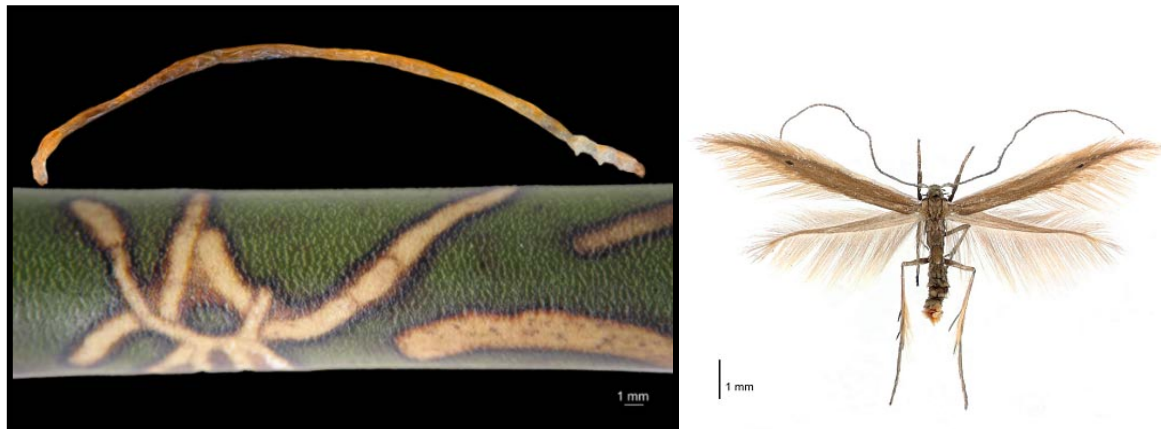


Restoring Wetlands Research Programme Update 4: July 2013 to June 2014

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Monitoring a threatened moth ('Fred the Thread') in Waikato peat bogs

The threatened stem-boring moth, *Houdinia flexilissima* (Lepidoptera: Batrachedridae), is known only from one host plant, *Sporadanthus ferrugineus*, which is also threatened. *Sporadanthus ferrugineus* is known from three isolated peat bogs in the Waikato, and four other wetlands following translocation or restoration. The distribution and abundance of *H. flexilissima* was assessed using a novel technique that involved counting and dissecting the *Sporadanthus* stems for the presence of larvae. *Houdinia flexilissima* appears to be able to survive wherever *S. ferrugineus* plants are present, and was found in natural, translocated, and restored wetlands. The moth established in small translocated populations ($\leq 270 \text{ m}^2$) from larvae contained within stems of the original translocated *Sporadanthus* plants, and at the restoration site by dispersal from adjacent natural populations 800 metres away. From a conservation perspective, the pattern of population establishment in the absence of additional interventions is encouraging for the long-term persistence of *H. flexilissima*.



Larva, early excavation tunnel, and adult male of *Houdinia flexilissima* (Lepidoptera: Batrachedridae). The larvae of *H. flexilissima*, colloquially named 'Fred the Thread', feed in the green photosynthetic layer of *Sporadanthus ferrugineus* stems, leaving these characteristic tracks. The adults are small delicate moths that are abundant in Waikato peat bogs between October and December. Photos: B. Rhode.

Relative of Fred the Thread found in Australia?

While on an International Mire Conservation Group symposium in Australia in December 2014, Dave Campbell spotted almost identical tracks on the stems of *Baloskion australe* at Pengelli mire, Kosciuszko National Park. *Baloskion australe*, known as southern or mountain cordrush grows in southeast Australia and is related to our *Sporadanthus ferrugineus* (both are restiads). If this proves to be a related moth species, it would suggest the moth travelled to New Zealand along with ancestral *Sporadanthus*. The jury is out, however, since no one seems to have studied the Australian insect, or ever reported a stem-boring species from the restiads. Corinne's colleague, Robert Hoare (Landcare Research Auckland), thinks the Aussie "Fred" is probably different from the New Zealand one, because an exit hole found on one *Baloskion* stem suggests the insect pupates outside the stem, whereas *H. flexilissima* pupates inside the stem.



Baloskion australe with tracks caused by an unknown stem boring larva, Pengelli mire, Kosciuszko.
Photo: D. Campbell.

Fertiliser studies: O Tu Wharekai

Studies led by NIWA (with significant support from DOC and Landcare Research) on the resilience of the O Tu Wharekai (Lake Clearwater) wetlands to N and P enrichment are now well advanced, with 3 years of seasonal fertiliser addition to small plots in each of the 3 dominant wetland plant communities to be completed in December 2014. Final sampling of plant and soil responses, planned for February 2015, will require another major team effort. The response of plant roots to nutrient additions has also been assessed using ingrowth cores, soil microbial responses assessed using cotton strip decomposition tests, and new methods for monitoring soil redox conditions (an indicator of soil waterlogging and associated biogeochemical conditions) tested using IRIS tubes (led by Scott Bartlam). The IRIS redox measurements involve inserting PVC tubes coated with iron oxyhydroxide into the soil for 28 days, then recovering them and quantitatively recording the extent of dissolution of the coating in different depth bands. IRIS tubes are now a standard tool for wetland delineation in the US, and we hope to be able to assess their potential utility for this in New Zealand conditions. DOC has funded installation of water level and soil moisture recorders in the O Tu Wharekai, which will help characterise the seasonal water levels to which the different plant communities are adapted, and help interpret the IRIS tube measurements. Measurements have also been carried out in association with Southern Cross University, Australia, to compare the nitrogen-stable isotope signatures of plants in areas of the wetland potentially impacted by agricultural intensification compared with those in pristine areas.

Fertiliser studies: Whangamarino

Data on the nutrient status (nitrogen or phosphorus limitation) of wetlands in the Waikato and their response to nutrient addition are currently being written up for publication by Chris Tanner. The study, initiated by Brian Sorrell, involved seasonal nutrient additions over a 3-year period to an early successional swamp (Toreparu), a mid-successional fen (Whangamarino), and a late successional bog (Kopuatai). Preliminary results were presented at the Wetland restoration Symposium in Auckland in February. Responses varied markedly for the different wetlands with P addition having a marked negative influence on the growth of many species. The growth of wire rush (*Empodisma robustum*) cluster roots, in particular, was curtailed under P fertilisation, drastically reducing its ability to form peat.

Invertebrate community responses to grey willow control at Whangamarino.

In New Zealand, willows are major invaders of riparian zones and wetlands. However, the impacts of willows on the invertebrate fauna within wetlands have yet to be quantified. Since January 2011, we have investigated the effect of grey willow control on the invertebrate community in a large-scale experiment at Whangamarino wetland, Waikato. In February 2012, half the experimental plots were

sprayed with glyphosate targeted at killing the grey willow present. Canopy invertebrates appear to respond more to changes in habitat complexity (i.e. willow canopy loss after control) than to the direct toxic effect of the herbicide used. For example, during the days immediately following the spray, before canopy cover had declined, beetle abundance remained stable. However, there was a significant decline in the mean abundance of predacious and herbivorous beetles 27 days after spraying at the herbicide-treated plots, where the canopy cover had reduced by approximately 50%. Despite the detrimental short-term effects of willow control on beetle abundance, monitoring in 2013 and 2014 shows that 1 and 2 years after spray there is a significant increase in the abundance of predacious and herbivorous beetles in the herbicide-treated plots. While further analysis is required, the observed changes appear to be related to changes in the habitat within the herbicide-treated plots, which are characterised by loss of willow canopy, creating an open habitat with native sedges and weedy annuals.



A malaise trap for sampling invertebrates, in an unsprayed plot in Whangamarino wetland. Photo: C Watts.

Vegetation tool for wetland delineation in New Zealand

We adapted the vegetation criterion of the USA wetland delineation system for regulatory purposes to New Zealand wetlands. This included the classification of some 973 native and exotic species according to fidelity to wetland: obligate wetland (OBL: occurs almost always in wetlands), facultative wetland (FACW: occurs usually in wetlands), facultative (FAC: equally likely in wetlands or non-wetland), facultative upland (FACU: usually in non-wetlands) or obligate upland (UPL: almost always in non-wetlands). Although the tool proved useful in delineating wetlands at most sites, it is recommended that additional assessments of soils and hydrology (as in the USA system) are used in cases where assessments are inconclusive or misleading. The report is available at:

http://www.landcareresearch.co.nz/_data/assets/pdf_file/0003/71949/vegetation_tool_wetland_delineation.pdf

National Wetland Restoration Symposium 2014

The 6th National Wetland Restoration Symposium Water and Wetlands: from Droughts to Storms was held in Auckland on 12–14 February 2014. The wetland programme was well represented with members providing ten presentations or workshops covering a range of topics from research results to community and iwi-initiatives. A highlight was Dave Campbell's keynote presentation on peatlands, carbon, and climate change. Many of the presentations are available on the National Wetland Trust website at: <http://www.wetlandtrust.org.nz/symposia.html>

The next wetland restoration symposium in 2016 will be held in the South Island, with possible contenders being West Coast and Sinclair Wetlands, Otago.

Scoping application of northern carbon flux models to southern peatlands

Prominent Canadian peatland biogeoscientist, Professor Nigel Roulet, visited New Zealand during March, along with his wife Kathy. Hosted by the University of Waikato, Nigel's visit was intended to extend collaborative research efforts between northern and southern hemisphere peatland researchers. Nigel met with peatland and lake modelling researchers, and interacted with graduate students. He also visited the 90-km² Kopuatai peat bog, where carbon exchange (CO₂, CH₄, DOC) measurements have been carried out since 2011. Nigel is interested in incorporating the floristically different New Zealand bog systems into his models of long-term and contemporary C-exchange and peat accumulation that were developed for the *Sphagnum* dominated northern systems.



Nigel and Kathy Roulet at the Kopuatai bog carbon exchange research site. Note Nigel's footwear – very optimistic for bog work. Photo: D. Campbell

Brief notes:

- Monitoring of vegetation in our long-term grey willow control experiment at Whangamarino Wetlands (a DOC-LCR-NIWA collaboration) is now into the 3rd year since spraying with glyphosate (see also the updates on terrestrial and aquatic invertebrate studies). It is pleasing to see a marked increase in native vegetation cover, especially sedges, occurring in the willow control areas, following an initial flush of exotic annuals.
- Janine Wech reports that sampling of aquatic invertebrates in the grey willow control study at Whangamarino is nearing completion, with the last field trip planned with DOC on 27 May 2014. Invertebrate samples were collected in March, May, Sept and Dec from sprayed and non-sprayed areas for the last 3 years to determine whether willow control affects aquatic wetland invertebrate communities. The next phase of this study (over the next 12–24 months) is to complete sample analysis and write up results.
- Alex Keyte-Beattie completed her MSc thesis on the contribution of the dense *Empodisma robustum* canopy litter at Kopuatai bog to overall ecosystem CO₂ emissions. She found that the tough and long-lived litter layer is highly resistant to decay, with only small contributions (<10%) to ecosystem respiration. It is thought that the mulch-like dense litter layer is a key factor in water retention in these warm-temperate bog ecosystems.
- Yvonne Taura has recently completed a 10-week internship scoping a cultural indicator for wetland health and based at Landcare Research, Hamilton. The project is funded by Waikato Raupatu River Trust and involved consultation with Waikato-Tainui kaumātua as part of the WRRT subcontract within the Wetlands programme. Thanks to Cheri van Schravendijk-Goodman for organising the internship.
- There has been great progress with restoration of the Maurea Islands, a project co-led by Waikato Raupatu River Trust and NIWA. One of the islands is being restored using traditional chemical methods for weed control; restoration of the other island uses a non-

chemical approach. Our inaugural wetland scholarship winner, Jonathon Brown is the main restoration practitioner, with lots of input from Cheri van Schravendijk-Goodman.

- Dave Campbell was interviewed in Kopuatai Bog by Alison Balance on Radio New Zealand's 'Our Changing World' on 22 May 2014. Kopuatai Bog is New Zealand's largest raised bog (10 000 ha) and is designated as a Ramsar site. To hear (literally) Alison and Dave stomping around at Kopuatai bog (but gently!) and talking about the ecology, hydrology, carbon storage and climate change, play the podcast:

<http://www.radionz.co.nz/national/programmes/ourchangingworld/audio/2596604/kopuatai-peat-bog-and-carbon-research>

Selected papers/chapters/theses

Campbell DI, Smith J, Goodrich JP, Wall AM, Schipper LA 2014. Year-round growing conditions explain large CO₂ sink strength in a New Zealand raised peat bog. *Agricultural and Forest Meteorology* 192–193: 59–68.

Clarkson BR, Ausseil AGE, Gerbeaux P 2013. Wetland ecosystem services In Dymond JR ed. *Ecosystem services in New Zealand – conditions and trends*. Lincoln, Manaaki Whenua Press. Pp. 192–202.

Clarkson BR, Clarkson BD 2013. Restiad bogs in New Zealand. In: Rydin H, Jeglum JK eds *The biology of peatlands*. 2nd edn. Oxford, Oxford University Press. Pp. 241–248.

Keyte-Beattie A 2014. The role of *Empodisma robustum* litter in CO₂ exchange at Kopuatai bog. Unpublished M Sc thesis, Hamilton, University of Waikato.

Tanner CC, Howard-Williams C, Tomer M, Lowrance R 2013. Bringing together science and policy to protect and enhance wetland ecosystem services in agricultural landscapes. *Ecological Engineering* 56: 1–4.

Watts C, Thornburrow D, Clarkson B, Dean S 2013. Distribution and abundance of a threatened stem-boring moth, *Houdinia flexilissima* (Lepidoptera: Batrachedridae) in New Zealand peat bogs. *The Journal of Research on the Lepidoptera* 46: 81–89.