. This adds understanding and prediction of flow-dependencies of ecosystem processes to modelling of instream habitat, based on empirical habitat suitability criteria. Over the past year, we completed a hydraulic-habitat, drift transport and drift-feeding trout NREI modelling study on the upper Clutha River for Otago Regional Council, and began one on the Aparima River for Environment Southland, to assist the councils with scoping minimum flow and water allocation options for their water plans. These efforts build on experience gained from similar recent investigations on the Mataura and Oreti rivers. Research team members included: John Hayes (team lead), Karen Shearer, Eric Goodwin and Rasmus Gabrielsson (Cawthron), Murray Hicks, Andrew Willsman, Jo Hoyle and Jeremy Walsh (NIWA). Outputs: Hayes *et al.* 2018d.

#### Enhancing habitat for native fish species -

In many New Zealand lakes, macrophyte beds and large woody debris sourced from riparian areas provide significant habitat for fish. Most native lake dwelling species require hard substrates on which to lay their eggs, and the larger structure provides refugia for fish to shelter from avian and fish predators during daylight periods. In lakes that have highly modified or no submerged and riparian vegetation, there can be little by way of structural habitat to provide these functions. This project (led by **Dave Kelly** with **Simon Stewart**) is aimed at testing the use constructed lakestructures for their ability to provide habitat functions for native fish. These structures could be combined with efforts to reduce wave exposure and stabilise denuded shorelines to enhance macrophyte regrowth along the lake margins.

And, coming up we have:

A national register and map of measures to improve water quality – This project is part of the National Science Challenge 'Our land and water'. It aims to provide a register and national map via LAWA of where and when restoration measures were implemented, and whether or not they worked, to output mitigation recommendations based on those findings. **Kati Doehring** will be leading this project along with **Christina Robb** (Happen Consulting) and **Richard McDowell** (AgResearch). **Outputs:** A national register and map of restoration measures to improve water quality via LAWA.



Installing lake habitat structures to improve habitat for fish.

Photos © Cawthron Institute

## EOS Ecology



New: Will Keay (Post graduate student)

'Environment Investigators' – Inanga are the focus for this Whitebait Connection programme where kids gain knowledge about their habitat, life cycle and threats. We've worked with local community groups to get 450 kids engaged and outside learning about their local waterways. Kids from 4 to 14 are provided with opportunities to explore the 'Love Zone' to look for īnanga eggs or assess the spawning habitat. Through these hands-on and practical experiences, kids can see their environment through their own eyes, and through the eyes of inanga, and become passionate about ways to improve their local 'Love Zone'. **Staff:** Kirsty Brennan. Collaborators: Avon Ōtākaro Network, Mountains to Sea Conservation Trust (Whitebait Connection), Ōpāwaho/ Heathcote River Network, Roimata Food Commons, Environment Canterbury. Outputs: Teachers' resource and student workbook, student projects and actions, including using code to create an īnanga life cycle animation, messages to the community about ecosystem guardianship, and kids with a better understanding of īnanga habitats and life cycles.

'Nature Agents' – Kids across Canterbury and Banks Peninsula are being immersed and engaged in science alongside scientists. *Nature Agents*, a participatory science programme, provides training for students and teachers to collect information about stream character, water quality, invertebrates and habitat (in-stream and riparian), and work through a series of data sheets. The comprehensive resources and participation by scientists are key to the programme's longevity. With Nature Agents across the region working with scientists and local authorities, we hope to increase awareness and, through behaviour change and better management, improve the health of our freshwater environments. Staff: Kirsty Brennan, Shelley McMurtrie, Bronwyn Gay, Alex James, Nick Hempston, Emily Demchick, Siobhán Culhane. **Collaborators:** Sian Carvell as our education consultant. Outputs: www.natureagents.co.nz, programme resources and data sheets, ArcGIS Online for schools, teaching activities, and kids who are more aware about the state of their local stream and what it means.

**Eastern Bays Shared Path** – Working as part of a multi-disciplinary team for the Hutt City Council, we are providing ecological advice on intertidal ecology and fish passage for the Eastern Bays Shared Path project. The project aims to improve cycling and pedestrian safety along the Eastern Bays of Wellington Harbour. The existing seawalls have low ecological value, so the construction of new seawalls provides an opportunity to enhance intertidal habitat. The new seawalls will contain textures, holes and unique features to improve the ability of intertidal biota to colonise these surfaces. Freshwater fish passage will be maintained through

appropriate design of culvert outlet extensions. We hope that the new seawalls will also encourage the local community and visitors to interact with the wonderful world of intertidal biota! **Staff:** Shelley McMurtrie, Kirsty Brennan, Alex James, Nick Hempston. **Collaborators:** Stantec, Hutt City Council. **Outputs:** Assessment of Environmental Effects on intertidal ecology and freshwater fish, and there will be some cool looking seawalls!

**Fish relocation/rescue** – Over the last 12 months from 1 October 2017, we have rescued a whopping 9,671 fish and waikoura from construction sites within Canterbury using a range of fish removal methods such as electrofishing, Gee minnow trapping, fyke netting and seine/drag netting. As many of these fish would not have survived the construction activities being undertaken, and around 8% were 'Threatened' or 'At Risk' species, it is encouraging to see fish relocation now being a standard part of most construction projects involving waterways. **Staff:** Nick Hempston, Emily Demchick, Siobhán Culhane, Shelley McMurtrie. **Outputs:** Fish relocation memos and happy fish.

**Piped stream ecology pilot study** – Piped streams are largely ignored when considering the values of urban waterways. To select sites for a more detailed study we lifted 20 manhole covers across three heavily urbanised Wellington catchments to collect basic habitat data and trial an extended handle net for sampling macroinvertebrates. In early 2019 we will be undertaking detailed macroinvertebrate, fish, and flying insect surveys at six piped stream sites. **Staff:** Alex James. **Collaborators:** Greater Wellington Regional Council. **Outputs:** Results memo, conference presentation.

#### Waverley Wastewater Treatment Plant (WWTP) – stream assimilative capacity

**study** – A research project to determine the capacity of a receiving waterway to assimilate the discharge from Waverley's WWTP, with the added complication that the waterway enters a dense wetland. Involves water quality sampling, a macroinvertebrate and fish survey, and reporting. **Staff:** Alex James. **Collaborators:** South Taranaki District Council.

1. Nature Agents training session in progress and examples of printed resources.

2. A shortfin eel found in a piped stream, Wellington.

Land Drainage Recovery Programme design

& construction oversight – Following on from the design phase, we have been overseeing the construction phase of several Land Drainage Recovery Programmes in Christchurch. While these programmes have been primarily about flood mitigation and bank stabilisation, we have been able to incorporate a number of design approaches to improve habitat for fish, including the incorporation of cover for fish (i.e., pipes embedded in the various bank treatments). **Staff:** Shelley McMurtrie, Nick Hempston.

#### Macroinvertebrate sample processing

Since the start of 2018, the EOS Ecology laboratory team has processed over 700 macroinvertebrate samples from both freshwater and estuary sites. These samples included 576 freshwater macroinvertebrate samples for six North Island regional councils taken as part of annual State of Environment monitoring. **Staff:** Emily Demchick, Nick Hempston, Siobhán Culhane. **Outputs:** Macroinvertebrate data contributing to a range of research and reports.

## Campbell Island Bicentennial Expedition – post survey invertebrate identifications

- We have been working with oligochaete specialist Adrian Pinder from the Department of Conservation, Biodiversity and Attractions in Australia on the identification of the abundant oligochaete fauna we collected during our 2010-11 research expedition to Campbell Island. The findings have been astounding, with at least 18 oligochaete species – including some new to science – making up over one third of the 49 freshwater taxa we have described from the island to date. This is the greatest documented diversity of freshwater oligochaetes from a subantarctic island. **Staff:** Shelley McMurtrie, Alex James, Nick Hempston. **Collaborators:** Department of Conservation, Biodiversity and Attractions, Australia. **Outputs:** Pinder *et al.* (in press).









## **Riverscapes Freshwater Ecology**



Over the past year, Riverscapes has focussed mainly on the continuation of long-term monitoring projects, including our willow control/mudfish habitat project (with DOC), the kākahi citizen science project (with GWRC), the perch spawning interference trials, the Barton's Lagoon exotic fish control project (both with Wairarapa Moana), and the Zealandia lower lake rehabilitation planning and preparation. We also did a bunch of consent monitoring and some fish surveying in Kāpiti wetlands and Pigeon Bush. Overall, the year has been a bit quieter for Amber because she started a PhD at Victoria University of Wellington, on kākahi translocation ecology!



Perch egg ribbon removed during artificial spawning substrate trials in Wairarapa Moana. Photo © Amber McEwan



Mudfish habitat created by fallen willow. Photo © Amber McEwan

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## Ryder Environmental



New: Bryony Alden, Mike Wakelin and Dean Olsen

In late 2017 we had a company change. After 22 years as Ryder Consulting, the ecology arm of the company now operates as Ryder Environmental. We continue to undertake freshwater, marine and terrestrial projects around the country. Over the last year we've been involved with a range of projects, from assessing small quarries in Southland to large wind farms in Taranaki, fish screen assessments in the South Island to mining assessments in Coromandel, monitoring for irrigation schemes in Canterbury to marine assessments in Northland, and assessments for hydroelectric power stations from Southland to throughout the North Island. We've had some staffing changes recently with the addition to the team of **Bryony** Alden and Mike Wakelin. Dean Olsen also recently re-joined the company after several years at Otago Regional Council and is enjoying getting back to his consulting roots and the diverse projects available. **Greg Ryder** recently returned from an extended overseas trip and is now preparing for his work as an independent commissioner on the Waikato Healthy Rivers/Wai Ora: Proposed Plan Change 1 hearings panel.

#### Lindis River investigations and hearing

 Following previous investigations into fish passage opportunities, the effect of surface flow and groundwater inputs on water temperatures, and birds in the Lindis River, the project has now reached hearing stage. Staff involved: Greg Ryder, Dean Olsen, Mark Sanders, Ruth Goldsmith. Matiri hydroelectric scheme – Monitoring of the freshwater and terrestrial components of the new scheme located near Murchison, as required by resource consents. Staff involved: Ruth Goldsmith, Mandy Tocher, Ben Ludgate.

#### **Queenstown Lakes District Council**

**wastewater discharges** – Reviewing information and providing an assessment of ecological effects for wastewater discharges throughout the Queenstown district. **Staff involved:** Dean Olsen, Greg Ryder.

#### Ecological surveys for Waihi gold mine -

Ecological assessments of periphyton, macroinvertebrate, and fish communities in the vicinity of the Waihi gold mine, as required by resource consents. **Staff involved:** Ben Ludgate, Dean Olsen, Greg Ryder.

#### Waterfall Park development, Queenstown

 Providing assessments of ecological effects of proposed development in the Queenstown district, including monitoring and hearing processes. Staff involved: Ruth Goldsmith.

Waverly Wind Farm, Taranaki – Completion of terrestrial and freshwater assessments of ecological effects of proposed wind farm in Taranaki. The process involved assessments, consultation and hearings, and the project is due to commence soon. **Staff involved:** Mark Sanders, Ruth Goldsmith.



Greg Ryder getting up close with the locals in Oman – doctor fish tending to Greg's feet.



Greg Ryder visited these picturesque wadis in the deserts of Oman during his recent overseas trip. Photos © Greg Ryder

## Te Waiora Joint Institute for Freshwater Management



New: Chris Tanner and Tim Manukau

NIWA and the University of Waikato have established a Joint Institute for Freshwater Management 'Te Waiora' to build partnerships to promote world-class research and management outcomes, and postgraduate education. Te Waiora seeks to increase freshwater research outputs and management capability, and enhance outcomes with environmental, cultural, social and economic benefits. It will do this by building regional and national partnerships, in particular with iwi, nurturing the next generation of scientists and water managers, and leveraging strategic international collaborations.

Building a collaboration - We have worked across NIWA and the University of Waikato to identify a range of research themes, co-develop new research proposals and understand how we can work better across the two organisational cultures to strengthen and broaden our research collaborations. A new co-developed MBIE Endeavour programme (Doubling On-farm Diffuse Pollution Mitigation) and a smart idea (Freshwater bioremediation using native mussels (kākahi)) proposal were successful in the latest funding round. We are now starting to build wider partnerships with a range of key partners.

Iwi Partnerships - With support from the Waikato River Authority (WRA), we engaged with river and lake iwi in the rohe of the University to explore ways we can best work together and to help shape the vision for Te Waiora. An iwi partnerships document has been agreed that outlines iwi research priorities and engagement principles between Te Waiora and iwi. Iwi representation is being integrated into the operational governance of the Institute, with three iwi representatives invited onto the Joint Management Committee. A position description for a WRA Chair in Mātauranga Wai has been co-developed with iwi input and provisionally approved for funding.

#### Graduate Programme in Freshwater

Management – A graduate programme is being developed for 2019 to foster the development of multi- and transdisciplinary capacity in freshwater management. Iwi and wider stakeholder involvement is being sought to address relevant knowledge gaps and management needs, challenge students with real-world issues, and promote understanding of the interactions between science, human behaviour, economics and policy.



Focus areas for Te Waiora research and capability-building.

and stakeholder partners.

## Tonkin + Taylor



**New:** Gerry Kessels, Selene Conn, Susan Jackson, Hannah Mueller, Andree Hickey-Elliott, Briar Taylor-Smith, Wiea van der Zwan, Adam Purcell, Marcus Cameron, Brenda Bartels, Alicia Wong, Ashleigh Johnston, David Pickett, Lucy Underwood and Wageed Kamish.

Tonkin + Taylor (T+T) has been experiencing growth across all areas of the business with some particularly skilled water experts joining us. The biggest shift came in May 2018, when Kessels Ecology joined the T+T family, boosting T+T's expertise and service offerings across New Zealand. T+T now has over 30 ecologists, many of these working in the freshwater space.

T+T's freshwater specialists have been working on a range of projects that draw together expertise in ecology, fluvial geomorphology, modelling, and engineering. Projects range from relatively simple development projects, monitoring projects and catchment management solutions, through to developing new guidance documentation, strategic policy and technical advice, and working on large, complex projects of significance. T+T continues to develop and apply fish passage solutions led by honorary ecologist **Bryn Quilter**, who chairs the New Zealand Fish Passage Advisory Group.

After an organisational re-shape in early 2017, T+T has been focussing on service offerings in the transport, energy, land development, waste and water sectors across all of NZ. Working across planning, design, consenting and implementation phases of these projects provides great opportunities for collaboration, but the challenge is always in balancing infrastructure development with strong ecological outcomes. Some of these projects are particularly large or remote, which can be tough but is providing opportunities to develop new ways of collecting data and keeping people safe.

#### Ara Tūhono - Pūhoi to Warkworth Project - In

2018, T+T's freshwater ecologists have continued working with Northern Express Group to deliver the pre-construction works for the Pūhoi to Warkworth Project. A number of temporary and permanent stream diversions and culverts had **Liza Kabrle, Duncan Law, Kylie Park, Alicia Wong** and **Lucy Underwood** busy salvaging and relocating over 10,000 native fish. An unexpected find was more than 800 freshwater mussels in the muddy banks of one of the major streams crossing the project's footprint. **For more info:** www.nzta. govt.nz/projects/ara-tuhono-puhoi-to-warkworth

Stream realignment and in-stream habitat enhancement projects – Engineers, ecologists and fluvial geomorphologists have been working together on several stream realignment and in-stream habitat enhancement projects throughout New Zealand. Selene Conn and Caleb Sjardin undertook a preliminary fish survey and geomorphic assessment of a waterway, a constructed wetland and a natural degraded wetland to guide which types of habitat should be recreated or enhanced in a stream realignment project. Selene and Josh Hodson also assessed the wider floodplain dynamics to help determine how the floodplain function can be improved to enhance the stream design and to help reduce sediment inputs into the harbour. **Justine Quinn** is working on a stream daylighting project in Auckland which was originally intended to be a 'pipe replacement'.

With the help of the local community, Selene, **Bryn** and **David Bouma** have developed a 'tool-box' of hard and soft engineering options to reduce sediment inputs in a central North Island catchment, using a geomorphic assessment to identify 'high-sediment' stream types. The tool-box provides solutions for both landowners and councils, with each solution targeting different sediment sources across a range of stream types.

Selene and Bryn are also developing a simplified tool to help a group of North Island river managers identify suitable 'low-risk' locations for in-stream habitat enhancement. The tool walks the user through a high-level stream classification, shows them the types of present habitat features, leads them on to choosing a suitable habitat feature to install at the chosen site, and encourages consideration of possible operational risks associated with the feature. Understanding how these features function ecologically and geomorphologically prior to detailed design stages will help guide how best to design them so they function as a selfsustaining system.



Alicia Wong holding up a net of freshwater mussels. Photo © Kylie Park

#### Hamilton City Stormwater Monitoring, Catchment Management Planning and

Southern Links – T+T freshwater scientists have been supporting Hamilton City Council with stormwater and city receiving environment monitoring and planning. **Dean** Miller has been working with council on a comprehensive update to its stormwater monitoring plan, aiming for a more adaptive and responsive approach to environmental data. Dean and Bryn are also contributing to a city wide stormwater master plan to support improved stormwater management and outcomes.

T+T's Hamilton team have been focussing on the Mangakotukutuku Stream catchment in southern Hamilton, within which a significant amount of greenfield development is kicking off. Dean, **Toni Shell**, **Steven Pratt** and **Duncan Law** have undertaken comprehensive monitoring in the catchment to meet stormwater monitoring and integrated catchment management plan requirements. The work has also supported the monitoring and investigation requirements for the Southern Links Road within this catchment, including mitigation and restoration planning to manage effects. T+T staff have collaborated with Morphum Environmental Ltd and AECOM on the various work streams.

#### Peka Peka to Ōtaki Expressway Project - T+T

has been working with Fletcher Construction Ltd over the past two years to deliver the design and construction phase of the PP2Ô project. Construction is underway, and as part of the works a number of permanent and temporary stream diversions have been undertaken, which required the rescue and relocation of native fish. During the Mangaone Stream temporary diversion, T+T ecologists were excited to find and relocate 284 lamprey/piharau. The majority of these were ammocoetes, but five were macrophthalmia. T+T staff collaborated with local iwi, Ngā Hapū o Ōtaki, to complete the work. **T+T staff involved:** Toni Shell, Steven Pratt, Dean Miller, Andrea Tuohy and Natalie Pilcher. **For more info:** www.nzta.govt.nz/projects/wellington-northern-corridor/ peka-peka-to-otaki-expressway



**PFAS sampling** – **Marcus Cameron**, **Andrea Tuohy** and others in the contaminated land team have been assisting Pattle Delamore Partners (PDP) and the New Zealand Defence Force (NZDF) with sampling for per- and polyfluoroalkyl substances (PFAS) at NZDF bases in Woodburne, Ohakea, and more recently in Whenuapai. The sampling has involved collection of surface water, groundwater and biota samples and subsequent analysis for PFAS. Freshwater species, including eels and watercress, have been sampled in Ohakea and Woodburne, and marine species more recently in Whenuapai. **For more information** and results of the testing, see www.mfe.govt.nz/land/pfas-and-polyfluoroalkyl-substances

#### Microbial Source Tracking and SafeNetworks Programme, Auckland Council – T+T has been

working with Auckland Council to lead the implementation of the SafeNetworks programme. This programme has been funded by Auckland Council's Water Quality Targeted Rate and aims to reduce public health risk at Safeswim beaches. The SafeNetworks programme aims to identify the causes of contaminated discharges entering stormwater drainage systems, and then implement a series of evidence-based interventions (as appropriate) to reduce public health risk. The delivery of this programme requires collaborative effort across different organisations and individuals. Within T+T, key staff are **Clint Cantrell**, **Jon Rix, Simon Aiken, Marcus Cameron** and **Justine Quinn**.

Justine has also been investigating water quality entering beaches in the Northern Manukau Harbour and Upper Waitematā Harbour to identify sources of microbiological contamination. Microbial source tracking has been used to determine potential animal sources of contamination and prioritise management interventions in line with the evidence-based approach. **Outputs:** www.knowledgeauckland. org.nz/assets/publications/TR2018-020-Water-qualityinvestigations-Christmas-Beach.pdf

Freshwater ecology in the regulatory context – Senior staff Josh Markham, Justine Quinn and Dean Miller continue to provide freshwater ecological input and advice to regional councils. This is a particularly busy area for the team in Auckland following the implementation of the Unitary Plan, which extends protection to intermittent streams. All staff are upskilling to enhance their understanding of the requirements around biodiversity offsetting and 'no net loss' of ecological function in the regulatory context.

#### Implementation of the National Policy Statement for Freshwater Management

**(NPS-FM)** – A contingent of senior T+T staff have been working with various private and public sector clients, helping them understand the implications of the NPS-FM 'bottom lines', and the 2018 ANZECC water quality guidelines on regional plans and stormwater consents. **Staff involved:** Marcus Cameron, Peter Cochrane, Clint Cantrell, Justine Quinn, Dean Miller and Brett Ogilvie.

#### Drinking water supply and water sector

**reform** – **Tony Cussins** has been working closely with central and local government on the water sector reform. This was a result of Tony's investigations into the contamination of the Havelock North water supply and his involvement in the subsequent Government Inquiry. Tony is working with other members of T+T and the wider sector to look into 3 Waters infrastructure investment and source protection measures as part of the reform. Tony chairs the Groundwater Working Group of the Drinking Water Advisory Committee as part of the Ministry of Health review of the New Zealand Drinking Water standards. **Outputs:** Havelock North water supply Campylobacter outbreak – source and ingress – Water NZ conference paper, 2017.

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## NON-PROFIT ORGANISATIONS

## Working Waters Trust



New: Bridget White

Working Waters Trust kicked off our first large urban project this year. Called Te Tuna Tāone – Urban Eel, it focuses on longfin eel habitat restoration and improving urban stormwater quality with school students in Christchurch. **Sophie Allen**, Projects Manager, has moved to a role with Waimakariri District Council as Water Environment Advisor. With the role transition, the Trust has handed-over leadership of a few long-term projects into the safe hands of our partner organisations, though it is always sad to say 'goodbye'. Sophie is carrying on as a trustee and voluntary manager. **Bridget White** has been newly appointed in the new role of Freshwater Project Coordinator, and we are looking forward to her growing into the role. This year, trustees **Lan Pham** and **Emerson Yeoman** welcomed their first baby, Khoi, to the family, which hasn't slowed them down at all! Another trustee, **Matt Wylie**, has finished his PhD and taken a role with the Seafood Production Team at Plant and Food in sunny Nelson, while trustee **Nicki Atkinson** has moved into the role of South Island Manager for the DOC–Fonterra Living Water partnership.

Read more on www.workingwaters.org and on Facebook.



Te Tuna Tāone – Urban Eel! Sophie Allen – Projects Manager from Working Waters Trust with a feisty longfin eel from the mighty Ōtākaro Avon River, and a spellbound audience from Conservation Volunteers New Zealand.

Photo © Neil Miller

## **RECENT PUBLICATIONS**

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# HE MAIMAI AROHA – FAREWELL



John Quinn, gifted musician, scientist, and long-standing member of the NZ Freshwater Sciences Society, died peacefully at home on Tuesday 13 November, surrounded by his family.

John dedicated his life's work to the health of New Zealand's rivers. At the upcoming AGM, the Exec Committee would have announced John as the winner of the 2018 NZFSS Medal for his services to freshwater science and management. Instead, in response to circumstances, Marc travelled to Hamilton to present John with the medal at his home. John and his family were deeply touched that NZFSS awarded him its highest honour and that the Society held him in such high regard.

John will be greatly missed by many. A public memorial service will be held at the Gallagher Academy of Performing Arts, University of Waikato, at 2 pm, Saturday, 2<sup>nd</sup> February 2019.

#### You can read more about his life and work in his obituary:

www.stuff.co.nz/waikato-times/108759436/Obituary-John-Martin-Quinn-PhD-August-5-1957-November-13-2018

## Or may like to watch these YouTube clips of some of his work and music:

- www.youtube.com/watch?v=pPPej-VFpRg
- www.youtube.com/watch?v=MWYNBlr5OrU
- www.youtube.com/watch?v=I57JxLmasI4

## John Quinn 05/08/1957–13/11/2018

## Excerpt from the letter of award read on presentation of John's NZFSS medal:

#### Dear John,

On behalf of the NZFSS, I bring you the Society's sincerest congratulations on your nomination and receipt of the 2018 NZFSS Medal for services to Freshwater Science and Management. The NZFSS shows its deep appreciation for all that you have done to advance and promote freshwater sciences during your amazing career by awarding you the Society's highest honour. In winning this award, you join an illustrious group of scientists.

Among your many contributions to science and management, you have helped make Whatawhata and Tukituki such well-known and well-understood sites of excellence in applied research.

Your career, from its beginning as a BSc Honours student at the University of Otago to your tireless and inspiring work as a Chief Scientist at NIWA, has supported many advances in freshwater sciences and has inspired so many of your colleagues, collaborators and friends. And you brought music to the freshwater world like no-one else!

John, the impact of both your work and your wonderful spirit will be felt and expressed within the freshwater community for many years to come. I'm sure that I can speak for everyone who knows you when I say that you will be sorely missed and very fondly remembered.

Well done, mate!

Michales

President, and on behalf of, the New Zealand Freshwater Sciences Society 🔳

# CONFERENCES



#### New Zealand Freshwater Sciences Conference 2018

This year, we celebrate NZFSS's 50<sup>th</sup> annual meeting in Nelson, 10–14<sup>th</sup> December. Celebrating 50 years, the theme of the conference is 'Ka mua, ka muri: Looking back, moving forward'. The programme includes plenary speaker presentations as well as special and contributed sessions, poster displays, a diverse array of exhibits, networking functions, and field trips that showcase Nelson's unique river environments and attractions. **More information on the conference website: www.nzfss2018.co.nz** Hope to see you there!

#### **Freshwater Management Conference 2019**

This nationally focused freshwater management conference will be held in Wellington, 11–12<sup>th</sup> February 2019. Join freshwater stakeholders from all sectors of New Zealand with sessions including:

- an examination of the legal regulations that shape freshwater management policies including updates on changes to NPS-FM, the relevant NES and other freshwater regulations and how these will affect users and stakeholders
- · collaboration and its role in successful freshwater management strategies for the benefit of all New Zealanders
- the future of freshwater infrastructure in New Zealand from design and funding to the technology and its implementation
- freshwater disaster management an update on recent freshwater supply crises
- a guided look at the freshwater sciences in New Zealand, the data that it produces
- modern life and its growing impact on the freshwater continuum.

Plus International Keynote Speaker Dr Luke Mosley, Senior Research Fellow, University of Adelaide, and Visiting Scientist, CSIRO. NZFSS members are entitled to a discounted rate. To qualify, enter the promotional code M0GO8K when booking online.

Super Saver registration available until  $7^{\rm th}$  December, and Early Bird registrations until  $17^{\rm th}$  January.

For more information, see the conference website: www.conferenz.co.nz/freshwater

#### New Zealand Freshwater Sciences Society & Australian Freshwater Sciences Society Joint Conference 2019

In 2019, we will have a joint conference with the Australian Freshwater Sciences Society (formerly Australian Society for Limnology, ASL) in Geelong, Victoria, starting 1<sup>st</sup> December.

More information will be available on our website (www.freshwater.science.org. nz) and on Facebook (www.facebook.com/ NZFSS) closer to the time.

#### INTECOL International Wetlands Conference 2020

The INTECOL (International Association for Ecology) Wetland Working Group will hold the 11<sup>th</sup> INTECOL International Wetlands Conference in Christchurch, in Spring 2020. For more information and updates, feel free to contact the

Chair of the organising committee, Dr Philippe Gerbeaux (027 536 7051; pgerbeaux@doc.govt.nz)

#### Society for Freshwater Science 2021

In 2021, the Society for Freshwater Science (formerly North American Benthological Society, NABS) is planning to hold their annual meeting in Brisbane.

More information to come!

#### Moawhitu D'Urville Island Stretch Goal site, June 2018

Photo © Tom Drinar

# AWARDS



## New Zealand Freshwater Sciences Society Medal Recipient 2017 Russell Death

Russell is the 2017 winner of the New Zealand Freshwater Science Society's highest honour in recognition of services to freshwater science, the NZFSS Medal. Russell has been a lecturer in freshwater ecology at Massey University for over 27 years. In that time, he has made outstanding contributions to the conservation and management of freshwaters through his commitments to research, scientific publishing and teaching, and communicating his knowledge to the public in many different ways. Russell co-founded the Freshwater Lab and the Innovative River Solutions Centre at Massey University. Along with his >100 peer-reviewed scientific publications, membership in numerous professional societies, work on the editorial board of the journal Freshwater Science and his international collaborations, Russell has provided technical advice to Ministries, Regional Councils and the Land and Water Forum, and has appeared as an expert witness in numerous hearings. He was recently invited to participate in the Ministry for the Environment's Science and Technical Advisory Group to assist in implementing the Government's Essential Freshwater package of freshwater reforms. Although he is humble and tends not to seek attention, he has appeared dozens of times in print and electronic media, contributing to public discourse on freshwater issues. Through his teaching

and supportive supervision, he has inspired many of his former students to pursue careers in freshwater science and management. His students say that while he has accomplished all of this, he manages to keep a healthy work-life balance and encourages his students to do the same by providing a positive, low stress learning environment. Those who nominated Russell for the NZFSS Medal included in their nomination no less than ten strong letters of support from highly regarded freshwater scientists, managers, consultants and politicians. The material included in the nomination left no doubt that Russell is a very worthy recipient of the NZFSS Medal for services to freshwater science. Congratulations Russell – keep up the great work!.

Marc Schallenberg
PRESIDENT

See freshwater.science.org.nz/index.php/awards/ nzfss-medal for further information about the rules and criteria for the NZ Freshwater Sciences Society Medal and Honorary Membership.

## S.I.L. Trust Awards

The Society administers grants for student and young researcher overseas travel, and visits by eminent overseas scientists through the S.I.L. 1987 Trust Fund. These awards help to facilitate international spread of freshwater science. The awards committee were pleased to announce this years recipients of the S.I.L. Trust Travel Award were: Jonathan Puddick, Anika Kuczynski, Pavel Mikheev, Emma Moffett and Justin Pomeranz. The S.I.L. Trust Guest Lecturer Award was not awarded this year.

#### S.I.L TRUST FUND (1987) GUEST LECTURER AWARD

For visits to and/or within New Zealand by eminent overseas limnologists, whose visits will benefit New Zealand's limnological research community as a whole.

freshwater.science.org.nz/index.php/awards/sil-1987-trust-fund-guest-lecturer-award

#### S.I.L. TRUST FUND (1987) TRAVEL AWARD

For young scientists to attend overseas conferences, seminars or workshops, or to visit institutions to learn techniques, develop expertise, use equipment, collections or library facilities not available in New Zealand.

freshwater.science.org.nz/index.php/awards/sil-trust-fund-1987-travel-award

#### S.I.L. TRUST TRAVEL REPORT 1

#### 2018 Australia and New Zealand Cyanobacteria Workshop (Sydney, Australia)

#### By Jonathan Puddick

The 6<sup>th</sup> Australia and New Zealand Cyanobacteria Workshop (ANZCW) was held at the University of New South Wales in Sydney (Australia) on 25–26 September 2018. Originally called the National Cyanobacteria Workshop, this year the name was changed to reflect the collaborative relationship growing amongst cyanobacteria researchers from either side of the Tasman Sea. The workshop has an intimate and low-key feel with around 130 participants, spanning researchers, regional authorities, water managers, water treatment specialists and cyanobacteria analysis providers. But despite the humble nature of the workshop, it was attended by delegates from as far away as Finland, Japan, South Africa and Brazil.

This year's keynote speakers were Sandra Azevedo (Federal University of Rio de Janeiro, Brazil) and Mark Matthews (CyanoLakes Ltd). Prof Azevedo provided a summary talk on the state-of-play for cyanobacterial toxicology and some unique pieces of historical context. This included information on the Caruaru Incident in Brazil, where over 50 people lost their lives when cyanotoxin contaminated water was used for dialysis treatment. Here, she described tests conducted to identify the factors which lead to the tragic event, which has highlighted the importance of properly understanding cyanobacteria growing in our drinking water supplies and recreational environments. Dr Matthews described the use of remote sensing to enhance cyanobacteria monitoring programmes and improve decision making. He provided a run-down of their interface for using satellite data to detect cyanobacteria in waterbodies and the development of the algorithms to facilitate this.

There was a diverse range of talks presented at the workshop, ranging from fundamental research on the ecology of cyanobacteria and toxin production, to the analysis of cyanotoxins and the characterisation of new toxin-producing cyanobacteria, to the monitoring of cyanobacteria blooms and their management, to the evaluation of water treatment strategies for removal of cyanobacteria and the noxious compounds they can produce. Some stand-out talks included: Phillip Orr (Griffith University) who provided a historical revision of previous studies on toxin production and related them to his own theories on the subject; Susie Wood (Cawthron) who described the coupling of modern molecular techniques with traditional paleolimnology to understand the historical (up to 1,000 years ago) water quality of New Zealand lakes and how we can use that information to set more appropriate water quality thresholds in the future;

Alescia Cullen (University of Newcastle) who provided a summary of her impressive PhD work on the genes that control saxitoxin production in Scytonema crispum; Laura Kelly (Victoria University of Wellington) who presented some of her PhD research on the use of quantitative-polymerase chain reaction (qPCR) assays to better understand toxin production in Microcoleus (previously Phormidium) blooms in New Zealand Rivers; Mark van Asten (Diagnostic Technology) who described the results of a recent trial, in collaboration with the Ohio Environmental Protection Agency (USA), using the Phytoxigene qPCR assay to monitor Ohio waterbodies for harmful cyanobacteria; and Michele Burford (Griffith University) who posed two important questions to the forum—are we using nutrient measurements correctly (for the management of cyanobacteria blooms), and are we measuring the correct things? Many of the talks sparked enthusiastic discussions that were carried on into break times

At the conference, I presented some of my Marsden-funded work looking to understand a phenomenon where cyanotoxins are sequestered by non-toxic strains of cyanobacteria. I discussed the results of my recent experiments, which showed that a range of non-toxic cyanobacterial genera, with differing growth strategies and morphologies, were able to sequester microcystins (a common class of cyanotoxin). This work included common bloom-forming cyanobacteria from New Zealand and was an advancement on the previous work in this area using a single strain of Synechocystis. The research presently underway to assess whether microcystin sequestration in non-toxic cyanobacteria provides them with the competitive advantages conferred to toxin-producing cyanobacteria, and demonstrate whether microcystin sequestration occurs in the natural environment, was also discussed

Overall, the conference was an invigorating experience, providing plenty of inspiring conversations and valuable connections with our neighbours 'across the ditch'. Attending the conference emphasised how important it is for Australasian cyanobacteria researchers to maintain good collaborative networks, as we are a relatively small community and have much to learn from one another. Thanks so much to the S.I.L 1987 Trust Travel Grant for supporting my attendance at the conference.

#### S.I.L. TRUST TRAVEL REPORT 2

### 2018 International Association for Great Lakes Research Conference (Toronto, Canada)

#### By Anika Kuczynski

Receipt of a S.I.L./NZFSS travel grant in April enabled me to attend the annual International Association for Great Lakes Research (IAGLR) annual meeting in Toronto, Canada on 18–22 June 2018. I represented New Zealand, gained visibility, networked, and received valuable feedback by presenting some of my work. Some key parts of the trip were:

- I gave two presentations related to my dissertation, and the ongoing research I am currently involved in at NIWA.
  - a. I gave an oral presentation titled 'Phosphorus Provenance and *Cladophora* in the Northern Lake Ontario Nearshore' in session #31 (Evaluation of the Current State of Ecological Modeling and Future Perspectives). I gained valuable feedback on my work, which will inform further writing of this manuscript for publication. I will also continue conversations with Alice Dove from Environment and Climate Change Canada (ECCC) to discuss appropriate sampling plans for monitoring *Cladophora* in Lake Ontario.
  - b. I presented a poster titled 'Using red-green-blue and multispectral camera imagery for stream periphyton monitoring' in session #60 (Seeing Below the Surface: Quantifying the Underwater Environment with Image Analysis). I received valuable feedback from viewers and hope to interact more with Colin Brooks from the Michigan Tech Research Institute (MTRI) in developing effective image processing algorithms.
- 2. I learned more about current water-related issues and research by attending a variety of general and technical presentations and all plenary talks, which helped me better understand challenges related to decision-making in environmental management and sustainability both in Canada and globally. Several talks focused on the challenges of mathematical modelling (empirical and mechanistic), which made me more sensitive to the importance of assessing model uncertainty and simplifying models as much as possible (but no more than

appropriate for the desired application). Topics of other presentations I attended include: changes in large lake temperatures and ice cover, an early warning hypoxia model, communication with farmers about monitoring and best management practices to reduce nutrient loads to water bodies, and using underwater video and still imagery to monitor invasive mussels, round gobies, and potentially *Cladophora*.

- 3. I served as a student oral presentation judge.
- I networked with student and senior researchers and staff from various organizations including Michigan Tech, MTRI, the University of Wisconsin-Milwaukee, Central Michigan University, the University of Waterloo, LimnoTech Ltd, the International Joint Commission (IJC), ECCC, and Freshwater Research. I also met with my U.S. and Canadian coauthors and discussed manuscripts that we are currently working on.

# BUDGET FOR THE YEAR ENDED 30 JUNE 2017

#### Legal Name of Entity

New Zealand Limnological Society Incorporated

#### Entity Type and Legal Basis Not-for-profit organisation; incorporated society

Other Trading Name: New Zealand Freshwater Sciences Society

#### **Registration Number**

1008510

#### **Entity's Purpose or Mission**

The Societys 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, president, secretary-treasurer, two elected officers and a newsletter editor. Elections for these positions are held every two years at the AGM.

#### Main Sources of Entity's Cash and Resources

Membership subscriptions; annual conference profit (if any)

#### Main Methods Used by Entity to Raise Funds

Membership subscriptions; annual conference profit (if any)

#### Entity's Reliance on Volunteers and Donated Goods or Services

Fully reliant on volunteers (Executive Committee and co-opted members)

#### **Postal Address**

Amy Whitehead, Secretary-Treasurer, C/- NIWA, PO Box 8602, Riccarton, Christchurch, New Zealand, 8011

## **Approval of Financial Report**

New Zealand Limnological Society Incorporated For the year ended 30 June 2017

The Governing body are pleased to present the approved financial report including the historical financial statements of New Zealand Limnological Society Incorporated for year ended 30 June 2017.

APPROVED

Committee

Ashitehead

Date 25 June 2018

Committee Phillip Jelyna

Date 25 June 2018

## **Statement of Service Performance**

New Zealand Limnological Society Incorporated For the year ended 30 June 2017

#### 'What did we do?', 'When did we do it?'

#### **Description of Entity's Outcomes**

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

#### Description and Quantification of the Entity's Outputs

2016 newsletter delivered to 535 members. Annual conference held. Published Advances in Freshwater Sciences book.

#### Additional Output Measures

Objective (a) met:register of membership updated as required. Objective (b) met: the annual conference was held in Invercargill in December 2016. Objective (c) met: NZFSS co-published Advances in Freshwater Sciences with the New Zealand Hydrological Society. Participated in meetings and workshops with Royal Society of New Zealand, the Land and Water Forum and the Freshwater Management and Infrastructure Forum. Objective (d) met: the 2016 annual newsletter was produced by Newsletter Editor Kati Doehring and Assistant Newsletter Editor Natasha Petrove. Objective (e) met: the 2016 newsletter was distributed to 535 members, including 16 organisations, in either PDF or hard copy format.

This statement has not been been subject to Audit.

# Statement of Financial Performance

New Zealand Limnological Society Incorporated

For the year ended 30 June 2017

#### 'How was it funded?' and 'What did it cost?'

Notes	2017	2016
1	832	0
1	19,327	17,736
1	5,301	91
1	1,880	1,929
	27,341	19,756
2	15,506	4,696
2	4,891	0
2	7,157	3,335
	27,554	8,031
	(214)	11,725
11	218,552	208,483
	218,552	208,483
11	178,483	205,624
	178,483	205,624
	40,070	2,859
•	39,856	14,584
	Notes	Notes         2017           1         832           1         19,327           1         5,301           1         1,880           27,341           2         15,506           2         4,891           2         7,157           27,554           (214)           11         218,552           11         178,483           178,483         178,483           40,070         39,856

This statement has been subject to Audit and should be read in conjunction with the accompanying Notes and attached Audit Report.

## **Statement of Financial Position**

New Zealand Limnological Society Incorporated As at 30 June 2017

'What the entity owns?' and 'What the entity owes?'

Account	Notes	30 Jun 2017	30 Jun 2016
Assets			
Current Assets			
Bank accounts and cash	3	51,952	49,079
Short Term Investments	3	108,400	55,536
Debtors and prepayments	3	16,595	25,908
Inventory	3	9,739	0
Other Current Assets	3	653	873
Total Current Assets		187,339	131,396
Total Assets		187,339	131,396
Liabilities			
Current Liabilities			
Creditors and accrued expenses	4	13,979	7,089
Other current liabilities	4	9,319	122
Total Current Liabilities		23,298	7,211
Total Liabilities		23,298	7,211
Total Assets less Total Liabilities (Net Assets)		164,041	124,185
i			
Accumulated Funds			
Accumulated surpluses or (deficits)	5	164,041	124,185
Total Accumulated Funds		164,041	124,185

This statement has been subject to Audit and should be read in conjunction with the accompanying Notes and attached Audit Report.

## **Statement of Cash Flows**

New Zealand Limnological Society Incorporated For the year ended 30 June 2017

#### 'How the entity has received and used cash'

Account	2017	2016
Cash Flows from Operating Activities		
Fees, subscriptions and other receipts from members	28,432	7,559
Receipts from providing goods or services	45,515	2,491
Donations	832	0
Payments to suppliers	(20,694)	(13,916)
Total Cash Flows from Operating Activities	54,085	(3,866)
Cash Flows from Investing and Financing Activi	ties	
Transfer to term deposit	(52,864)	(2,329)
Interest receipts	1,652	2,021
Total Cash Flows from Investing and Financing Activities	(51,212)	(308)
Net Increase/ (Decrease) in Cash	2,873	(4,174)
Cash Balances		
Cash and cash equivalents at beginning of period	49,079	53,253
Cash and cash equivalents at end of period	51,952	49,079
Net change in cash for period	2,873	(4,174)

## **Statement of Accounting Policies**

New Zealand Limnological Society Incorporated For the year ended 30 June 2017

#### 'How did we do our accounting?'

#### **Basis of Preparation**

The entity 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 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)

The entity is registered for GST. All amounts are stated exclusive of goods and services tax (GST) except for accounts payable and accounts receivable which are stated inclusive of GST.

#### Income Tax

The NZ Limnological Society Incorporated is exempt from income tax as it is a scientific research body as defined by section CW 49 of the Income Tax Act 2007

#### Bank Accounts and Cash

Bank accounts and cash in the Statement of Cash Flows comprise cash balances and bank balances with original maturities of 90 days or less.

#### 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**

The society transitionedon 1 July 2015 from preparation of General Purpose information in accordancewith New Zealand Generally Accepted Accounting Policies (NZ GAAP) to PublicBenefit Entity Simple Format Reporting – Accrual (Not-For-Profit). The transition had minimal impact on existing accounting policies of the society

## Notes to the Performance Report

New Zealand Limnological Society Incorporated For the year ended 30 June 2017

Account	2017	2016
4 Analysia of Devenue		
1. Analysis of Revenue		
Pees, subscriptions and other revenue from members	9.050	17.040
Subscriptions - Current	0,009	17,049
Subscriptions - In Arrears	11,200	47 726
Revenue from providing goods or services	19,327	17,730
Sales - Book - Advances in NZ Freshwater Science	5,164	0
Sales - Book - Crustacea Identification Guide	137	91
Total Revenue from providing goods or services Interest, dividends and other investment revenue	5,301	91
Interest Income	1.880	1.929
Total Interest, dividends and other investment revenue	1.880	1.929
Other revenue	-,	-,
Donations - for SIL Trust	32	0
Donations - Student Prizes	800	0
Total Other revenue	832	0
Account	2017	2016
2 Analysis of Exponsos		
2. Analysis of Expenses		
	2 200	2 200
Audit Fee Awarda - Saciaty Madal	2,200	2,300
Awalus - Society Medal	49	611
Bad Debts Written Off	5 5 2 8	011
Consulting & Accounting	4 500	0
General Expenses	332	35
Membership fees - RSN7	653	1 200
Postare	152	143
Printing - Newsletter	448	408
Website	688	0
Total Other Expenses	15.506	4.696
Cost of Goods Sold	,	-,
Cost of Goods Sold - Advances in Fresh Water Science	4,891	0
Total Cost of Goods Sold	4,891	0
Grant, Donations and Awards Costs		
Awards - Best Student Paper	500	500
Awards - Jolly Student Travel	1,000	400
Awards - SIL Trust Conference Prizes	800	800
Donation - Gift to SIL Trust	4,857	1,635
Total Grant, Donations and Awards Costs	7,157	3,335
Account	2017	2016
---	---------	--------
3. Analysis of Assets		
Bank accounts and cash		
Non Profit Org A/C	51,952	49,079
Total Bank accounts and cash Short Term Investments	51,952	49,079
Term Deposit 07	56,913	55,536
Term Deposit 08	51,486	0
Total Short Term Investments Debtors and prepayments	108,400	55,536
Accounts Receivable - Subscription Revenue	7,820	15,540
Accounts Receivable - Other	7,471	5,368
Prepayments	1,304	5,000
Total Debtors and prepayments Inventory	16,595	25,908
Advances in Fresh Water Sciences book	9,739	0
Total Inventory Other current assets	9,739	0
GST Receivable	0	586
Interest Accrued	653	288
Total Other current assets	653	873
Account	2017	2016

#### 4. Analysis of Liabilities

Creditors and accrued expenses		
Accounts Payable.	791	0
Accrued Expense	8,031	2,400
Donation Owed to SIL Trust	5,157	4,689
Total Creditors and accrued expenses Other current liabilities	13,979	7,089
GST Payable	(3,569)	(3,569)
GST	12,367	3,569
Subscriptions in Advance	522	122
Total Other current liabilities	9,319	122
Account	2017	2016

# 5. Accumulated Funds

Accumulated Funds		
Opening Balance	124,185	109,601
Accumulated surpluses or (deficits)	39,856	14,584
Total Accumulated Funds	164,041	124,185
Total Accumulated Funds	164,041	124,185

#### 6. Commitments

There are no commitments as at 30 June 2017 (2016:Nil).

#### 7. Contingent Liabilities and Guarantees

There are no contingent liabilities or guarantees as at 30 June 2017 (2016:Nil).

#### 8. Related Parties

There were no transactions involving related parties during the financial year other than:

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

- Payment of donations to the SIL Trust 1987 \$4,857.

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 were (i) to send young New Zealand scientists to an overseas conference; (ii) to bring prestigious scientists to New Zealand; and (iii) to recognise the best student paper delivered a 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 NewZealand Limnological Society elected during Society elections (held every two years). In each year that 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

Account	2017
The SIL 1987 Trust held the following balances as at 30 Ju	une 2017:
AMP Equity Trust at 30 June 2017	22,154
BNZ Current Account at 30 June 2017	7,059
BNZ Term Deposit at 16 June 2017	20,000
BNZ Unit Trust at 16 June 2017	21,376
Total The SIL 1987 Trust held the following balances as at 30 June 2017	70,589
Account	2016

V	
NZ Bond at 19 August 2016	20,837
BNZ Unit Trust at 17 June 2016	18,662
BNZ Term Deposit at 17 June 2016	20,000
BNZ Current Account at 30 June 2016	6,750
Total The SIL 1987 Trust held the following balances as at 3	0 June 2016 66,249

#### 9. Events After the Balance Date

There were no events that have occurred after the balance date that would have a material impact on the Performance Report (Last year - nil).

# 10. Ability to Continue Operating

The entity will continue to operate for the foreseeable future.

Account	2017	2016
11. Analysis of Conference Revenue and Expenses		
Conference Revenue		
Sponsorship	57,957	38,913
Registration Fees	160,596	169,570
Total Conference Revenue Conference Expense	218,553	208,483
Venue Hire, Food, Accommodation and Other Expenses	145,573	168,945
Conference Management Fees	32,910	36,679
Total Conference Expense	178,483	205,624
Net Conference Income	40,070	2,859
Account	2017	2016
12. Aged Subscriptions Receivable		
0 to 1 Year	1,021	10,279
1 to 2 Years	2,331	4,400
2 to 3 Years	1,696	622
3+	2,374	239
Total Aged Subscriptions Receivable	7,422	15,540



Crowe Horwath New Zealand Audit Partnership Member Crowe Horwath International

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#### INDEPENDENT AUDITOR'S REPORT

To the Executive Committee of the NZ Limnological Society Incorporated

#### Opinion

We have audited the performance report of NZ Limnological Society Incorporated on pages 5 to 13, which comprises the entity information, the statement of financial performance and statement of cash flows for the year ended 30 June 2017, the statement of financial position as at 30 June 2017, and the statement of accounting policies and other explanatory information.

In our opinion:

- a) the performance report on pages 5 to 13 presents fairly, in all material respects:
  - the entity information for the year then ended; and
  - the financial position of NZ Limnological Society Incorporated as at 30 June 2017, and its financial performance, and cash flows for the year then ended

in accordance with Public Benefit Entity Simple Format Reporting – Accrual (Not-For-Profit).

#### **Basis for Opinion**

We conducted our audit of the statement of financial performance, statement of financial position, statement of cash flows, statement of accounting policies and notes to the performance report in accordance with International Standards on Auditing (New Zealand) (ISAs (NZ)), and of the entity information in accordance with the International Standard on Assurance Engagements (New Zealand) ISAE (NZ) 3000.

Our responsibilities under these standards are further described in the *Auditor's Responsibilities for the Audit of the Performance Report* section of our report.

We are independent of the NZ Limnological Society Incorporated in accordance with Professional and Ethical Standard 1 (Revised) *Code of Ethics for Assurance Practitioners* issued by the New Zealand Auditing and Assurance Standards Board, and we have fulfilled our other ethical responsibilities in accordance with these requirements. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Other than in our capacity as auditor we have no relationship with, or interests in, the NZ Limnological Society Incorporated.



#### Information other than the financial statements and auditor's report

Management are responsible for the other information. The other information comprises the information included in the Performance report on pages 1 to 4, but does not include the financial statements and our auditor's report thereon.

Our opinion on the financial statements does not cover the other information and we do not express any form of audit opinion or assurance conclusion thereon.

In connection with our audit of the financial statements, our responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial statements or our knowledge obtained in the audit or otherwise appears to be materially misstated.

If, based on the work we have performed, we conclude that there is a material misstatement of this other information, we are required to report that fact. We have nothing to report in this regard.

#### **Responsibilities of Management for the Performance Report**

Those charged with governance are responsible on behalf of the NZ Limnological Society Incorporated for:

- (a) Identifying outcomes and outputs, and quantifying the outputs to the extent practicable, that are relevant, reliable, comparable and understandable, to report in the statement of service performance;
- (b) The preparation and fair presentation of the performance report, which comprises:
  - the entity information;
  - the statement of service performance; and
  - the statement of financial performance, statement of financial position, statement of cash flows, statement of accounting policies and notes to the performance report

in accordance with Public Benefit Entity Simple Format Reporting – Accrual (Not-For-Profit) issued in New Zealand by the New Zealand Accounting Standards Board; and

(c) For such internal control as those charged with governance determine is necessary to enable the preparation of the performance report that is free from material misstatement, whether due to fraud or error.

In preparing the performance report, those charged with governance are responsible for assessing the NZ Limnological Society Incorporated's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless those charged with governance either intend to liquidate the NZ Limnological Society Incorporated or to cease operations, or have no realistic alternative but to do so.



#### Auditor's Responsibilities for the Audit of the Performance Report

Our objectives are to obtain reasonable assurance about whether the performance report as a whole is free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with ISAs (NZ) and ISAE (NZ) 3000 will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the decisions of users taken on the basis of this performance report.

As part of an audit in accordance with ISAs (NZ) and ISAE (NZ) 3000, we exercise professional judgement and maintain professional scepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the performance report, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion, The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the NZ Limnological Society Incorporated's internal control.
- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.
- Conclude on the appropriateness of the use of the going concern basis of accounting by those charged with governance and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the NZ Limnological Society Incorporated's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the performance report or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the NZ Limnological Society Incorporated to cease to continue as a going concern.
- Evaluate the overall presentation, structure and content of the performance report, including the disclosures, and whether the performance report represent the underlying transactions and events in a manner that achieves fair presentation.

We communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

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#### **Crowe Horwath New Zealand Audit Partnership**

CHARTERED ACCOUNTANTS Dated at Nelson this 25th day of June 2018

Crowe Horwath New Zealand Audit Partnership is a member of Crowe Horwath International, a Swiss verein. Each member firm of Crowe Horwath is a separate and independent legal entity.

# MINUTES OF THE 50<sup>TH</sup> ANNUAL GENERAL MEETING OF THE NEW ZEALAND LIMNOLOGICAL SOCIETY INC.

(Trading as New Zealand Freshwater Sciences Society)

Held at Claudelands Events Centre, Hamilton

Wednesday 22 November 2017

[FOR APPROVAL: Minutes to be approved and confirmed as true record at the 2018 AGM]

The Annual General Meeting commenced at 5:52 pm and was chaired by Marc Schallenberg, President.

Present: Marc Schallenberg (President), Amy Whitehead (Secretary-Treasurer) and 67 members.

## 1. Apologies

David Rowe, John & Yvonne Stark, Kevin Collier, Kristy Hogsden, Michele Stevenson, Paul Scholes, Rosemary Miller, Sophie Allen, Ton Snelder, Kate McArthur, Ian Kusabs, Clive Howard-Williams.

# 2. Minutes of the 49<sup>th</sup> AGM circulated

Matters arising from minutes: Dealt with under general business.

*Motion:* That the minutes be accepted as a true and correct record of the 49<sup>th</sup> AGM (Kit Rutherford / Roger Young – *carried*)

# 3. President's report [Marc Schallenberg]

NZFSS has continued to be active in promoting freshwater science and networking within the freshwater science community in 2017.

This 2017 election year made abundantly clear that water issues are amongst the biggest concerns for New Zealanders. It was interesting to see how swimmability, irrigation, water pollution, water pricing and other water issues were among the issues of political discussion, debate and analysis during the election campaign. This attention on freshwater issues highlighted the strong social relevance of our Society's work on freshwaters and hopefully inspired all of our members to continue to get our science out into the public realm to help New Zealand achieve its freshwater goals. We acknowledge the following people among our membership who regularly engage with the mainstream media and promote evidence-based analysis and policy: Mike Joy, John Quinn, Graham McBride, Jenny Webster-Brown, Tim Davie, Scott Larned, Russell Death, Gerry Closs. I know there are others too. Keep up the good work.

Our new government seems poised to change direction on some water-related policies and I think that our Society can play a key role in helping inform central government with the best scientific knowledge available. I predict these will be exciting times for our Society.

Apart from the election, some of the interesting events related to freshwater issues in the past year have included:

- the rejection of the contentious Ruataniwha dam proposal by the Supreme Court,
- the Whanganui River was bestowed the rights, duties, responsibilities and liabilities of a "legal person" under New Zealand law. Whanganui Māori successfully argued that the river is an ancestor and therefore a legal person. This is a world first for a river.
- the publication of the 10-yearly OECD environmental performance review for New Zealand
- the publication of The Prime Minister's Chief Science Advisor's (Sir Peter Gluckman's) report on the state of New Zealand's freshwaters
- the publication of the Ministry for the Environment's Clean Water Package which included new goals to be achieved for swimmable rivers and lakes
- the establishment of a coalition of NGOs and industry groups and its development of a Freshwater Rescue Plan for New Zealand

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- John Hayes (Cawthron Institute) was awarded the NZFSS Medal for 2016 for his services to advancing freshwater science Congratulations John!
- Mike Joy (Massey University) won the Inaugural Critic and Conscience of Society Award bestowed by the Gama Foundation. This award includes a \$50,000 prize to facilitate Mike's work. Congrats Mike!
- Christoph Matthaei (University of Otago) and Jay Piggott (ex-University of Otago) are nominees at the NZ River Awards in the River Story category for their work on multiple stressors in the Kauru River. Congratulations and good luck Christoph and Jay!

The OECD's environmental performance review was very interesting and informative. Simon Upton (former Minister for the Environment in Jim Bolger's Government) was the lead author of the OECD report has taken up the Parliamentary Commissioner for the Environment position after Jan Wright's term at the ended earlier this year.

The above items highlight that it's been another interesting and exciting year for freshwater issues and science. It's great to see many of our members promoting these issues to the public via the main stream media and other avenues of dissemination.

#### NZFSS activities in the past year

Below is a list of the main activities carried out by the NZFSS this year:

#### Submissions\*:

- 1. Detailed submission on MfEs Clean Water 2017 package, and we engaged with the media on issues surrounding the swimmability standards and goals
- 2. Submission on the Department of Conservation's New Zealand threatened species management strategy
- 3. Preparing a submission on National Environmental Monitoring Strategies for Water Quality in Groundwaters, Lakes, Rivers and Coastal Waters (due Dec. 6)

#### Letters of support for:

- 1. The proposed Indo-Pacific Fishes Conference 2021 in Auckland
- 2. The proposed 2020 INTECOL Wetlands conference in Christchurch

#### Society business:

- 1. Production of the 2017 NZFSS Newsletter (if people still need a copy, you can go back to Amy's email of last week and find a members link to it, or go to our website for a public version without contact details of members).
- 2. Migrating our website over to a new platform with a new design (hopefully online by Christmas)

\*All NZFSS submissions will be on our new website, which will hopefully be online by Christmas.

Although we have achieved some important outputs (e.g., constructive comment on Clean Water 2017 and Swimmability), we haven't been able to achieve all of our targets for this year due to the unexpectedly slow process of migrating our website and associated online facilities to a new platform. We decided to take advantage of the Royal Society's offer of assistance with this via a web design company that offered good rates if we adopted a template designed for specifically for Royal Society constituent societies. While the new website looks like it will be an excellent platform, we still haven't got a forum facility linked to it. So, we've not been able to initiate debate and consult the membership via these new tools as we had hoped to do. We hope that the forum will be available before Christmas so that we can move forward on things like prioritising projects to support with our cash surplus and potentially revamping the NZFSS awards and constitution – all projects that we had hoped to progress this year with the help of a web forum to facilitate discussion and input by the membership.

#### The NZFSS cash reserves – and what to do with them

As discussed at the last AGM, the society is accumulating a large reserve of cash and many members have expressed concern that we are not investing some of this reserve to help accomplish the society's goals. We have collected many good ideas as to what could be done with the reserves and, once the new website and forum goes live, we will set about working with the membership to prioritise projects and determine what an appropriate amount of cash reserve should be for the society.

#### Renewal of Māori members of the executive

Thanks to Tara McAllister and Ian Kusabs for their work as Māori representatives on the Executive. We warmly welcome our new Māori representatives, Yvonne Taura and Brett Cockeram.

#### General Thank yous

The NZFSS has benefitted greatly from the skills and energy of people on the Executive Team and by many members of our Society who assist with our various functions (for example, writing submissions). This past year in particular, we have been assisted greatly by members at large in putting together our submissions. In particular, we would like to thank NZFSS

members Keith Hamill, Chris McBride, John Quinn and Susie Wood for their help. I would like to specifically thank these NZFSS executives and assistants for their help so far this year: Richard Allibone (submissions), Lisa Carlin (website admin), David Hamilton (submissions), Phil Jellyman (submissions), Kate McArthur (submissions), Natasha Petrove (newsletter), Marine Richarson (newsletter) and of course our chief organiser and keeper of accounts, Amy Whitehead (Secretary/Treasurer).

If members have any thoughts or comments for me and/or the Exec, feel free to send those to us.

I move from the Chair that this report be accepted. (Adrian Meredith – carried)

# 4. Secretary-Treasurer's report [Amy Whitehead]

#### Finances

The accounts for the 2016-2017 financial year are still with the auditors Crowe Horwath in Blenheim. I'll send out the final financial statements to all members once I receive them (as part of the constitution, the audited financial statements should be presented to members).

Our total assets as at 30 June 2017 were \$159,659, including two Term Deposits (\$107,706).

**Income** earned for the 2016 financial year came from the 2016 Invercargill conference (\$50,860), subscription income (\$21,980), and interest earned from our term deposit and current account (\$821).

**Main expenditure** items for the 2016-2017 financial year included the editing and printing of Advances in Freshwater Science (\$14,450). Expenses also included RSNZ membership fees (\$1,957), student awards (\$2,300), the website upgrade (\$688), hardcopy newsletter and postage expenses (\$600), and bank fees (\$957).

The Society made a **net surplus of \$53,624** for the year ended 30 June 2017. This compares to a surplus of \$1,225 for the 2015-2016 financial year.

Reasons for this difference include:

- Conference income for the 2017 financial year was \$50,860 (2015-16: \$14,771). This conference income was unexpected and resulted due to lower costs, higher attendance and greater sponsorship than anticipated.
- No subscription invoices went out to members in 2015-2016. A recommendation from Crowe Horwath was to get subscriptions sent out early in the 2016-2017 financial year (and this is also part of our Constitution), which led to higher than normal membership subscription payments in that financial year.

Of this surplus, we have approval from the membership to spend \$20,000 in the coming year, as approved at the 2016 AGM.

Table 1. Income and expenses for the 2016 – 2017 financial year

#### Profit & Loss

New Zealand Limnological Society Incorporated 1 July 2016 to 30 June 2017

Income	
Conference Income	\$50,859.99
Interest Income	\$820.80
Sales - Book - Crustacea Identification Guide	\$136.98
Subscriptions - Current	\$12,183.36
Subscriptions - In Advance	\$521.75
Subscriptions - In Arrears	\$9,274.49
Total Income	\$73,797.37
Gross Profit	\$73,797.37
Plus Other Income	
Donations - for SIL Trust	\$32.00
Donations - Student Prizes	\$800.00
Total Other Income	\$832.00
Less Operating Expenses	
Audit Fee	-\$326.40
Awards - Best Student Paper	\$500.00
Awards - Jolly Student Travel	\$1,000.00
Awards - SIL Trust Conference Prizes	\$800.00
Awards - Society Medal	\$48.80
Bank Fees	\$956.88
Book Formatting & Editing - ANZS	\$5,650.00
General Expenses	\$332.17
Membership fees - RSNZ	\$1,956.52
Postage	\$152.43
Printing - Book - Advances in Freshwater Science	\$8,800.00
Printing - Newsletter	\$447.80
Website	\$687.50
Total Operating Expenses	\$21,005.70
Not Drofit	¢=> <>> <>
	\$35,025.07

#### Membership

Membership by member type shows the breakdown of our membership regardless of financial status (Table 2) This shows that waged and student member numbers are relatively stable over the last five years. The database is due a clean-up which is why the numbers are a little higher this year.

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	2017	2016	2015	2014	2013
Ordinary waged	371	384	337	326	345
Unwaged / Student	124	122	113	108	125
Honorary	9	9	9	9	10
Life	4	4	4	4	4
Other (Societies)	5	5	5	5	5
Corporate (Libraries)	11	11	11	12	13
TOTAL	526	535	479	464	502

Invoices for the 2017-2018 financial year were sent out late this year, which is why there are more unpaid current members than last year. Invoice reminders will be sent out shortly to those in arrears. However, many thanks to those who have recently paid their invoices, particularly those who were in arrears.



Figure 1. Financial status of members on 21 November 2017, compared to 2016.

The number of members in arrears by 3 years is creeping up again, and reflects 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. This will be tidied up during the next year as we transition from the very manual current system of membership management to the new online membership system associated with the new website.

#### Website Upgrade

The RSNZ hosts the websites of member societies, including the NZFSS website. In 2017, they initiated a subsidised website upgrade for interested societies. NZFSS have been working with the website design team at Prefer Limited to update and upgrade our website. New features include an online membership management system with facility for online credit card payments, an improved email system for communicating with members and a modern, mobile-friendly design. The cost of

the upgrade to date is \$5156.25. We are currently working with Prefer to develop an online forum to facilitate discussion amongst members and hope to launch the new website in the new year.

- <u>Jenny Webster-Brown:</u> Questioned high bank fees.
- <u>Amy Whitehead:</u> Partly due to the implementation of the new online credit card payment service, which meant that we are currently paying for two payment services. The old manual service will be cancelled soon.

Motion: That the Society accounts for 2016-2017 be accepted (Amy Whitehead / Doug Booker carried)

*Motion:* That the Auditor for the next financial year be Crowe Horwath NZ Ltd., Blenheim. (Amy Whitehead / Natasha Grainger – *carried*)

5.	SIL 1987	Trust Fund	report	[Kit R	utherford]
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SIL 1987 Tru	ist	Financial Statement 8	th Novemb	er 2017				
		Assount number	Reasonable -	Internet	Amount		channe	
30/00/2016	AMP (AIT)	N7 Eined leterast Trust	C225292	interest	S20.756		change	
30/09/2016	AMD Int. Equity Tout	1623006	5333304		\$20,750			
30/09/2016	RN7 Ready Money	02 0343 0048 153 000			\$10,901			
30/09/2016	BNZ Term deposit #1	9348153-01006	12/09/2016	4.25%	\$10,000			
30/09/2016	BN7 Term deposit #1	9348153-01000	12/09/2013	4.23%	\$10,000			
TOTAL ASSETS at FY	ending 30th September 2016	5546135-01007	12/03/2017	4.4034	\$71,221			
30/09/2017	AMP (AIT)	NZ Fixed Interest Trust	\$335382	I I	\$20,815		\$59	Note 1
30/09/2017	AMP Int Fourty Toust	1622996	3333302		\$22,154		\$3,193	and a
9/10/2017	BN7 Beady Money	02 0343 0048 153 000			\$206		33,473	
30/09/2016	Ph/7 Term deposit #1	9349153-01006	12/00/2018	4.75%	\$10,000		-	Note 3
30/00/2016	BNZ Term deposit #2	0348153-01000	12/09/2010	4.40%	510,000			Note 2
5/10/2017	BNZ Term deposit #2	9349153-01007	\$100,000	2 954	\$2,000			Note 2
6/10/2017	DH2 Term deposit #3	0340153-01000	3/10/2013	3.03%	\$7,000			Note 3
6/10/201/	Bitz Term deposit #4	3348153-01003	3/10/2018	3.00%	55,000		(3.373	Note a
TOTAL ASSETS at at	November 2017			I I I	\$75,176		23,653	_
Not lo conce la laure	1				(2.20)			1000
Net increase in inves	itments I				53,253			Note 4
Net income					\$10,689			Note 5
5% of assets	1. 2010			L	33,/59			
Available for awards	s in 2018			I I	\$17,700			-
Income/expenditure						prizes	income	
19/10/2016	Award	Stewart				-\$1,600		
14/10/2016	Award	student prizes				-\$800		
15/08/2016	NZFSS	Donations 2016			\$1,852		\$1,852	
15/08/2016	NZFSS	Donations 2015			\$2,537		\$2,537	
monthly	BNZ	bank fees			-\$60			
12/09/2016	BNZ	interest TD #1			\$380		\$380	
10/05/2017	Award	Goeller				-\$2,000		
11/09/2017	BNZ	interest TD #1			\$325		\$325	
11/09/2017	BNZ	interest TD #2			\$780		\$780	
6/10/2017	NZESS	Donations			\$4,875		\$4,875	
6/10/2017	Award	student prizes				-\$800		
NETT					\$10,689	-\$5,200	\$10,749	
Notes								
Note 1	performing poorly - may rein	vest	Note 4	AIT and IET only				
Note 2	reinvested		Note 5	income less fees				
Note 3	new investments							
	I							
JOQ. the her								
Treasurer								
8th November 2017								

Motion: That the SIL 1987 Trust Fund report for 2016-2017 be accepted (Kit Rutherford / David Hamilton - carried)

## 6. General Business

#### A. What to do with the NZFSS cash reserves? [Marc Schallenberg]

Reserves have grown substantially this year due to a large profit generated by our 2016 Invercargill conference

Progress on determining a plan of action to spend some of our reserves was hindered by the migration of our website and web forum facilities and concomitant problems with our web forum software. This migration to a new platform began in June and has not yet been completed. When our new web forum is available, the Society will begin an open discussion on the forum about the various suggestions provided by members, which will be followed by a vote by the members and inclusion of the activities in the 2017/18 annual plan.

Here is a summary of ideas put forth by NZFSS members at the 2016 AGM:

#### 1. Lecture tour:

Host an international guest to go out to smaller centres (e.g. Nelson, Gisborne) and give talks, speak to communities (would involve airfares, etc.). Include one of our own members on the tour.

#### 2. General support of members

Use for succession planning and getting the home community to attend conferences. Use growing reserves to strengthen the society, better support students to go to conferences and overseas study, support middle layer of scientists and scientists in the community.

#### 3. Sponsor society outreach initiatives

Invite participation from developing countries; interact and invite a member from similar organisations to attend NZFSS conference. Fund a restoration project and have a public focus day, inviting members of the public. Also encourage networking with other societies / affiliation with other societies. Support freshwater education/research/development projects in developing countries.

#### 4. Society publications

Writing and publishing Society books. Members could be funded to write and publish forward-looking policy/think pieces.

#### 5. Executive stipends

Consider paying Executive members a stipend to fund time spent on Society work.

#### 6. Financial assistance for the production of NZFSS White Papers (think pieces)

Production of forward-looking policy think pieces (e.g. white papers) on freshwater issues relevant to New Zealand. For example, is it time for NZ to consider a moratorium on freshwater conversion, and if so, do we have the expertise to put a credible case forward in the form of a white paper?

Marc requested that any further ideas be emailed to him by end of November 2017.

- <u>Richard Storey:</u> Noted that the constitution limits spending to only benefiting NZFSS members.
- <u>Phil Jellyman</u>: The Executive did not nominate executive stipends this suggestion came from another member.

#### B. Revamping of NZFSS conference awards [Marc Schallenberg]

From discussions at the 2016 AGM, it was apparent that there were divergent views on conference award numbers, sponsorship, etc. and a motion was tabled to put together a sub-committee to consider these issues.

Since then, then there has also been some discussion among the Executive about creating an award for early career scientists.

It is probably time to rationalise not just the conference awards, but also consider putting up an NZFSS award for early career scientists to go along with the NZFSS Medal. A review should also include the establishment of clear criteria for awards to assist judges.

If any members would like to be involved in a subcommittee to undertake this work this year and provide recommendations at the next AGM, please contact Phil Jellyman (phillip.jellyman@niwa.co.nz)

- Natasha Grainger: Will the awards subcommittee be separate from the current awards committee?
- <u>Marc Schallenberg:</u> Yes, this will be a separate committee.
- <u>Scott Larned:</u> Suggested an Early Career Researcher award.

#### C. Updating the NZFSS constitution (last updated 14 years ago) [Marc Schallenberg]

The NZFSS constitution was last updated 15 years ago (Appendix A). Some discussion about updating the constitution was had at last year's AGM, but we ran out of time to fully discuss/decide or agree on actions. Various members have suggested that some updates would be good so that the constitution better reflects the diverse roles of our evolving Society.

Some suggestions for changes have included:

1. Should we have a Te Reo Māori Society name in addition to our English name? 2. Adoption of a public outreach objective

- 2. Updating our communication protocols
- 3. Allowing for voting other than by postal ballot

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4. Reflect the ability to co-opt members onto the Executive

If any member would like to join a sub-committee to look at updating our constitution, please contact David Hamilton (david.p.hamilton@griffith.edu).

#### D. International Society of Limnology [David Hamilton]

Many members may not be aware of the overarching global organisation of SIL, the International Society of Limnology, which has been going for nearly 100 years. SIL now has biannual congresses and these are important events for those around the globe who are working on freshwater. The next conference is in Nanjing, China, in 2018. SIL also publishes the journal Inland Waters and just recently has made available an enormous archive from previous proceedings:

- SIL Communications, 1953-1996: Internationale Vereinigung für Theoretische und Angewandte Limnologie: Mitteilungen
- SIL Proceedings, 1922-2010: Internationale Vereinigung für Theoretische und Angewandte Limnologie: Verhandlungen

All of these publications are available on line to members. In addition, members of SIL benefit from a substantial reduction in registration fees to the SIL Congress

New Zealand has just a handful of members of SIL and the international committee is questioning specifically why NZ is so poorly represented. It should also be noted that NZFSS has benefited from the 1987 SIL Congress in NZ by having an ongoing award as a result of profit from that Congress. Jay Piggott also won the overall best student paper from SIL last year (amongst representatives from > 70-80 countries). SIL membership is US\$93 p.a. for full member or US\$30 for three years as a student member.

- <u>Carolyn Burns:</u> Noted the benefits of attending SIL conferences as they tend to be more welcoming than some North American conferences.
- David Hamilton: Echoed Carolyn's comments and said that it is easy to sign up to SIL online.

#### E. NZFSS Newsletter and abstract archive [David Hamilton]

David Hamilton has scanned all of the available past conference abstracts and these will be made available on the new website. He is still missing 5–6 conferences and will send out a request to members to see if anyone has copies that could be scanned.

# F. Should NZFSS make an approach to the new Government offering freshwater and estuarine expertise towards developing national policy frameworks, expert peer-reviews, etc.?

Political awareness raising?

- <u>Scott Larned</u>: What would the process for approaching the government be?
- <u>Marc Schallenberg:</u> Write a letter to relevant Ministers.
- <u>Kati Doehring:</u> Supports the initiative and sees it as a good opportunity for science communication.
- <u>Scott Larned:</u> We need a targeted list with options need to make sure we don't promise something that we can't deliver on.
- John Quinn: RSNZ has regular dinners at parliament that we could present at. Could write to Andrew Clennan(?) and make the offer to present.
- <u>Scott Larned:</u> We need a subcommittee and a deliberate process
- <u>Carolyn Burns:</u> Could we use the process that was used to write Sir Peter Gluckman's paper on freshwater? Is the Labour Government using the same process to get its advice and direction?
- Joanne Clapcott: Suggested that we get consensus to see if this is a good idea and then form a committee
- Jenny Webster-Brown: Could suggest in letter that NZFSS acts as the first point of contact for access to member experts
- Marc Schallenberg: Suggests writing letters to David Parker, Eugenie Sage and the CEOs of relevant ministries.
- <u>Scott Larned:</u> to head subcommittee and get feedback from Neil Deans
- <u>Carolyn Burns:</u> Should also send the same information to Simon Upton.

#### G. Post-conference press release [Marc Schallenberg]

In the past, NZFSS has often produced post-conference press releases. These have often been ignored by the media. Let Marc know before the end of the conference if you think of a pithy, punchy, media-friendly statement summarising an important key theme from the conference. We will ask Dacia Herbulock from the Science Media Centre to help with crafting the press release.

#### H. Announcement of the NZFSS Medal for 2018 winner [Marc Schallenberg]

The award committee considered a strong nomination this year and is excited to award the 2018 NZFSS Medal which recognises outstanding contributions our understanding and management of freshwaters to Russell Death. Congratulations Russell! At our 50<sup>th</sup> conference next year, Russell will officially receive his medal and hopefully give us a plenary.

#### I. Annual and 5-year plans [Marc Schallenberg]

Annual Plan (2018)

- Establish a constitutional reform subcommittee to organise amendments / changes to our constitution. Members will be able to have input on proposed amendments and a proposal for updates will be provided for members to vote on at the next AGM.
- Revisit our conference awards.
- With the help of members, prioritise projects to be supported by our financial surplus and spend \$20k of the surplus, as agreed at the last AGM.

#### Five-Year Plan (2018-2023)

- Update the constitution to reflect NZFSS evolution
- Develop and run an international workshop
- Produce a series of forward-looking policy/think pieces
- Engage creatively with SIL and ASLO conferences if possible.

## 7. Future Conferences

**INTECOL** Wetlands conference

• <u>Natasha Grainger</u>: No update yet whether the proposal to host 2020 conference in Christchurch has been successful but there was lots of support. We are competing with Brisbane.

ASL joint conference 2019

• Marc Schallenberg: Nothing known about when or where at this stage

Nelson was announced as the location for the 50<sup>th</sup> NZFSS conference. Dates are still to be decided. Send any celebration suggestions to Joanne Clapcott.

The meeting closed at 7:05 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.

- 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.
- 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.
- 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 31<sup>st</sup> 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 1<sup>st</sup> July in each year and the amount shall be fixed at a General Meeting. Members whose subscriptions are not paid by the succeeding 30<sup>th</sup> of June shall be unfinancial and shall be liable to forfeit all benefits of membership. The financial year shall conclude on the 30<sup>th</sup> 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 twothirds 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,

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- 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 postgraduate 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.



#### How do I Join?

Print/pull out this page, fill in your details, then post to: Amy Whitehead, NZFSS Secretary-Treasurer, c/- NIWA, PO Box 8602, Riccarton, Christchurch 8440 or email to: amy.whitehead@niwa.co.nz.

DETAILS:		
TitleFirst Name	Middle Initial/s	Last Name
Postal Address		
Email		
Telephone: (main)	(alternate)	<u></u>
Membership Type: (select one)	Waged Student	Unwaged
Brief list of your professional interests:		
PERMISSIONS: (Please select your p	referred option for the following and	sign to authorise)
I agree to the NZ Freshwater Sciences Socie	ety publishing my membership detai	ls:
	Signature	
I give permission for my email address to	be added to the NZESS email mailin	g grain.
Yes No	Signature	1
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	
<b>PAYMENT:</b> (Please select appropriate )	boxes)	
Waged/Corporate \$55 per annum	Unwaged/Student \$15 per annum	Life Membership \$1375
ODonation to the SIL Trust* (optional)	\$4	
	Total Amount \$	
Payment by Direct Credit (preferred Date paid	method) – Acct: BNZ 02–0700–03542	213-00 (include your name in the Reference/Details field)
Payment by Credit Card (please tick of	one) 🔷 Visa	Mastercard
Name on Card	Card Number	
Card Expiry Date	Signature of Cardh	older
<b>Payment by Cheque</b> – Make payable t	o "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



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