

REPORT

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Prepared For: Technical Committee

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Subject: **Lake snow technical workshop proceedings and research priorities –
recommendations and programme cost estimates**

1. Background

Lake snow is a term given to the clumping together of microscopic bacteria and algae with a mucus-like polysaccharide material by diatoms, in this case *Lindavia intermedia*. Lake snow has been causing significant problems in Lake Wanaka for a number of years including fouling of fishing gear and blocking water filters. Work done by Dr Marc Schallenberg and Dr Emilie Saulnier-Talbot (Laval University, Canada) has confirmed reports from anglers that lake snow appeared in Lake Wanaka in around 2004 and lake snow has since been observed in a number of other New Zealand lakes, including Lake Wakatipu (May 2016) and Lake Hawea (September 2016).

A workshop on lake snow was held at ORC on 20 December 2016. The primary objectives of the workshop were:

1. To develop and prioritise research questions relevant to the identification of potentially feasible methods of managing the effects of lake snow.
2. To scope the methodology, timeframe and resource requirements for answering each research question.

Workshop participants represented Landcare Research, Cawthron Institute, NIWA, University of Waikato, University of Otago (Catchments Otago), Ministry of Primary Industries, Queenstown-Lakes District Council, Environment Canterbury, Environment Southland and Otago Regional Council. The workshop proceedings are described in Ryder Consulting Ltd Report: Lake Snow Technical Workshop, 20 December 2016, Report on Workshop Discussion and Outcomes.

Workshop participants unanimously agreed that in order to manage the effects of lake snow further work is required to understand the lake snow diatom, *Lindavia intermedia*, and the production of lake snow mucus, technically known as Transparent Exopolymer Particles (TEP's). To date there is no information available that allows the identification of feasible options to manage lake snow and a significant amount of work is required to get to a point where management options are available.

Priority research areas identified at the workshop are outlined in Appendix A, with the priority level as agreed by council staff and workshop participants as well as the approximate costs to deliver each component. Feedback from the experts since the workshop indicated some subtle changes in the table, however most viewed the majority of research recommendations as either having high or medium-high priority. The

priority ranking also attempts to recognise that some components will take longer to organise and undertake whereas others (e.g., literature reviews) are less reliant on external factors (e.g., equipment, seasonal components, etc.).

Some components lend themselves to a collaborative investment across local and national territorial authorities and research organisations, while others would be best supported by focused research programs, including postgraduate research (see Catchments Otago MBIE bid below).

2. Catchments Otago MBIE bid

Catchments Otago has submitted a bid to the Ministry of Business, Innovation and Employment (MBIE) Endeavour fund titled '*Sustaining the Southern Great Lakes: integrating research & management for sustainable ecosystems, communities and economies*'. This proposal is being led by University of Otago in collaboration with various stakeholders (including Regional Councils) and other research organisations. The focus of this bid is to gather much needed scientific knowledge that is required to underpin informed management of the large, alpine lakes of the lower South Island, including understanding fundamental lake functioning, effects and drivers of invasive species, historical changes in these lakes as well as the development of models that will enable evaluation of various future scenarios (such as climate change and catchment development).

A substantial portion of the Catchments Otago proposal aligns directly with the research priorities outlined during the workshop and would be the most effective way of delivering much of the priority research (specifically, components 2A(ii), 2C in Appendix A). Therefore, ORC has indicated that this proposal has its support including direct financial support and the inclusion of Dr Uytendaal as a "key individual" in the research proposal.

3. Field trials of BioFish and water quality profilers

Workshop participants identified that there were no standard measurement methods for quantifying lake snow. It was suggested that a trial be undertaken using the University of Waikato's BioFish to assess its utility in investigating the distribution and abundance of lake snow in the water column and its ability to differentiate lake snow from other components of the phytoplankton community.

Field trials of the University of Waikato's BioFish and Sea-Bird water quality profilers (Figure 1 and Figure 2) were completed on 25 and 26 February 2017. Although data collected during the trial has not been analysed in detail, the initial thoughts of experts involved with the survey (Professor David Hamilton (University of Waikato), Dr Marc Schallenberg (University of Otago), Dr Adam Uytendaal (ORC)) is that the BioFish instrument is likely to have limited use in measuring the presence of lake snow directly. This is based on real-time observations of data collected by the BioFish coupled with measurements of lake snow presence/absence during the trial. Despite this, the field trial collected a large amount of extremely valuable information on water quality and lake stratification dynamics that will improve our understanding of lake processes. Therefore, no further BioFish trials are anticipated at this stage.



Figure 1 BioFish tow and communication cable. The BioFish is towed at varying speeds approximately 90 meters behind the boat and ‘swims’ up and down through the water as determined by the controller standing in the boat. Lake Wanaka, 26 February 2017.

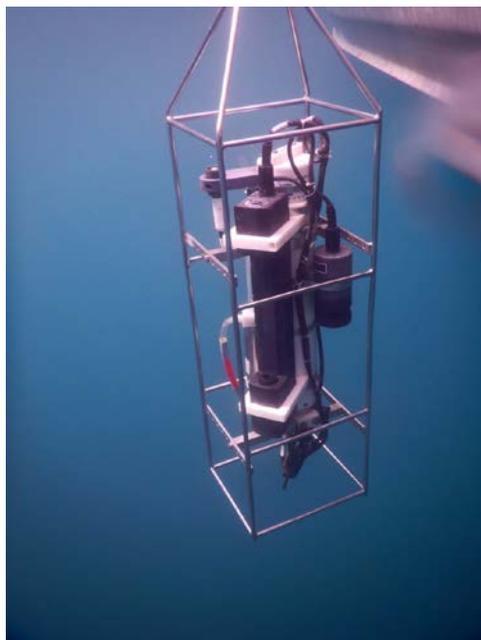


Figure 2 University of Waikato’s Sea-Bird deep-water profiler being deployed in Lake Wanaka, 25 February 2017. The profiler was deployed to the lakes maximum depth of 330 metres.

4. Work to date

To date ORC has spent or committed \$112,000 of internal and external costs to the investigation and management of the effects of lake snow.

As previously advised to committee, ORC has commissioned Dr Phil Novis (Landcare Research) to undertake genetic analysis to determine whether the species is a recent introduction from overseas, and if so, to attempt to locate the source of that introduction. Genetic profiles of samples from three NZ lakes (Coleridge, Wanaka and Wakatipu) will be examined and compared with samples coming from overseas. The

technical aspects of this work are progressing well and the main challenge has been in obtaining samples from overseas, which has proved difficult up to now, in part due to the northern hemisphere just coming out of winter (meaning many lakes have been frozen).

Monitoring of the trophic state of Lakes Hawea, Wanaka, Wakatipu and Hayes started in September 2016. This monitoring is undertaken every month. To date 6 separate runs have been completed with the 7th programmed for the 16th and 17th of March. During each run, data collected includes depth profiles of dissolved oxygen, pH, temperature and chl_a fluorescence (estimate of algal biomass); water clarity measurements using a secchi disk; samples for phytoplankton and zooplankton counts; 'lake snow' tows using a downrigger; and water samples for laboratory analysis of nutrients (including carbon), suspended solids and chlorophyll *a*.

A briefing on lake snow, lake water quality and monitoring undertaken by ORC for hoteliers was held in Queenstown on 28 November 2016 and community meetings were held in Wanaka and Queenstown on 14 December 2016. The meeting with hoteliers and the community meeting in Wanaka were well attended. Staff also attended a meeting organised by the Wanaka Branch of the Royal Society of New Zealand on 24 February, and ORC had a representative on a panel of organisations that have management responsibilities for Lake Wanaka. It is estimated that more than 200 people attended that meeting.

5. Programme of further research for 2017/18

Of the priority work streams identified by workshop participants, ORC staff have identified components 1 ii); 1 iii); 2A i); 2B i); and 5 as being of highest priority for direct funding by ORC. The estimated total external cost of these work streams is of the order of \$90,000, with ORC staff time costs estimated to be \$30,000.

Progressing these components would provide:

- 1) A comprehensive understanding of whether *L. intermedia* is native to New Zealand and its history in Otago waterways. This work will complement the genetics work being undertaken by Landcare Research. This provides important context to the problem and will affect the direction of other workstreams;
- 2) Literature reviews focussing on the shift of phytoplankton community structure to increased dominance by centric diatoms (such as *L. intermedia*) internationally and on over-production of polysaccharides by diatoms. These reviews will provide a solid understanding of existing knowledge and will form the foundation for any future work to investigate the drivers of dominance by *L. intermedia* and over-production of TEPs;
- 3) Support for the public to monitor and report on lake snow dynamics from around the region. Information gathered from the public will help guide any future investigations.

It is recommended that the work outlined above is undertaken in the 2017/18 financial year. Consideration of the further work outlined in Appendix A is dependent on the outcome of the MBIE bid, which should be known by late 2017.

The MBIE bid highlights that the issue is relevant to all of the Southern alpine lakes. Consideration should be given to establishing a governance group comprising elected members of the three regional councils (Canterbury, Otago, Southland) to coordinate the management response and engagement with central government on this issue.

6. Recommendations:

- 1) That the outcomes of the expert workshop convened by ORC in December 2016 are noted.
- 2) That inclusion of the programme of further research described in this report in the Draft 2017/18 Annual Plan is endorsed.

Dr Gavin Palmer
Director of Engineering, Hazards and Science

Attachment:

- Ryder Consulting Ltd Report: Lake Snow Technical Workshop, 20 December 2016, Report on Workshop Discussion and Outcomes.