SESSION 3 : THE LAKE WEED MENANCE

SESSION CHAIR – Mayor Steve Chadwick

LAKE WEED AND THE ROTORUA TE ARAWA LAKES THEN AND NOW

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Tracey is a scientist in NIWA's Freshwater and Estuaries Centre with more than 15 years' experience in submerged vegetation management, with a focus on the use of aquatic plants as indicators of lake ecological condition. She has carried out biannual surveys of the submerged vegetation in the Rotorua Te Arawa lakes since 2002. Her current research looks at proactive management strategies for the prevention and spread of freshwater invasive species.

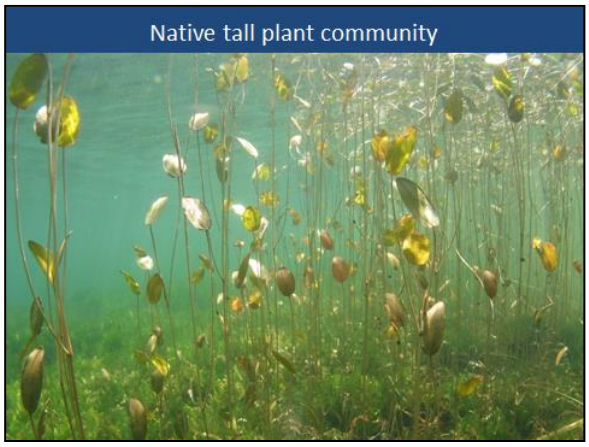
TRANSCRIPT

Kia ora katoa kotou. This afternoon we will be looking beneath the surface of the Rotorua Te Arawa lakes at the submerged aquatic plants that grow within them – the good the bad and the ugly. We will have a look at the special native aquatic plants that occur naturally in the lakes, familiarise ourselves with the weed species that have invaded them and look at how these weeds have (and are) changed the natural condition of the lakes. We will also look at how submerged plants are being used to report on the condition of our lakes and what these plant communities can tell us about the state of the lakes yesterday and today.

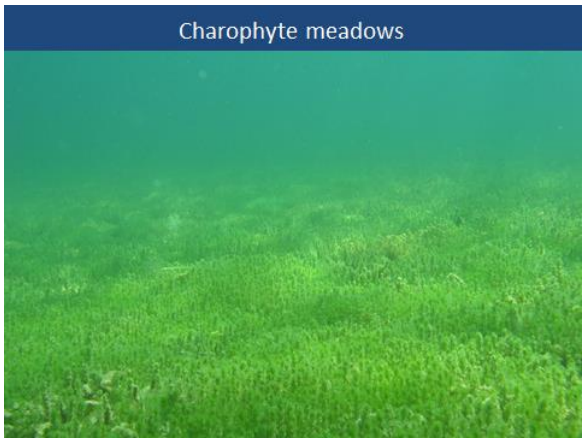
To gain a better understanding of our lakes, let's begin by going for a swim. But not just an ordinary swim, one that requires your imagination. So, grab your swimwear, don a pair of fins and a snorkel and join me for a swim in the Rotorua Te Arawa lakes prior to the arrival of any alien invasive weeds over a century ago.

Arriving on the edge of the lakes in our time machine 100 years ago, many of the lakes would have looked similar in places to what they look today – beautiful and unspoiled by land use changes. In sheltered areas, the first aquatic plants we would have seen were those in the 'emergent zone'. This zone is made up of a variety of wetland species and include our tall sedges, rushes and grasses. They tend to be tall growing and can occupy the lake margin from just above the water line and can grow down into the water to a depth of around 2 metres.

When looking for a good spot to swim however, we would want to avoid fighting our way through the emergent zone and find a more exposed site around the lake where access to the water would likely have been easier. Once on the water's edge, let's start walking into the shallows and at around ankle to knee deep we would come across our 'turf' or 'low mound community'. There are around 26 species that contribute to this community type and they all tend to be low growing, less than 10 cm, and give the appearance of a grass-like turf or attractive carpet. Many of them are morphologically similar and are often referred to as our knife, fork and spoon communities because of the differing shapes of their leaves, and Deborah Hofstra will look at this community in more detail. This turf community is also able to tolerate short-term exposures out of water so can survive changes in water level.

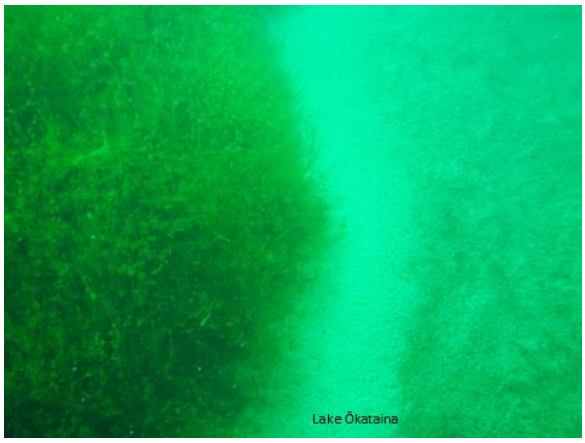


Next at around a metre depth, we will need to don our mask and snorkel and start swimming. As we continue to swim down the profile we would next likely see growing towards the surface our tall native plant community. This includes our pondweeds (*Potamogeton*) and milfoil (*Myriophyllum*) species that are most often seen growing through other native plants, like the turf or charophyte communities. The key thing to note with these taller growing native species is that they are not problematic, they have an open growth habit that allows light to penetrate through them and do not have much of an impact on the plants like the turf or charophyte species growing below. They can grow down to around 6 metres. This photo is very representative of most lakes in the area at that time.



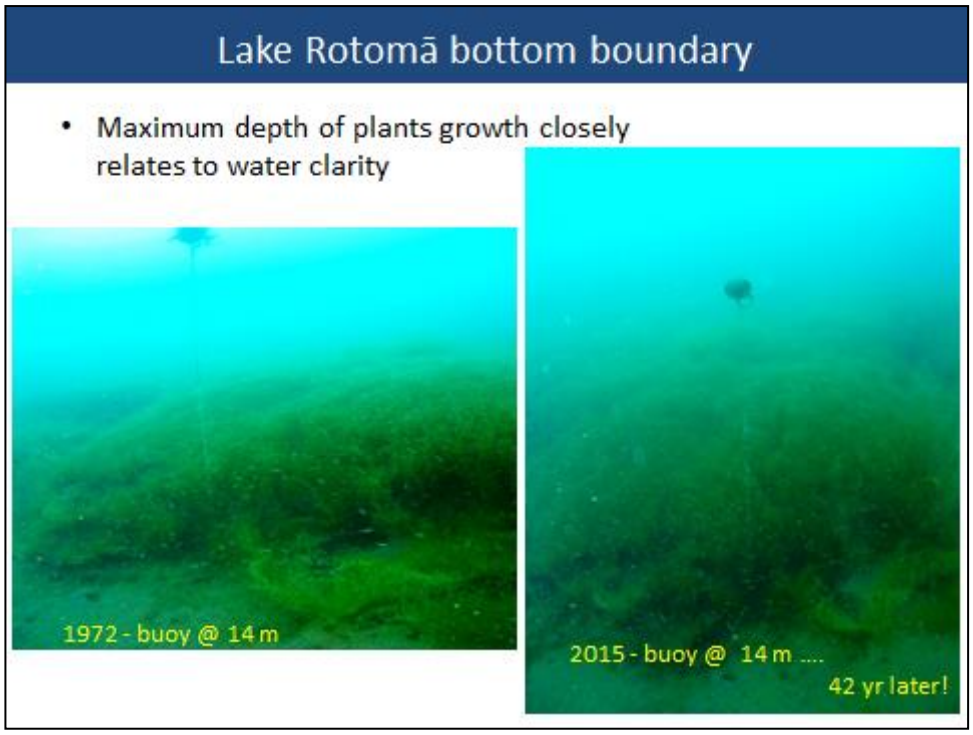
By now during our swim, we would also have seen our native charophytes. Charophytes are in fact macro-algae and are closely related to land plants. They are distinctive in that they can form beautiful bright green dense meadows, up to a metre tall down the profile. Looking down on them

from the surface, it would seem like we are floating over a grassy meadow (or mini underwater pine forest) that covers the lake bed and they play many important roles to the lake ecosystem.

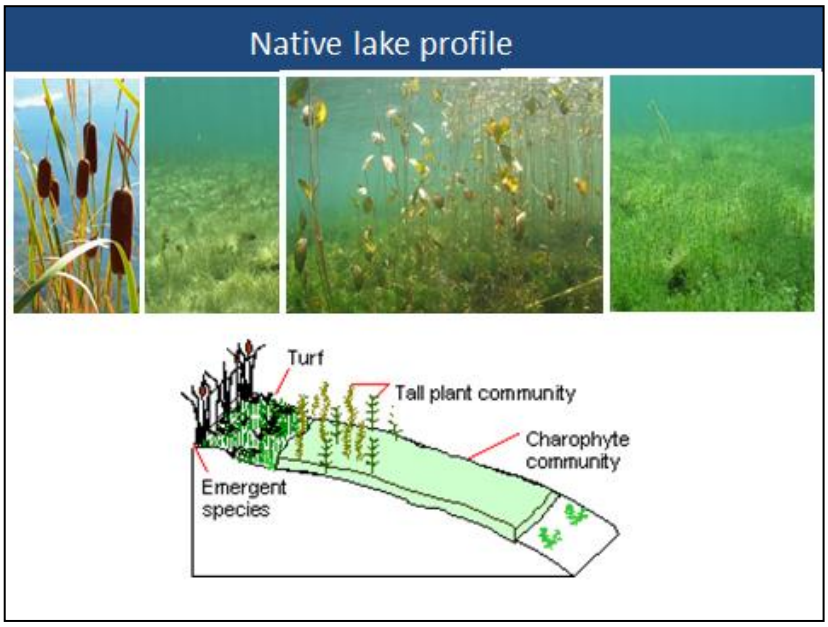


To reach the bottom depth limit of the charophytes, we would need to change our snorkels for scuba. This photo, looking down from above, shows the bottom depth limit of a charophyte bed and you can see how the meadow comes to quite an abrupt stop. The maximum depth to which plants can grow to directly reflects the water clarity, which is just how much light is still available to them. A hundred years ago many of the Rotorua Te Arawa lakes would have been expected to have had charophyte meadows extending to beyond 20 metres in depth.

The photo below shows a marker buoy that John Clayton placed at the bottom boundary of the charophytes at one site in Lake Rotoma in 1972. At that time, the bottom boundary of the plants was 14 metres, and in 2015, 42 years later, this marker was still present showing the bottom boundary of charophytes had stayed the same. This indicates just how stable the water clarity of Lake Rotoma has remained over the last half decade.



To summarise our swim, the next slide is a profile of the main components of the native communities that we just swam through. It shows the emergent zone growing around the lake margin, but only in sheltered areas, the turf community and charophytes, and the taller growing native species growing amongst these species in the middle section.

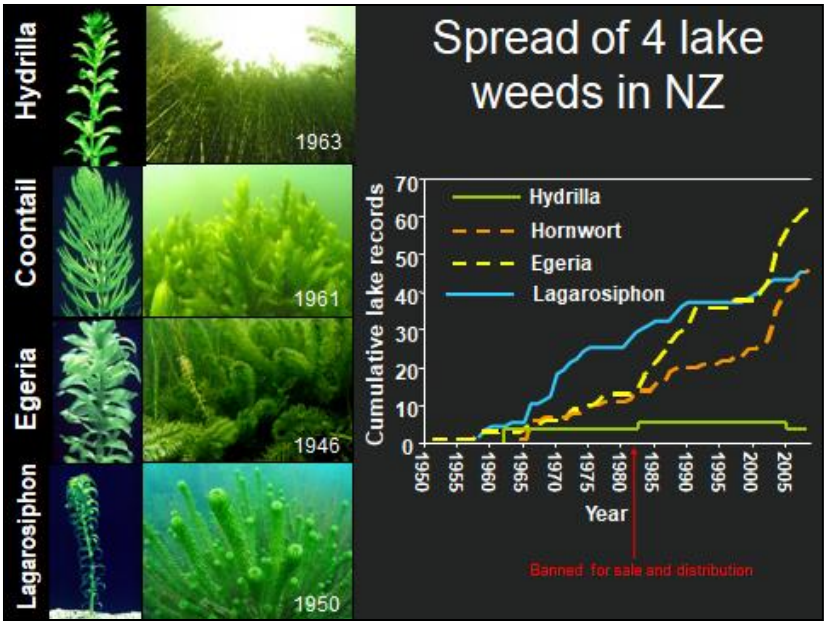


Returning now in our time machine back to the present day– unfortunately our lakes are under attack! Alien invasive weeds, species that have originated from other countries, have had spectacular success in invading the Rotorua Te Arawa lakes. Dense tall weed beds now occupy much of the littoral zone, particularly between 2 to 8 metres, and few lakes still retain all of the components of their natural native plant communities.

The Rotorua Te Arawa lakes contain four of New Zealand's worst submerged weeds shown below in order of increasing weed impact from left to right. Elodea and Lagarosiphon are both wide spread through both islands.

Egeria is known to be widely naturalised in most of the North Island and in Marlborough, with a few sites known elsewhere in the South Island. Hornwort, New Zealand's worst submerged plant species, is wide spread throughout the North Island. It has also been found in a few sites in the South Island but it has not been seen there now since 2008 so it is hoped that hornwort has now been eradicated from the South Island. Thankfully the Rotorua Lakes do not have

the final weed shown here – hydrilla. Hydrilla would have an even bigger impact on our lakes than hornwort and has only been found in four small lakes in the Hawkes Bay Region. After 50 years of active management the hydrilla in these lakes is now considered under full control and it is hoped that is on its way to being eradicated.

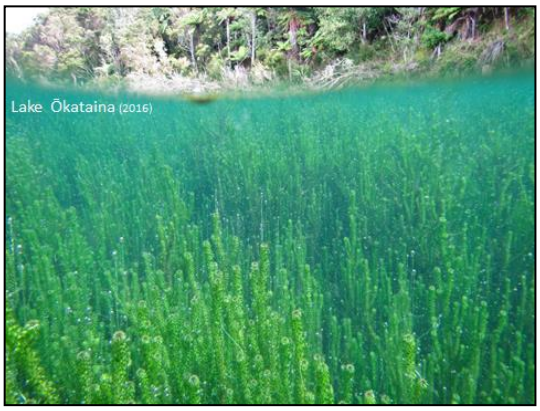


The graph emphasises the rapid spread of these lake weeds in New Zealand since the 1950's, despite these species being banned for sale and distribution since 1982. All of these weed species reproduce vegetatively which means they are spread very easily from the movement of small vegetative fragments. The key vector in the movement of weed fragments is people, either through deliberate means, from ornamental ponds, release from aquariums into other water bodies, or through accidental spread from contaminated trailers, boats and fishing nets.

Elodea was the first oxygen weed species to invade the Rotorua Te Arawa lakes. It is likely to have first established in Lake Rotorua during the 1930's, given that the Ngongotaha trout hatchery had this weed in their hatchery around this time and that the ponds were flushed annually into the Ngongotaha stream which flows into the lake. Elodea is easily recognised by the arrangement of its leaves in whorls of three and is the only oxygen weed that can now be sold and distributed in New Zealand through the aquarium trade. It is the most benign of the weeds so does not tend to grow as densely nor occupy the same range as the worst weeds.

Lagarosiphon was likely the next weed to arrive in the region. By the mid 1950's it had been found in Lake Rotorua and by 1957 it was also present in Lake Rotoiti. It is a hardy

plant that anchors to the bottom sediments with thick brittle stems and roots, and can form dense weed beds up to 5 metres tall and down to a depth of around 6 metres. It is recognisable because of its distinctive curved leaves that appear around the stem in a spiral pattern. This photo taken in Lake Okataina last year shows the extent of lagrosiphon around the margins of the lake and the impact it has had on native plant communities. At some sites it is surface reaching and extends down to the bottom limit of plant growth.



Egeria first appeared in Lake Rotorua in 1983. It is denser and leafier than the other oxygen weeds, with larger leaves usually in whorls of 4-5. It is bottom rooted and can form dense surface reaching beds up to 5 metres tall and down to 8 metres deep. It also is the only one of these oxygen weeds to have conspicuous white flowers that can be seen on the water surface during summer.

Hornwort is New Zealand's worst submerged weed species and was first noted in Lake Rotorua in 1975. It has stiff dark green leaves that are finely divided with small teeth, making the plants rough to touch.

Hornwort forms dense surface reaching weed beds and can grow down to more than 10 metres. As it has no roots these dense weed beds can be prone to drift, and on steeper profiles can continue to slump down into deeper water further smothering out native vegetation below, as has been the case in Lake Tarawera.

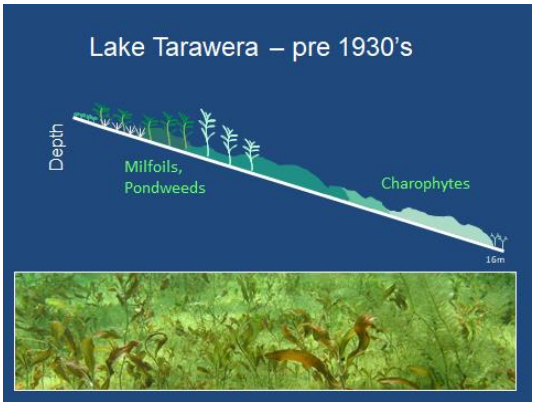
The problem with invasive species is that they have no natural enemies, such as plant-eating insects, and can spread and grow more quickly than our native aquatic plants, causing major damage to our freshwater habitats. As well as smothering out our native plants, including native seed banks, dense invasive weed beds can restrict the movement of water, cause flooding, block irrigation and drinking water intakes, destroy habits for native fish and wildlife, decrease water quality and can restrict recreational activities such as boating, fishing and swimming.

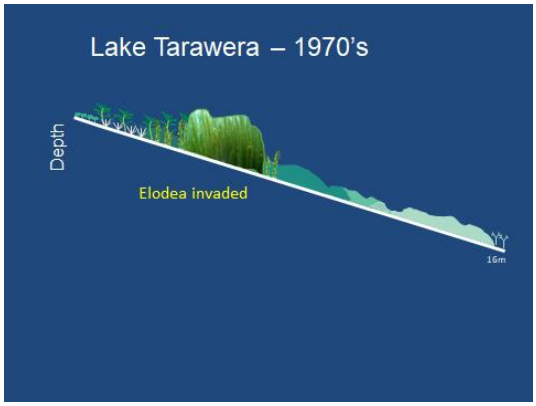
The negative effects of these weed beds are obvious when looking at them from underneath. The base of the beds are like virtual desserts consisting of highly flocculant smelly sediment. The sediments in these areas are too loose to support kōura or kākahi, and can become deoxygenated, particularly at night.

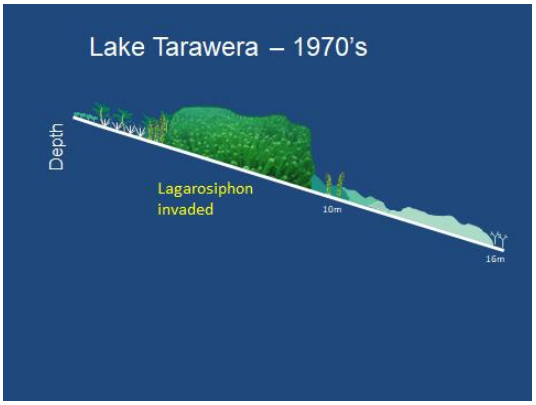
From the surface of the weed beds, the problems are even clearer. Photos show the weeds interfering with boating and swimming activities on the lake.

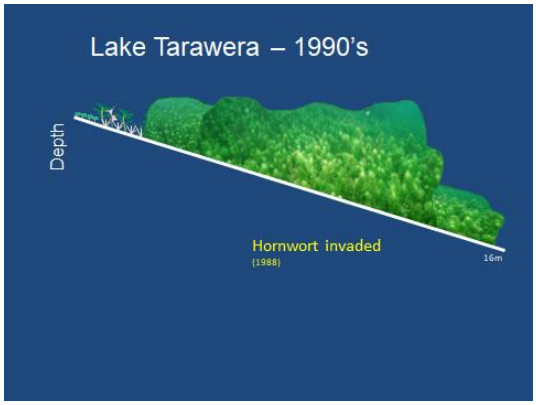
Weed rotting and smelling after being washed on shore is not something the community or tourists want to face when they head down to the lake.

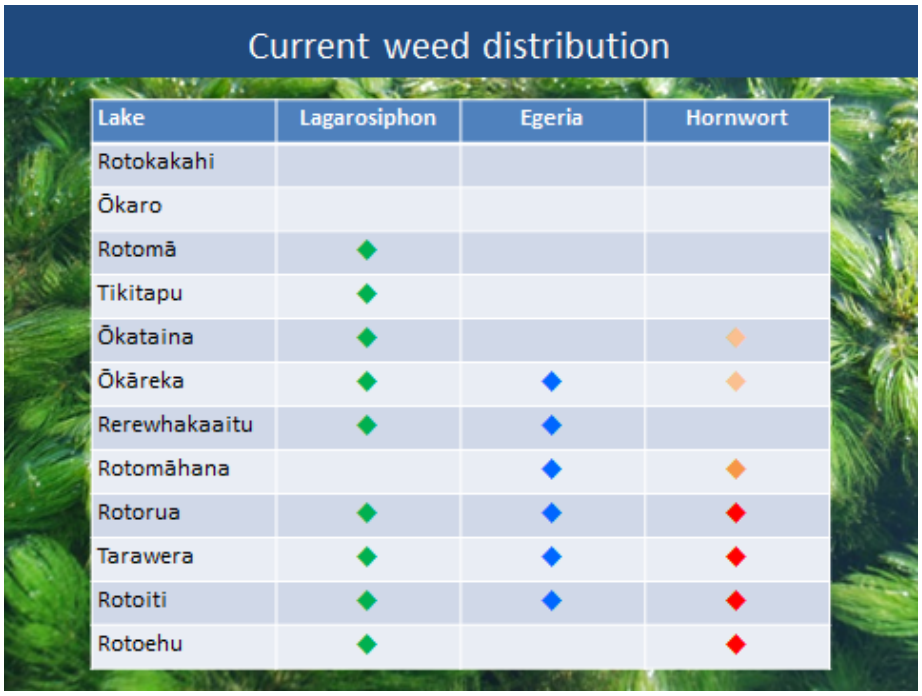
The sequence of slides below shows how weeds have changed the underwater landscape in Lake Tarawera, but these changes are representative of the changes that have occurred in other Rotorua lakes as well. In Tarawera in the 1930's, prior to any invasive weeds, the lake contained a healthy and diverse community of native submerged vegetation with charophyte meadows growing to around 16 metres in depth. In the 1970's elodea, and later lagarosiphon, invaded Lake Tarawera impacting on the middle zone of native vegetation down to around 6 metres in depth. Note that during this time native charophytes were still happily growing beyond the weed beds. Hornwort was first found in Lake Tarawera in 1988 and by the mid-1990's it had spread around most of the lake and had doubled the maximum depth of invasive plant growth smoothing out much of the native vegetation. By 2005 hornwort was responsible for the widespread displacement of almost all former deep water charophyte meadows.



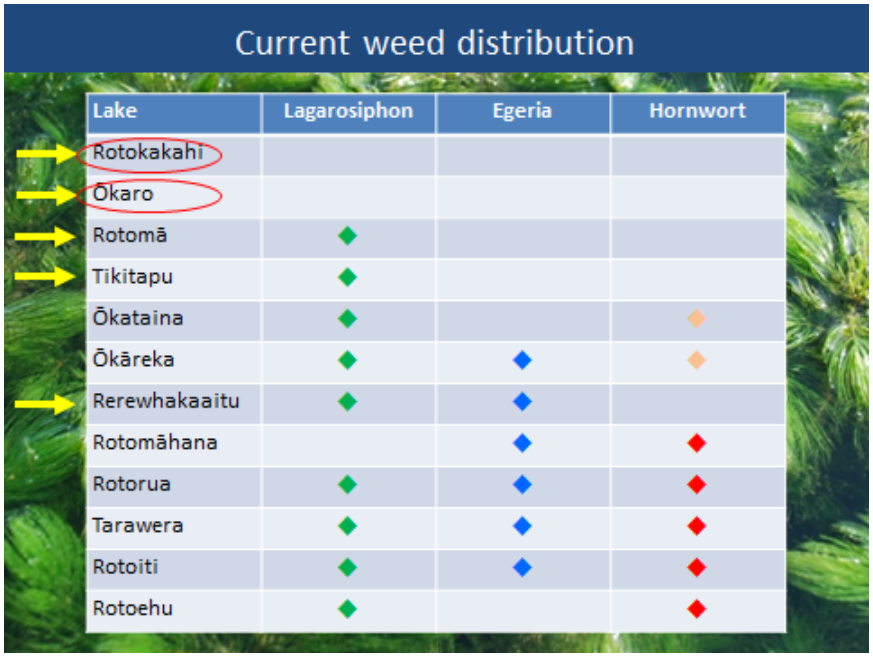








So where are these weeds now? This table shows that lagarosiphon is now present in most of the lakes with a few exceptions being lakes Rotokakahi, Ōkaro and Rotomāhana. Egeria is in six of the 12 lakes and hornwort is well established in four lakes (Rotorua, Tarawera, Rotoiti and Rotoehu). Hornwort has also been found in lakes Rotomāhana, Ōkataina and Ōkāreka where it is being managed. In Okataina hornwort is currently found at only 1 of 12 sites where hornwort was previously recorded. No hornwort has been found in Ōkāreka for several years. There are still lakes that have not had hornwort (Rotokakahi, Ōkaro, Rotomā, Tikitapu and Rerewhakaaitu).

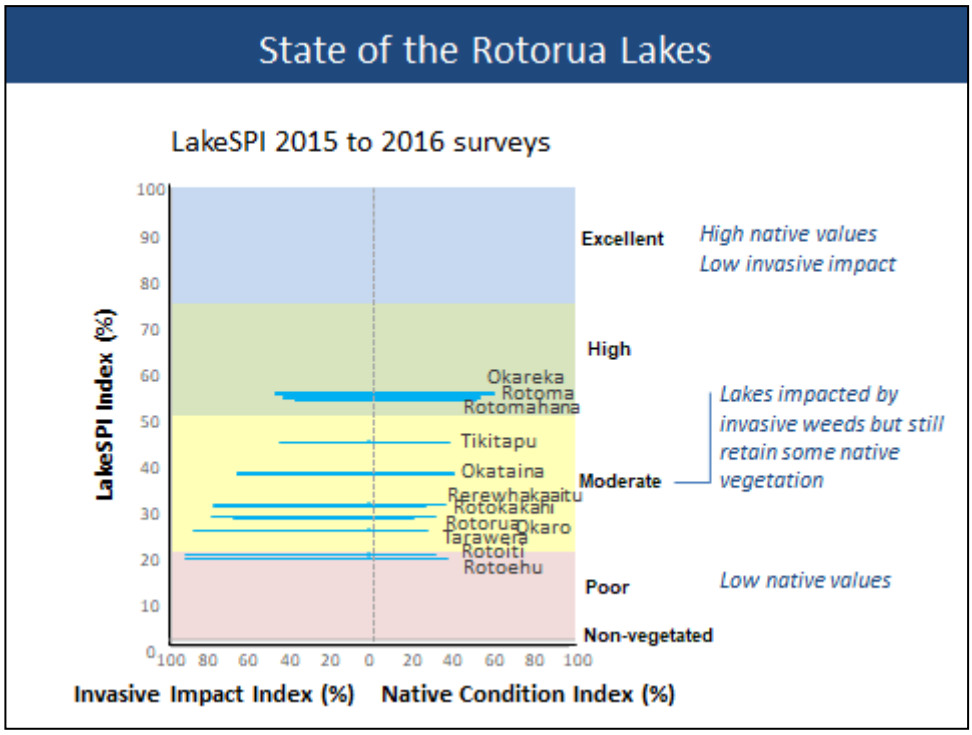


Lakes Rotokakahi and Ōkaro are the only two lakes that remain free of off the worst invasive species. Although Lake Rotokakahi is widely impacted by elodea it does not have

the worst species. This is primarily attributed to its restricted public access due to its sacred status to Te Arawa. Okaro is also free of the worst species but has a more restricted depth range on account of its water clarity.

Submerged plants are being increasingly used as bio-indicators to help assess the health of lakes. They make great indicators because they are non-mobile, cannot swim away, and are easy to see and identify because of their size. Because they are in the lake system all year round they can reflect environmental condition over an extended period of time, and also bring a focus to the littoral zone where greatest public interact occurs.

In the Rotorua Te Arawa lakes we have been using LakeSPI, or Lake Submerged Plant Indicators, to assess each of the lakes biannually since 2005. It provides three indices or scores that allow lake managers to assess and report on the status of their lakes and to monitor changes occurring within them over time. Because the LakeSPI method can be applied to historical data, which dates back for the Rotorua lakes to at least the late 1970's, we now have a really good picture of how the lakes have changed over the time. LakeSPI report cards for each of the Rotorua Te Arawa lakes are available at www.lakespi.niwa.co.nz.



For the purpose of ranking and discussing LakeSPI results, lakes are categorised into five main categories indicating overall lake condition: excellent, high, moderate, poor and non-vegetated. The LakeSPI indices for the lakes ranged widely from 19% to 55%. While most lakes would have once been categorised in excellent and high condition, representing those lakes with high native values and low invasive impact, only Lakes Rotomāhana, Rotomā and Ōkāreka fall into this group. Most of the lakes fall into the moderate group of lakes that are representative of those lakes that are impacted in varying degrees by invasive weeds but still retain some native vegetation. Lakes Rotoiti and Rotoehu however fall into the poor category reflecting the extent of invasion and dominance of hornwort in these two lakes.

It is not all bad however. While many of the lakes are showing a decreasing trend in lake condition, others are showing signs of improvement due to management initiatives being carried out on the lakes.

I would like to finish by thanking my colleagues at NIWA who will also be presenting this afternoon. Thank you also to the Bay of Plenty Regional Council who funds the survey work on these lakes.

Thank you.