Aquatic Pest Report 2017

Bay of Plenty Regional Council
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5 Quay Street
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NEW ZEALAND

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Cover Photo: Boat Shed Bay, Lake Tarawera
Photographer: Melissa van den Heuvel

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Executive Summary

The Bay of Plenty region is home to many of New Zealand's most well-known lakes and rivers. They attract a significant number of visitors each year and the lakes health and wellbeing are vital to the success of the region's economy and are therefore worth protecting. The number, popularity and close proximity of the lakes to each other and Waikato waterways make them extremely susceptible to invasive species.

Four invasive weed species elodea, egeria, lagarosiphon and hornwort have been identified as the main invasive species that have established within the Rotorua lakes. These weeds contribute to water degradation and have an adverse effect to human recreational activities. Equipment associated with recreational activities has been identified as one of the principle means through which weed fragment spread throughout water bodies. Eggs from pest fish species such as koi carp and catfish are of concern as they can 'hitchhike' on weed fragments as well as the invasive freshwater algae didymo. Though didymo is not currently present in the North Island, it was first discovered in South Island river catchments in 2004 and has now spread to over 150 rivers throughout the South Island.

The aim of the Aquatic Pest Awareness Programme is to identify levels of public awareness whilst simultaneously educating users about the threats posed by invasive weeds, fish and algae species. Ultimately the programme educates user as to how they can prevent the spread of pest species. The awareness programme was conducted by surveys taken at boat ramps around a number of lakes and popular river sports throughout the Rotorua region. During these surveys a promotional pack including 'Check, Clean, Dry' merchandise and educational material was offered to users for free. Awareness and decontamination stations were established at events and educational material was distributed to a number of retail and tourism outlets. A portable decontamination boat wash station was set up for 15 Days over the summer period and a total of 203 users used this facility.

A total of 683 surveys were conducted over the 2016/2017 summer period. Of those users surveyed, it was found that 74% had checked/cleaned their vessels between waterways. In addition to this, it was found that 78% of all users surveyed were aware of the requirement to clean between waterways and were aware of the correct procedure to complete this. Three users were identified to have weed fragments attached to either their vessels, trailers or equipment. In addition to this, the boat wash identified a further four vessels with weed fragments attached.

The majority of users were identified to have come from the Rotorua region (47%) followed by the Tauranga region (23.5%). The majority of users were using vessel with an outboard motor (80%) and the majority of all users took part in water sport activities. Sixty percent of all river users surveyed were using kayaking equipment for their chosen activity.

Due to consistent surveying methods being used over the last five years, data is comparable when analysing aquatic pest awareness. It was found that 26% of lakes users surveyed, were identified to have a high level of aquatic pest awareness whilst 11% were found to have no awareness at all. One hundred percent of river users surveyed this year were identified to have a high level of didymo awareness, which was a 23% increase from the previous year.

Contents

Part 1: Introduction

1.1 Background on Bay of Plenty fresh waterways

The Bay of Plenty region is home to many of New Zealand's most well-known lakes and rivers. Contained within the Rotorua lakes region are 16 lakes of varying sizes and depths. The high level of volcanic activity over the past hundreds of thousands of years has created the collection of lakes seen today (Rotorua NZ, 2016). Whilst these lakes are in close proximity to each other, many have no surface outlets and as a result, it is thought that the lakes within the district are interconnected via groundwater and subsurface flows (Collier & Grainger, 2015).

The Rotorua lakes area is considered by the people of Te Arawa and New Zealand as taonga and is treasured as a natural asset of beauty (Bay of Plenty Regional Council, 2017). The protection and restoration of the Rotorua lakes is a high priority for locals due to the large source of economic, recreational and cultural benefit, to not only the region, but also to the country. However, the number, popularity and close proximity of the lakes within the region makes them extremely susceptible to invasion of invasive pest species such as hornwort (see Part 2). One of the biggest mediums in which pests spread throughout freshwater ecosystems is through human activity such as fishing, water tourism and recreational activities (Department of Conservation, 2014).

In addition to the lakes, there are a number of rivers in the Bay of Plenty region which are known worldwide for their Class 5 white water. These rivers attract white water rafting businesses and white-water kayakers to the region. The recreational and tourism values of the region's rivers are of high importance to the BOPRC
(New Zealand Tourism Guide, 2017).

The Bay of Plenty region is within a three hour drive of New Zealand's largest city, Auckland, and is home to an international airport. Rotorua district's tourism for 2016, including both domestic and international tourists, contributed $765m dollars to the economy (Ministry of Business and Employment, 2016). Rivers and lakes throughout the region contribute greatly to this tourism output. Therefore, lakes and rivers are a vital asset to the region's growth and development.

Figure 1 Lake Rotoma, Photo Credit: Melissa van den Heuvel

1.2 Invasive Weed Species

Freshwater lakes, rivers and streams throughout the Bay of Plenty region are extremely vulnerable to non-native pests and algae. These pests have the ability to out-compete native flora and fauna whilst altering fragile eco-systems within New Zealand (Kelly & Hawes , 2005). Accidental transferal of pest weeds and algae have the ability to form large beds and platforms that can potentially smother native plant and fish habitats, whilst diminishing the aesthetic and recreational values of freshwater systems (Compton, De Winton, Leathwick, & Wadhawa , 2012).

Invasive non-native weed species are one of the biggest drivers of biodiversity loss throughout freshwater systems (Anderson, Dunn, & Stebbing, 2014). Hornwort (*Ceratophyllum demersum),* Canadian pondweed (*Elodea Canadensis),* lagarosiphon *(Lagarosiphon major)* and egeria *(Egeria densa)* are four invasive pest weed species that threaten lakes within the Rotorua Region (Clayton, 1996). The Rotorua lakes Region consists of 16 lakes; it is of importance to note that when all four species are grouped together, they are present throughout the region. However, individual lakes contain different combinations of each species (De Winton, Champion, Clayton, & Wells , 2009). The dispersion of weed species throughout the region signifies the importance of ensuring weeds are not transferred from one lake to another. See Appendix 1.

Invasive weed species possess characteristics that enable them to spread rapidly and thrive within New Zealand's aquatic environments. As a result of the lack of naturally limiting factors such as grazers and predators, invasive weeds species have not evolved alongside native fish and invertebrates (Francis, 2012). Invasive weed species often asexually reproduce via the means of fragmentation, which allows for the fast distribution throughout waterways. In addition to the rapid reproduction, invasive weed species can grow in thick blankets altering habitats for native species (Bickel & Closs, 2008) whilst smothering native aquatic plants (Kovalenko & Dibble, 2014). The thick mats of invasive weed species can clog the intakes on jet boats and inhibit recreational activities (Department of Conservation, 2015). In many cases, only one sex of the invasive weed species has been introduced resulting in constraint by a lack of natural dispersal methods, therefore, the aquatic weeds are highly reliant on the dispersion via human activities, both accidental or deliberate.

The Aquatic Weed Risk Assessment Model (AWRAM), shown in Table 1, is a useful tool that compares the success of one aquatic pest species with another (Champion P. D., Clayton, Petroescheysky, & Newfield, 2010). This model attributes the ecology, biology, weediness and management of each of the four weeds species listed above and are assessed based on their behaviour in new habitats. Each trait is ranked on a scale of 0-100 and then combined to give a total score.

Table 1 The Aquatic Weed Risk Assessment Model

Common Name	Scientific Name	AWRAM Score
Hornwort	*Ceratophyllum demersum*	67
Egeria	*Egeria densa*	64
Lagarosiphon	*Lagarosiphon major*	60
Canadian pondweed	*Elodea canadensis*	46

The Bay of Plenty Pest Management Plan outlines the statutory management of these four species. The objective of the pest plan as outlined in Section 5 (Contaminated pest plants) of the plan, is to reduce the distribution and the densities of known populations. Target species include egeria, hornwort and lagarosiphon (Section D (4)). To meet the contaminant objective, rules and methods are included in the plan. Most notably, landowners and occupiers are responsible for these three plants in specified areas (See Figure 3 within the Pest Management Plan). In addition, the summer awareness program promotes Rule 6 of section D that; "*no person shall move, or allow to be moved, any machinery, vessel, organism, risk goods, or other goods that are contaminated with any containment pest plant, and that any persons seen to be moving these goods be subjected to prosecution"* (Bay of Plenty Regional Council, 2011).

Although the aquatic pest awareness summer students do not have enforcement authority, if person(s) are seen to be offending in accordance with Rule 6, students will record the number plates of the offending vehicles and provide this information along with any other relevant details to a Land Management/Biosecurity Officer with the correct authority (Bay of Plenty Regional Council, 2011).

1.2.1 **Hornwort**

Ceratophyllum demersum hereby referred to as hornwort, is a submerged fresh water macrophyte which can occupy both shallow and deep littoral habitats (Pelechaty, Pronin, & Pukacz, 2014). Unlike many other macrophytes, hornwort has the ability to inhabit low light environments and can dominate in eutrophic and turbid habitats (Pelechaty, Pronin, & Pukacz, 2014) (Keskinkan, Goksu, & Forster, 2004). Hornwort was first found in the Bay of Plenty in Lake Rotorua in 1975 (Burton & Clayton, 2015) and has since established in Lakes Rotoiti, Tarawera, Rotomahana, and more recently Ōkataina and Ōkāreka. It must be noted that Lake Ōkataina and Lake Ōkāreka are both under active control for hornwort. Lake Ōkataina has a cordon across the arm of the lake in which hornwort is present. This cordon works to contain the weed from spreading to other areas in the lake. Lake Ōkāreka has an eradication program which has presented a positive result as of August 2015.

Hornwort can be identified by its filiform leaves in whorls of (6-)8-10(12), dichotomously branched with minute teeth which make the plant feel rough to the touch (Wilmot-Dear, 1985). Hornwort lacks a root structure (Les, 1991) but has modified leaf structures that anchor the plant in lake sediment (Keskinkan, Goksu, & Forster, 2004). In clear lakes, hornwort can be found in depths of up to 16 m and has dense beds which can reach up to 10 m in height resulting in the inhibition of light penetration to native species (Wells, De Winton, & Clayton, 1997) (Champion, Clayton, & Rowe, 2002).

Hornwort has become well established throughout the North Island and has been eradicated from the South Island of New Zealand. The widespread establishment of hornwort throughout the North Island has caused detrimental effects on the environment and recreational values within freshwater systems (Champion, Clayton, & Rowe, 2002) (Wells, De Winton, & Clayton, 1997). Hornwort has cost the hydro-electric power industry millions of dollars, due to the requirement of regular maintenance needed to keep hornwort from blocking hydro systems (Coffey & Clayton, 1988).

Hornwort is considered a highly invasive weed species, due to the rate and ease in which it can form a new plant via vegetative fragmentation (Les, 1991) (Champion, Clayton, & Rowe, 2002). These fragments are regularly snapped and dislodged as a result of wave action, currents, and boats (Coffey & Clayton, 1988). As a result, hornwort is easily transported around the lakes via human activity and can thrive in water of varying clarity, temperature, light, and nutrient levels (Coffey & Clayton, 1988).

Hornwort is a very high risk aquatic weed species according to the AWRAM scale. As a result, hornwort is an unwanted organism under the Biosecurity Act 1993 and is banned from sale, propagation and distribution under the National Plant Pest Accord (Ministry for Primary Industries, 2016). The vulnerability of the Rotorua lakes and the capability of hornwort to thrive in a number of varying habitats possess a risk to aquatic biosecurity.

Figure 2 Hornwort, Photo credit Xia Stevens

1.2.2 **Lagarosiphon**

Lagarosiphon or commonly known as curly oxygen weed originated from South Africa. It was first introduced in the 1950s as an ornamental pond plant and has since widely naturalised in the waterways of New Zealand (Martin & Coetzee, 2014) (Coffey & Clayton, 1988). The Rotorua lakes are dominated by lagarosiphon, as it is a generalist species that has effective means of dispersal (Bickel & Closs, 2008). It is present in all Rotorua lakes except for Lakes Rotomahana, Ōkaro and Rotokakahi (Department of Conservation, 2015).

Lagarosiphon is a submerged freshwater perennial that is characterised by its alternating leaves that curve downwards; they are between 6-20 mm long (Champion & Rowe, 2012). Lagarosiphon is dioecious (sexes on different plants), and currently only female plants are present in New Zealand. Dispersal of lagarosiphon is therefore facilitated by fragmentation which occurs during human activities and through disturbances to water bodies during storms events (Champion & Rowe, 2012).

This invasive oxygen weed prospers in clear, shallow water of depths up to 6.5 m and may only grow up to 1 m in murky water. It prefers cooler waters in the temperate zone with optimum temperature of 20-23°C and a maximum temperature of 25°C. Lagarosiphon survives in both high and low nutrient levels and grows best under high light intensity with a moderately fast to slow flowing water (Invasive Species Specialist Group, 2006).

Lagarosiphon blocks intakes of hydro-electric systems, thus causing economic burdens (Bickel & Closs, 2008). Lagarosiphon can form dense floating mats in deep water reservoirs which can block light penetration, eliminating growth of native plants and smothering benthic invertebrate populations (Csurhes & Edwards, 1998). If dense mats are present, oxygen depletion can occur at night which can have detrimental effects on invertebrates and fish (Bickel & Closs, 2008). Once the establishment of lagarosiphon is widespread, controlling the growth is extremely difficult. Lagarosiphon is a large threat to the native biodiversity of the Rotorua region due to its ability to outcompete and replace native macrophyte species (Bickel & Closs, 2008) (Csurhes & Edwards, 1998).

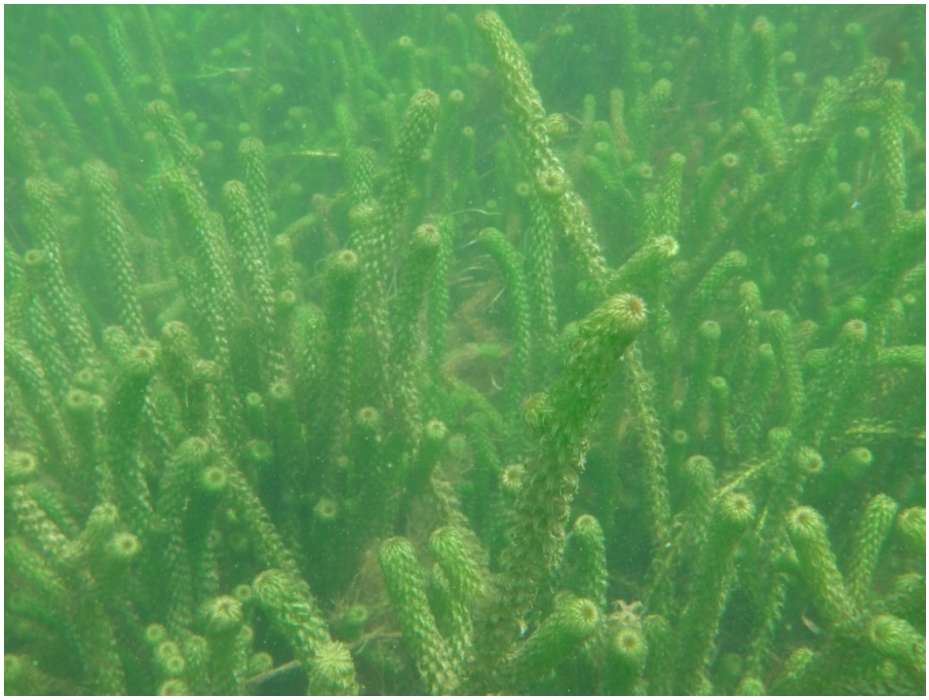

Figure 1 Lagarosiphon in Lake Tarawera, Photo Credit: Gordon Tieman

1.2.3 **Egeria**

Egeria is a submerged freshwater perennial herb that is native to South America and was introduced to the New Zealand waterways via the aquarium trade (De Winton, Champion, Clayton, & Wells , 2009). Egeria was first found in Lake Rotorua in 1977 and has since established in Lakes Rotoiti, Ōkāreka, Tarawera, Rotomahana and Rerewhakaaitu (Wells & Clayton, 1991). Egeria forms dense mono-specific strands that restrict water movement in streams whilst trapping sediment and causing fluctuations in water quality (Champion, Clayton, & Rowe, 2002). Egeria is difficult to manage and its dense growth creates anoxic conditions that smother benthic communities and restricts light penetration to surrounding native plants (Ribaudo, Bertrin, & Dutartre, 2014). Similar to hornwort, egeria is a weed that has a major impact on hydroelectric dams. As well as that, egeria can also impede irrigation flows and drainage within a catchment due to its growth habits (Chapman, 1970).

The leaves and stems of egeria generally have a bright green appearance with short internodes. This gives the plant a leafy appearance and the stems can grow up to 5 m in length (Ministry for Primary Industries, 2016). The individual leaves are minutely serrated, linear, and arranged in whorls of four to eight (Invasive Species Specialist Group, 2006). Currently, there have only been male egeria plants observed in New Zealand. This has resulted in the reproduction and spread of the weed to be entirely by vegetative methods. The fragile character of egeria makes it relatively easy to break and spread throughout water bodies (Haramoto & Ikusima, 1988). Egeria is a generalist species that has a very effective means of dispersion. It is of high importance that mitigation methods are set in place to limit the accidental dispersal of egeria through the remaining Rotorua lakes.

1.2.4 Elodea

Elodea canadensis or Canadian pondweed was the first invasive weed species introduced into New Zealand in 1868 (Champion, Clayton, & Rowe, 2002). Elodea was presumably brought to New Zealand with the intention of oxygenating waterways to support future introduced species of non-native fish (Champion, Clayton, & Rowe, 2002).
Lake Rotomahana is the only lake within the Rotorua region where elodea is not present.

Elodea is a submerged bottom rooted aquatic plant that is native to North America. Elodea has the ability to grow and multiply rapidly in a diverse range of environments and conditions (Min, et al., 2013). Elodea forms thick mats over substrate and often reaches heights of up to 6 m (Popay, Champion, & James, 2010) (Champion, Clayton, & Rowe, 2002). Large growths of elodea can have significant economic and ecological effects within an environment (Zehnsdorf, Hussner, Eismann, Rönicke, & Melzer, 2015). Ecologically it is a major threat to waterways as it can modify the habitat and out-compete other plant species for light and space (Champion, Clayton, & Rowe, 2002). As with hornwort and egeria, elodea can have a significant economic effect through the blockage of hydro dams and hamper boat traffic and recreational activities (Zehnsdorf, Hussner, Eismann, Rönicke, & Melzer, 2015).

Elodea has a similar appearance to other oxygen weeds such as lagarosiphon and egeria. However, elodea can be identified by its three leaves which are arranged in whorls around the stem. Elodea canadensis also has flowers which are carried to the surface by long slender stalks for pollination via wind and water (Hulme, Nentwig, Pysek , & Vila , 2010).

Reproduction and dispersion of elodea are primarily completed by vegetative fragmentation of stems that float away and root before forming a new plant (Hulme, Nentwig, Pysek , & Vila , 2010). Fragments of this particular species have high survival rates which allow it to be dispersed over long distance (Barrat-Segretain, Elger, Sagnes, & Puijalen, 2002). Alike the other main aquatic weeds, human recreational activities are believed to be the main dispersal methods for moving fragments of elodea around and assisting in the spread of the invasive weed (Barrat-Segretain, 2004).

1.3 Pest fish

The Rotorua lakes region is relatively free of invasive pest fish species. Introduced pest fish species pose as a serious threat to the water quality of the lakes in the region. Pest fish prey and compete with native aquatic species and game fish and in addition, certain species stir sediment while feeding, which starves visual feeders and degrades water clarity (Dykzel, 2001) (Champion, Clayton, & Rowe, 2002).

Currently, a small number of pest fish are present in the Rotorua lakes region; these include gambusia (*Gambusia affinis*), catfish (*Ameiurus nebulosus*) and the common goldfish (*Carassius auratus*).

The arrival of *Gambusia affinis*, hereby referred to as Gambusia, is poorly documented. They are suspected to have been introduced in the 1930s for mosquito controls due to their predation on mosquito larvae, hence the common name mosquito fish (Turoa, 2009). They are now widely spread throughout the Rotorua lakes region and furthermore New Zealand. Gambusia are a highly aggressive fish species which attacks numerous native fish species and prey on native fish eggs whilst competing with native aquatic species. They are considered an unwanted organism under the Biosecurity act 1993 (Dykzel, 2001).

The common goldfish (*Carassius auratus*) are suspected to be introduced into the Rotorua lakes region as part of the naturalisation of New Zealand (Thomson, 1922). They are now common throughout the Rotorua lakes region and compete with native aquatic species (Champion, Clayton, & Rowe, 2002).

In March 2016, a population of brown bullhead catfish was discovered in Lake Rotoiti. Currently, over 300 have been captured by the BOPRC. The population is suspected to be mostly confined to Te Weta Bay, however, further fyke netting has captured catfish in the Okere Arm in smaller abundance (Grayling , 2016). Brown Bullhead catfish can significantly impact water quality, and has the ability to degrade habitats for native flora and fauna. Pest confinement and eradication methods are currently being investigated by the BOPRC (Grayling , 2016).

Abundant populations of other pest species are widespread in adjoining regions and pose as major threats to the Rotorua lakes region if introduced. Koi carp *(Cyprinus carpio)* are found in large numbers in rivers, lakes and streams in the Waikato region (Dean, 2001). As with catfish, koi carp can significantly impact on water quality, and has the ability to degrade habitats for native flora and fauna (Champion, Clayton, & Rowe, 2002). Fertile eggs of invasive pest species can attach to aquatic weeds and equipment used through human activity around waterways. This can inadvertently spread pest fish from invaded waterways to uninvaded waterways. The ease of pest fish dispersion highlights the importance of cleaning, checking, and drying all equipment when moving between waterways (Clements, 2006).

1.3.1 **Koi Carp**

Koi carp (*Cyprinus carpio*) are an invasive pest fish species in New Zealand. Koi carp are an ornamental variety of the East Asian common carp which originated from Asia, before being introduced to Europe as a food source (Clements, 2006) (Viswam, 2010). Due to the heartiness of the koi carp, they are suitable for aquaculture and are the third most common introduced fish in the world. Koi carp are thought to have been introduced accidently to New Zealand in the 1960s as part of the goldfish consignment. Koi carp were first noticed in the Waikato region in 1983, where a breeding population had already been well established. The release of koi carp into the wild from private ponds and flooding began the spread of carp to other regions in New Zealand such as Auckland and Waikato (Viswam, 2010).

Koi carp can grow up to 120 cm and weigh up to 60 kg (Allen, 2005). In New Zealand they have not been recorded to reach such sizes and are more commonly found to grow up to 70 cm. Koi carp are often mistaken for goldfish as they have a striking resemblance to them, however, unlike goldfish, koi carp have two barbels at each corner of the mouth. The colour of carp varies greatly; in the wild, they are usually olive green to bronze or silvery in colour with a pale yellow underside. The ornamental strain are brightly coloured with orange yellow and white markings; if this strain escapes in to the wild, koi carp will soon revert to the wild colouring. Koi carp and goldfish can interbred; first generation hybrids have drab coloration and one pair of barbels but subsequent generations of hybrids maybe highly variable (Viswam, 2010).

Koi carp feed by sucking up bottom sediments and blowing out what is not wanted. In doing so they stir up sediments and leave the water murky. During this process, aquatic plants are dislodged and are unlikely to re-establish causing habitat and food loss for native fish, waterfowl and invertebrates (Bellrichard, 1996) (Laird & Page, 1996). Koi carp pose a serious risk to the Rotorua lakes district and there is a prohibition on the movement and sale of live koi carp (Champion, Clayton, & Rowe, 2002).

Figure 2 Koi carp showing distinctive barbels

1.3.2 Catfish

The brown bullhead catfish (*Ameiurus nebulosus*) are a more serious threat to Rotorua's waterways than previous years, as populations have now been found in Lake Rotoiti.

Catfish are native to North America and have been in New Zealand since 1878 (Barnes & Hicks, 2003). Catfish have smooth scale-less skin which is dark brown to olive green in appearance and they have a paler colour present on their sides and bellies (Mc Dowall, 1990). They have eight distinctive barbels surrounding their mouth (Mc Dowall, 1990) and a sharp spine on the leading edge of their dorsal and pectoral fin. Catfish are an extremely robust fish and can establish in a wide range of habitats. They commonly grow to 200–300 mm in length and can live for over five years (Champion, Clayton, & Rowe, 2002). Catfish are carnivorous and prey on insects, crustaceans (such as koura), molluscs, small fish and fish eggs. Catfish degrade waterways as they use their barbels to probe the substrate for prey. This probing stirs the sediment causing a decline in water clarity (Champion, Clayton, & Rowe, 2002).

Mature catfish are known to prey on juvenile rainbow trout in Lake Taupo and compete with them for prey fish such as smelt (Cryer, 1991). There is the potential in Lake Rotoiti for them to prey and/or compete with trout species present (Grayling , 2016).

Catfish main vectors for distribution are through accidental introductions. Eggs can become stuck on weed fragments on boating equipment such as trailers and anchor warps. Catfish eggs can stay viable for long periods of time provided they stay moist. This makes places such as anchor wells on boats, a high priority for cleaning after anchoring in contaminated waterways. This distribution method is of low risk as catfish have well-guarded egg nests, therefore, it is thought a more likely vector of distribution is for juvenile catfish to become trapped in the cordon wells of boats (Grayling , 2016).

Figure 3 Van Ewert holding a catfish caught on Lake Rotoiti, Photo Credit: Geoff Ewert

1.3.3 Tench and Rudd

Tench (*Tinca tinca*) were introduced to New Zealand in 1868 and they are a cyprinid fish belonging to the same family as goldfish, rudd, and koi carp (Rowe, 2004). In addition to accidental introduction, tench have been and are often spread illegally to new water bodies by coarse-fish angling enthusiasts (Carter, 2009). When present in waterways that lack large predating fish, tench may grow to unusually large sizes, making them attractive to anglers from overseas. Tench prey on zooplankton and benthic invertebrates and have been blamed for the reduction in benthic invertebrates in overseas lakes (Rowe, 2004). Tench are generally limited to slow-moving shallow water but have a wide tolerance to environmental conditions. They have fleshy, downturned mouths with a small barbell on each side along with bright red eyes and are typically olive green in colour (Rowe, 2004).

There is strong evidence that high-density populations of tench can reduce lake water clarity by disturbing sediments and tench can also increase nutrient recycling in shallow lakes, which aids in accelerating eutrophication in the lake (Rowe, 2004). Indirect negative effects on native fish are also possible due to reduced food supply, changes in water quality, and reduced macrophyte cover. Tench are now found in Oamaru, Christchurch, Nelson, Northland and Tauranga (Dean, 2001). In the Bay of Plenty they are thought to be present at Lake McLaren and in the surrounding waterways. It is an offence under the Biosecurity Act 1993 to sell, release or move tench in the Bay of Plenty region (Bay of Plenty Regional Council, 2011).

Rudd (*Scardinius erythrophthalmus*) are native to Europe and Central Asia and belongs to the cyprinid family (Hicks, 2003). They were illegally introduced into New Zealand in 1967 via a private consignment of juvenile rudd that were reared to adulthood and encouraged to breed (Department of Conservation, 2017). The resulting fish were strategically and deliberately released to a number of ponds within the Waikato region, however, have since spread to the Northland region as well as Manawatu, Canterbury and Nelson (Department of Conservation, 2017).

Rudd prefer slow flowing water habitats and are able to tolerate a wide range of temperatures (Hicks, 2003) and prey on a variety of invertebrates and vegetation. Due to their feeding habits, rudd have the potential to modify native macrophyte communities aiding in the invasion of aquatic pest weeds (Lake, Hicks, Wells, & Dugdale, 2002) (Hicks, 2003). Furthermore, in large stunted populations rudd have the potential to degrade trout fisheries (Hicks, 2003).

1.4 Didymo

Didymo *(Didymosphenia geminata)* or 'rock snot' as it is more colloquially known as due to its unpleasant appearance, is an aquatic organism that poses a serious risk to the Bay of Plenty's freshwater ecosystems. Didymo is a single celled algal micro-organism which can be spread through a single drop of water due to its vegetative cell division. Due to this, didymo can remain undetected in rivers as it is invisible to the naked eye (Ministry for Primary Industries, 2012). Didymo thrives in clear, shallow, cold and nutrient poor water and is heavily influenced by the annual weather and rainfall patterns (Bhatt, Bhaskar, & Pandit, 2008). High light levels and stable flow conditions are also favourable for didymo and are required for the initial attachment to the substrate (Kuhajek, et al., 2014). Although didymo is microscopic, it can attach itself by stalks to stream, river and lake beds. These stalks develop further to form thick brown layers that smother not only rocks but also submerged plants and other biota (Ministry for Primary Industries, 2012). Didymo can be distinguished from other species of algae on the basis of its beige/brown/white colour and its spongey cotton wool like texture (Aboal, Macro, Chaves, Mulero, & Garcia-Ayala, 2008).

Didymo is believed to have been brought to New Zealand in 2004 via human assisted means, for example, on footwear, fishing equipment and/or boats (Global Invasive Species Database, 2017). Didymo has been reported to affect a number of different industries and resources including but not limited to, New Zealand's commercial eel fisheries, industrial and agricultural water intakes, local recreational values, international and domestic tourism, and existence values associated with the extinction of native species (Branson, 2006). However, other studies have suggested that there is not enough evidence to support claims that didymo is harmful to native fish populations and more research into the subject is required (Whitton, Ellwood, & Kawecka , 2009).

Many rivers within the North Island have the ideal conditions for didymo growth and often these rivers are used for recreational purposes such as fishing and kayaking. For this reason, these two activities have been identified as two of the most likely causes of didymo proliferation throughout the different rivers and waterways.

Studies have shown that didymo has the ability to establish within the North Island without any restrictions (Kuhajek & Wood, 2009). As a result of this, the absence of didymo from the North Island can be put down to having good management and biosecurity practices. The eradication of a microscopic organism in a natural freshwater waterway is practically impossible and not a viable option, a 'Check, Clean, Dry' campaign has been developed by the Ministry of Primary Industries (MPI). The awareness campaign is a proactive approach to stopping the spread of didymo around the country. This campaign is directed towards members of the public and educates waterway users of the best methods to clean vessels, clothing and equipment when moving between bodies of water.

Figure 4 Didymo Bloom, Photo Credit: Carole-Anne Gillis

1.5 Awareness programme and survey background

The Bay of Plenty region's fresh waterways are used by not only local residents but also domestic and international users. The waterways are used for a variety of recreational activities with a range of different equipment, clothing, vessels and trailers. This equipment has been identified as the primary items capable of transferring invasive weed and pest fish species, as well as live didymo cells between waterways within the region and New Zealand.

In August 2004, representatives from Department of Conservation (DOC), Eastern Fish and Game, Bay of Plenty Regional Council (BOPRC), Te Arawa Lakes Trust, Land Information New Zealand (LINZ), and Rotorua Lakes Council (RLC) formed the Aquatic Pest Co-ordination Group (APCG).These organisations work in partnership to determine and improve public awareness in regards to their role in the dispersal of aquatic pests.

Since 2004, BOPRC has employed two tertiary students to assist with the Aquatic Pest Advocacy Programme. These students engage with members of the public over the busy summer period and strive to educate and create awareness of aquatic pest issues within the region and throughout New Zealand. Whilst engaging with the public, students conduct a survey created by APCG (Appendix 2). Educational material and merchandise provided by MPI and the BOPRC are distributed free of charge to participants of these surveys.

Data collected over this period is analysed and made available to members of APCG and MPI through the creation of this report.

1.6 Aims and objectives

The annual Aquatic Pest Advocacy Programme's major aim is to determine awareness of aquatic pests by recreational and commercial users of lakes and rivers within the Bay of Plenty region, whilst simultaneously educating these users about how pest fish, weeds and didymo are transported between waterways. In addition, it educates water users on how to best minimise the risk of these pests spreading. The distribution of educational material to retail outlets, i-SITE locations and tourist accommodation provides an additional approach to promoting awareness. This method also ensures the target audience can access information throughout the year, not just during the three months of the programme.

Data collected while carrying out this aim is to be presented and analysed in this report. General and specific recommendations will also be made so that correct action can be carried out by the respective organisations if required.

Part 2: Methods

Between 3 December 2016 and 30 January 2017, a total of 683 surveys were collected at fresh waterways throughout the Bay of Plenty region. Surveys were undertaken every weekend and for three days during the week. Survey days lasted for eight hours with varying start times based around the target audience and the weather.

During this summer, BOPRC had a portable boat wash station in use for 15 days over busy weekends and public holidays. The aim was to clean boats as they were either entering or leaving lakes dependent on the specific needs of each lake. Although the boat wash does not use any detergent solution, the high water pressure is enough to remove any loose fragments on the boat/trailer.

In addition to carrying out surveys; relevant retail outlets, information sites, tourist accommodation and tourism activities were visited during the programme dates and were provided with educational material and merchandise. This ensured that information relating to aquatic pests was available year round. Organisers of aquatic events were also contacted and provided with information, merchandise and decontamination gear/services if required.

2.1 Boat ramp surveys

Boat ramps on Bay of Plenty lakes were visited multiple times during the summer period. The lakes were broken down into two regions (northern and southern) and were visited on alternating days to ensure time was distributed evenly.

Once at the ramp, the surveyor would park the vehicle out of the way of turning trailers and other vehicles but close enough to the ramp to be able to see vessels launching and coming in. Ramp users were observed and only approached while waiting for the ramp or preparing their vessel to leave.

When a user had been approached, the surveyor began to ask a series of questions in accordance with the APCG survey (Appendix 2). Information gathered included lake name, ramp name, origin of user, if the user had been previously talked to about aquatic pests, last water body visited, vessel type, recreational purpose, perceived level of interest in aquatic pest issues and level of awareness of both aquatic pests and didymo. To eliminate bias when assessing the user's awareness of aquatic pests and didymo, a series of six questions were asked, three in regards to aquatic pests and three about didymo. If the user could answer all three questions about aquatic pests correctly, they were considered to have a high level of awareness, if the user could answer two correctly they were considered to have medium awareness and users who could only answer one correctly were considered to have a low level of aquatic pest awareness. Furthermore, users who could not answer any questions correctly were considered to have no awareness. This system was also used to assess user's didymo awareness. Two questions in regards to pest fish were asked to find out whether any pest fish had been observed and if the user knows what to do if a pest fish is observed.

Based on the information collected, users were educated with current aquatic pest issues and provided with instructions on ways to help stop the spread of aquatic pests. Education was tailored to the specific recreational purpose of the craft and the interests of the lake users e.g. fishermen were educated about species of pest fish and jet boats/jet skis were talked to in regards to carpets on trailers.

All lakes users were encouraged to preserve and report any suspicious looking fish and hand them in to either DOC or BOPRC.

Upon the completion of the survey and once the user had been educated, a promotional pack containing further information and merchandise was provided to the user for further reference. Once again, this year surveyors entered all information gathered into an iPad which was then uploaded to the Cloud and could later be collated and analysed.

The following list comprises all the boat ramps visited over the summer period, the locations of which are displayed on the maps in Appendix 3.

Figure 5 Boat Shed Bay at Lake Tarawera. Photo Credit: Melissa van den Heuvel

Northern region

- **Lake Ōkataina**
- **Lake Rotoehu**
  - Kennedy Bay
  - Ōtautū Bay
- **Lake Rotoiti**
  - Otaramarae
  - Delta Ramp
  - Gisborne Point
  - Hinehopu
  - Okawa Bay
- **Lake Rotomā**
  - Merge Lodge
  - Matahī Spit
- **Lake Rotorua**
  - Hannah's Bay
  - Ngongotahā Mouth
  - Hamurana
  - Hamurana Springs Mouth
  - Sulphur Point
  - Lakefront

Southern region

- **Lake Aniwhenua**
  - Campground and Ramp
- **Lake Matahina**
- **Lake Ōkāreka**
  - Boyes Beach
  - Acacia Point Reserve
- **Lake Rerewhakaaitu**
  - Guy Roe Reserve
  - Domain
  - Brett Road DOC Campground
  - Ash Pitt Road DOC Campground
- **Lake Tarawera**
  - The Landing
  - Boat Shed Bay
  - Stoney Point
  - Bay View Road
- **Lake Tikitapu (Blue Lake)**

Waikato region

- **Whakamaru**

  Upon the completion of the reporting period, data collected from the surveys was accessed from the Survey 123 database, collated and then analysed. In order to remain consistent with previous years, origin of owner was expanded into regional categories. Within the Bay of Plenty region, the origin of owner was expanded into local districts as displayed in Appendix 5.

  Lake Whakamaru has been included in surveys despite the fact that it is located in the Waikato district. This inclusion was due to the high volume of people travelling from the lake to a number of the Rotorua lakes. As Lake Whakamaru is heavily infested with hornwort and the Waikato Regional Council is in its first year of actively promoting freshwater pest awareness, it was deemed appropriate to educate users at this site.

2.2 River site surveys

While the Rotorua lakes are the main focus of the awareness programme, this year, rivers throughout the Bay of Plenty region were also visited.

The following list comprises all of the rivers visited during the summer period:

- **Western Bay of Plenty**
  - Wairoa River
- **Ōpōtiki District**
  - Waioeka River
- **Rotorua District**
  - Ngongotahā River
  - Awahou River
  - Kaituna River
  - Waitetī River
  - Hamurana River

The Waioeka River located just outside of Ōpōtiki was visited on one occasion due to its remoteness. The Waioeka is a pristine river that attracts fishermen and travellers from all over the country and world.

Rotorua River sites were visited for short periods of time, and when present river users were approached and educated. As with lake users, river users were asked the same questions in accordance to the APCG survey (Appendix 2). More time was spent educating river users about didymo as this happens to have a more direct impact on river users for future use.

2.3 Retail and tourism awareness

Prior to the busy Christmas holiday period, a number of retail outlets, campgrounds and local businesses were visited throughout the region to distribute material, educate and provide updated information about the invasive pest species that threaten lakes and rivers within New Zealand. Organisations targeted were ones which either frequently used the waterways as a part of their business, had customers who would often be using waterways, or had customers that lack understanding on biosecurity issues in or around our waterways. In particular, businesses such as rafting companies, boat and kayak shops, and retail outlets selling fishing and tramping gear were targeted.

Retail outlets and campgrounds visited are listed in Appendix 6.

At each of the businesses targeted, owners were educated about the risks associated with water use and why it is so important that their customers understand and are aware of the risks at hand. The threat of didymo was emphasised to relevant businesses, in order to assure that travellers from the South Island are taking the correct precautions and understand how to clean their equipment to stop the spread of didymo. The majority of the businesses that were visited showed an interest in the campaign and willing to take an active role in our campaign which is a good sign.

Merchandise supplied by the Ministry of Primary Industries and the BOPRC included A4 and A3 posters, brochures and pocket booklets. Businesses that were actively using the waterways or had a number of customers who did, were provided with a more extensive range of merchandise, including key rings, bumper stickers, pens and clothing.

2.4 Event awareness and decontamination stations

Attendance at water based events within the Bay of Plenty region was vital as they provided an opportunity to talk to a wider audience and increase aquatic pest awareness to a different section of society. These events catered to groups with a diverse range of interests all over New Zealand, some had not spent a lot of time in this region's waterways. In addition, these events provided the opportunity to talk to and distribute information to spectators, organisers as well as family and friends of competitors.

During November 2016, relevant aquatic events within the region were identified and information provided by organisers was assessed to determine the risk to the lake/rivers health. Correspondence with organisers helped establish whether it was possible and/or necessary to speak at briefings, provide support with decontamination stations and what merchandise would be most appropriate for distribution.

As with previous years, the focus was on event organisers to take initiative and control of the decontamination process.

Listed below are the following events which were attended or were apart of during the programme:

- Rotomā Sailing Regatta
- Kaituna Enduro
- Half Iron Man
- Rotomā Water Ski Race
- Blue Lake Rowing Regatta
- Blue Lake Multi Sports
- Lake Rotoiti Wooden Boat Parade
- Blue Lake Open Water Swim

During the 2016/2017 Summer Aquatic Pest Awareness Programme, Rotomā Sea Scouts Sailing Regatta, Rotorua Iron Man, Blue Lake Multisport and the Blue Lake Open Water Swim event were provided with decontamination equipment. This decontamination was done with a 10% 'Simple Green' detergent solution which was used for wet suit dipping or to spray down equipment to reduce the risk of spreading aquatic pests. These events were also provided promotional material to be given away as spot prizes as well as information on aquatic pests.

The Blue Lake rowing regatta and the Rotomā Water Ski Race made it a requirement within their registration that all gear must be decontaminated prior to being allowed on the lakes. These events were provided with information and promotional material.

This year was the first year that BOPRC summer students organised to spend time with three classes at Otonga School. The students educated the children about the importance of freshwater health and the effects people have on our freshwater systems. A discussion took place before the classes were split into two groups so that they could play interactive games. Instructions to the games played can be found in Appendix 7.

Figure 6 Summer student Melissa interacting with Otonga School pupils, Photo Credit: Sonja Hoogenboom

Part 3: Results

3.1 Boat Ramp Survey

3.1.1 Distribution of surveys conducted at lakes

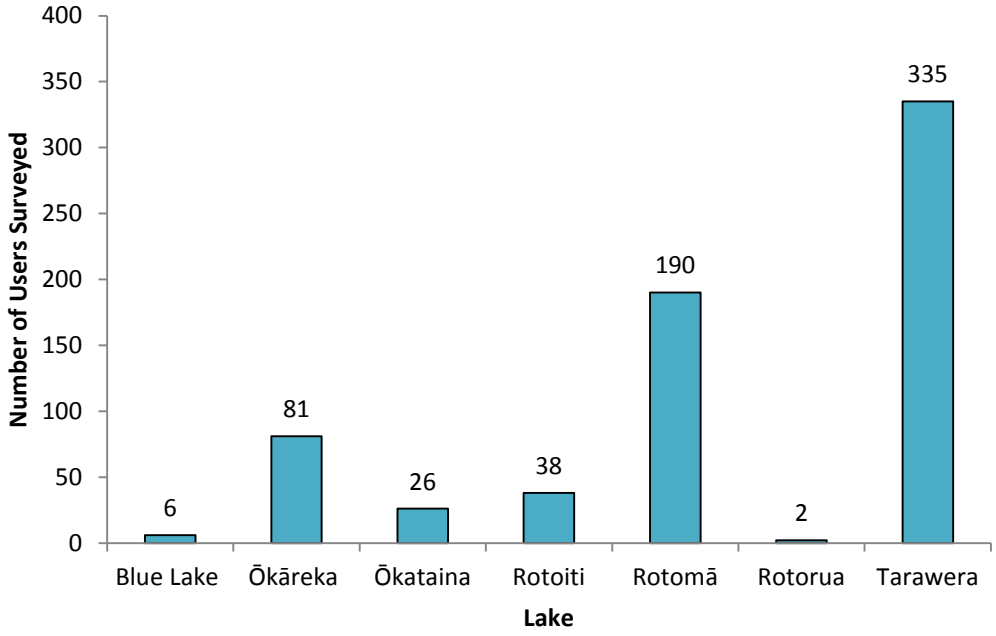

Figure 7 Number of users surveyed at each lake 2016/2017

3.1.2 Distribution of surveys conducted at boat ramps

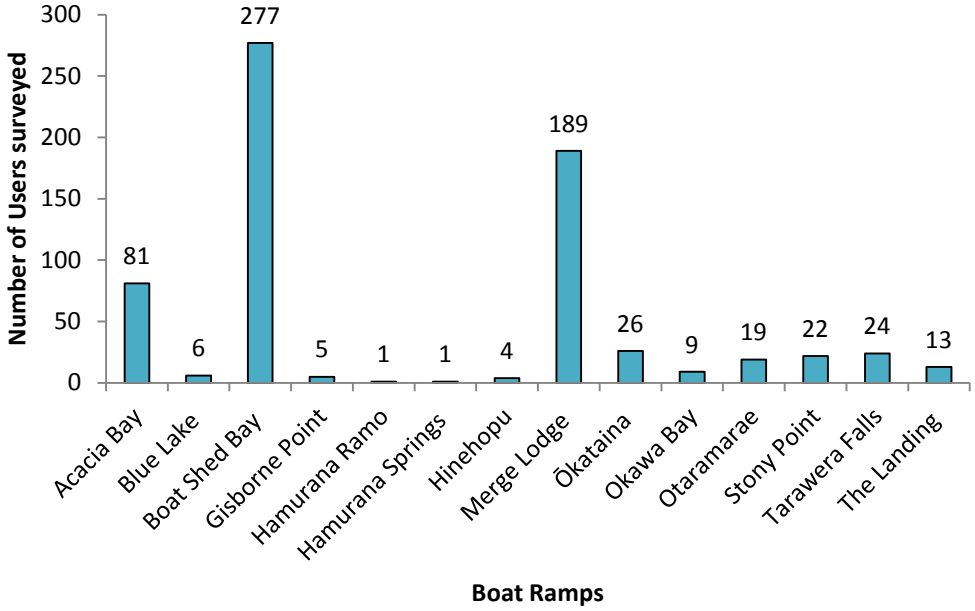

Figure 8 Number of users surveyed at each boat ramp

3.1.3 **Was vessel check/cleaned prior to launching?**

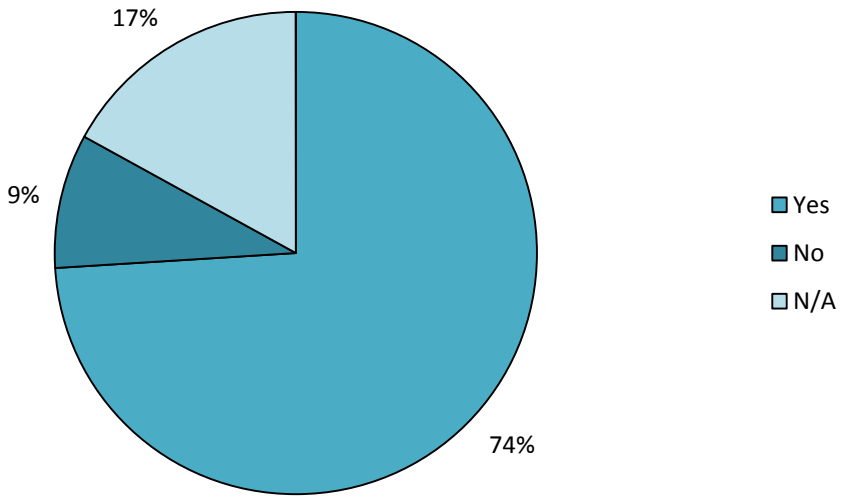

Figure 9 Percentage of vessels checked/cleaned prior to launching (%)

3.1.4 **Do you know how to check clean before launching?**

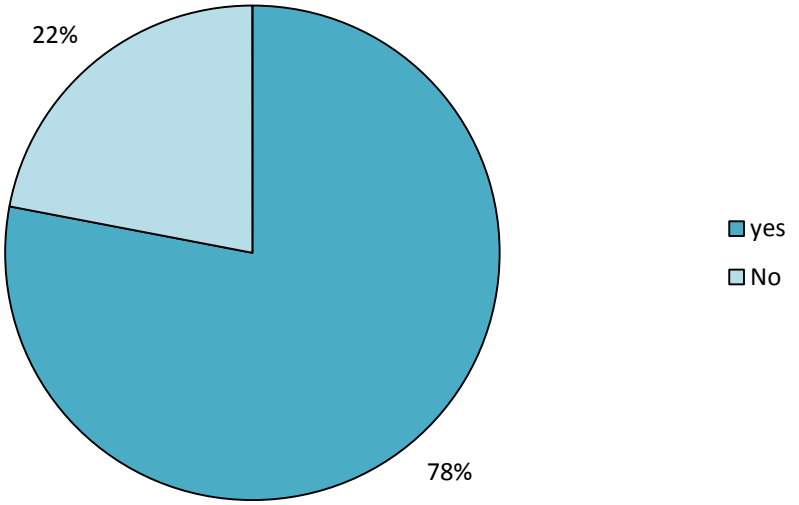

Figure 10 Percentage of users that know how to check/clean prior to launching (%)

3.1.5 Vessel type

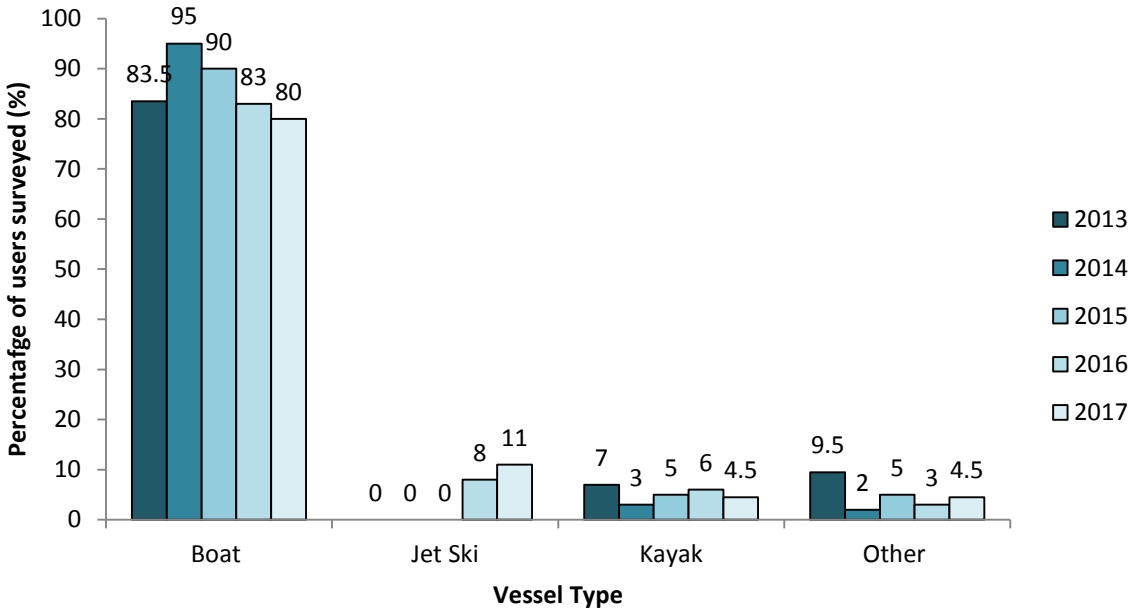

Figure 11 Vessel types surveyed at boat ramps (%)

3.1.6 Recreational purpose

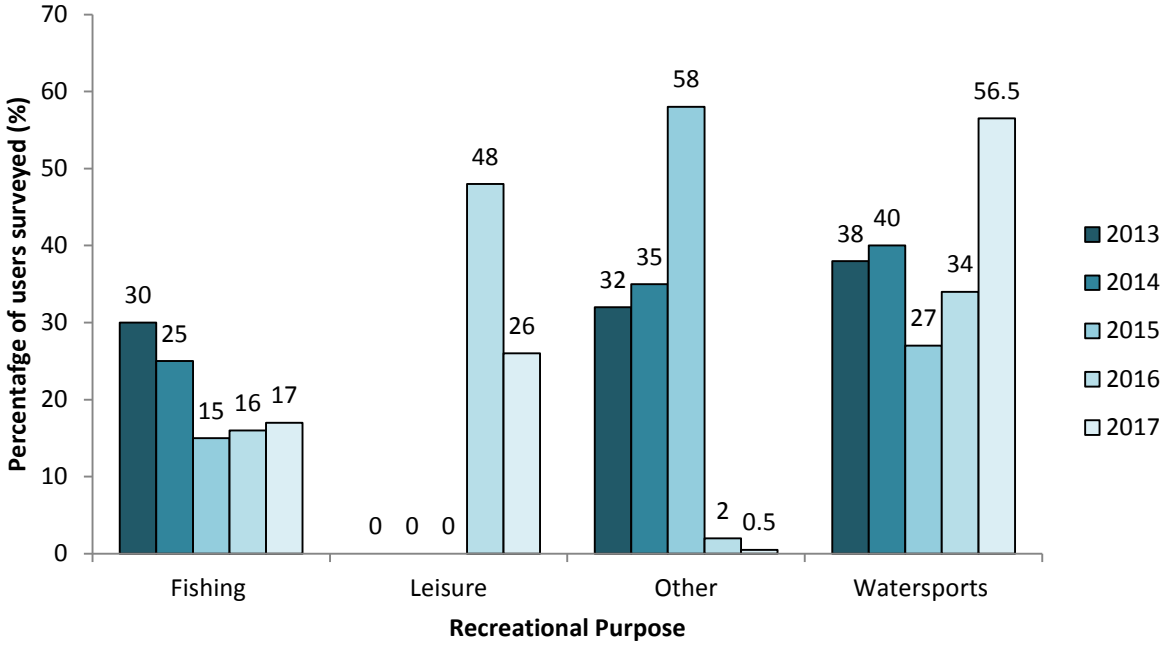

Figure 12 Recreational purpose of users surveyed (%)

3.1.7 Origin of owners

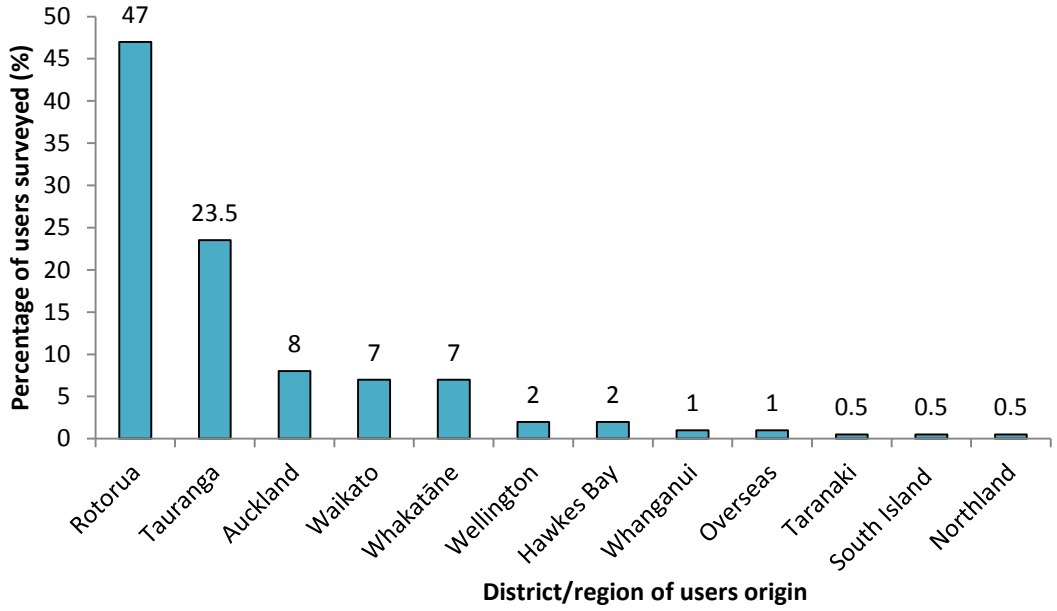

Figure 13 Percentage of users surveyed from each district/region (%)

3.1.8 Last waterway used

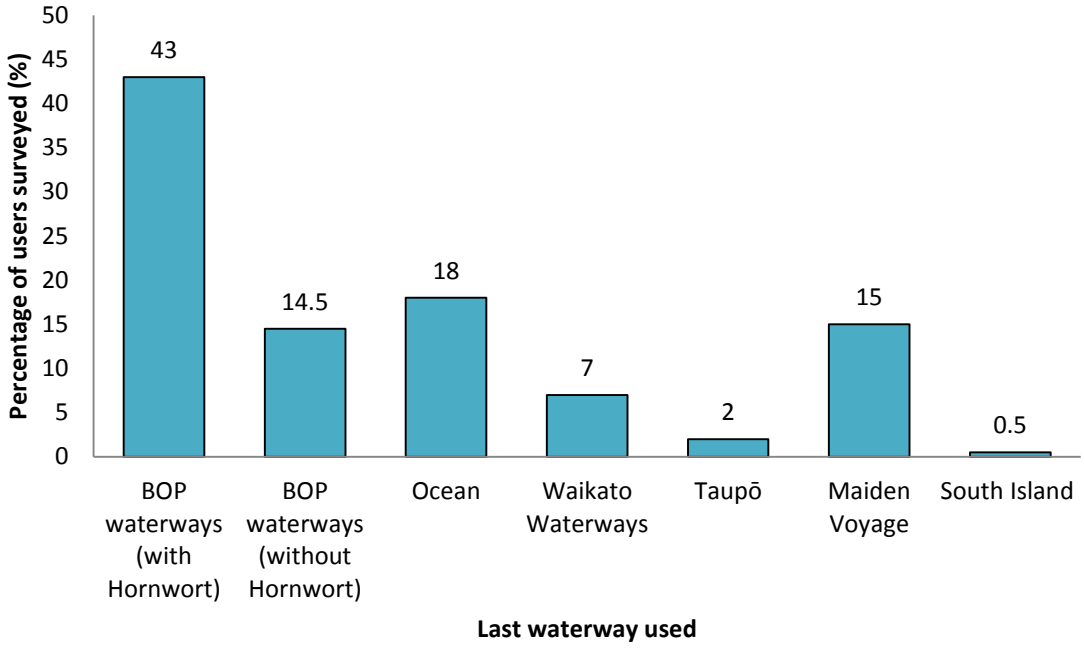

Figure 14 Users last waterway used (%)

3.1.9 Levels of aquatic pest awareness

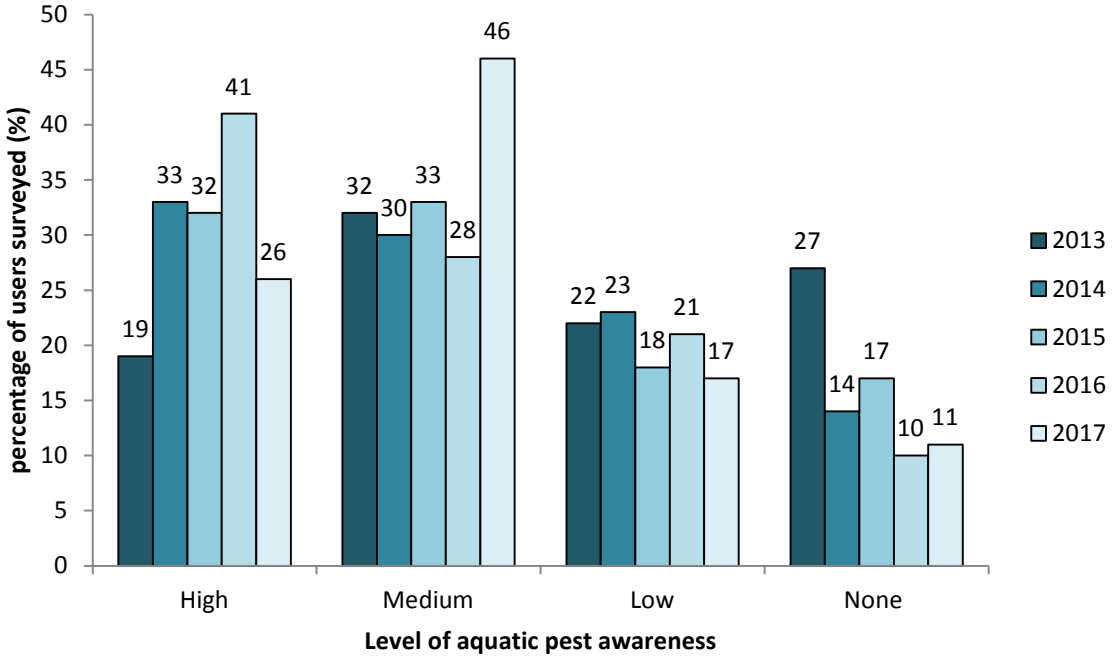

Figure 15 Aquatic pest awareness among lake users (%)

3.1.10 Level of didymo awareness amongst ramp users

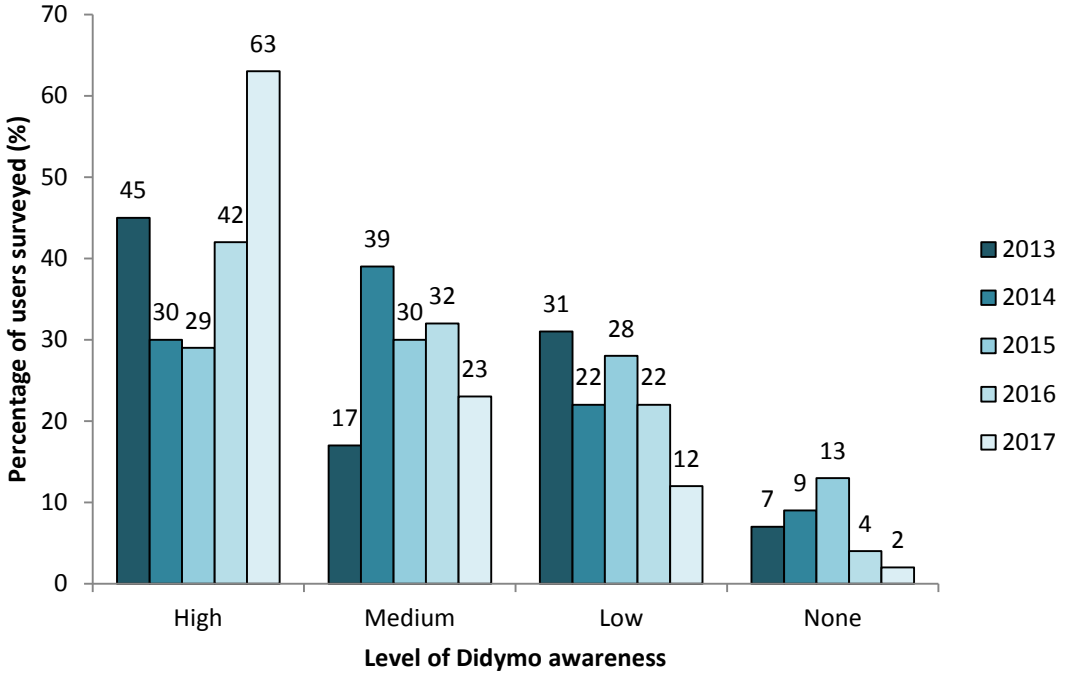

Figure 16 Didymo awareness among lake users (%)

3.1.11 **Perceived level of interest**

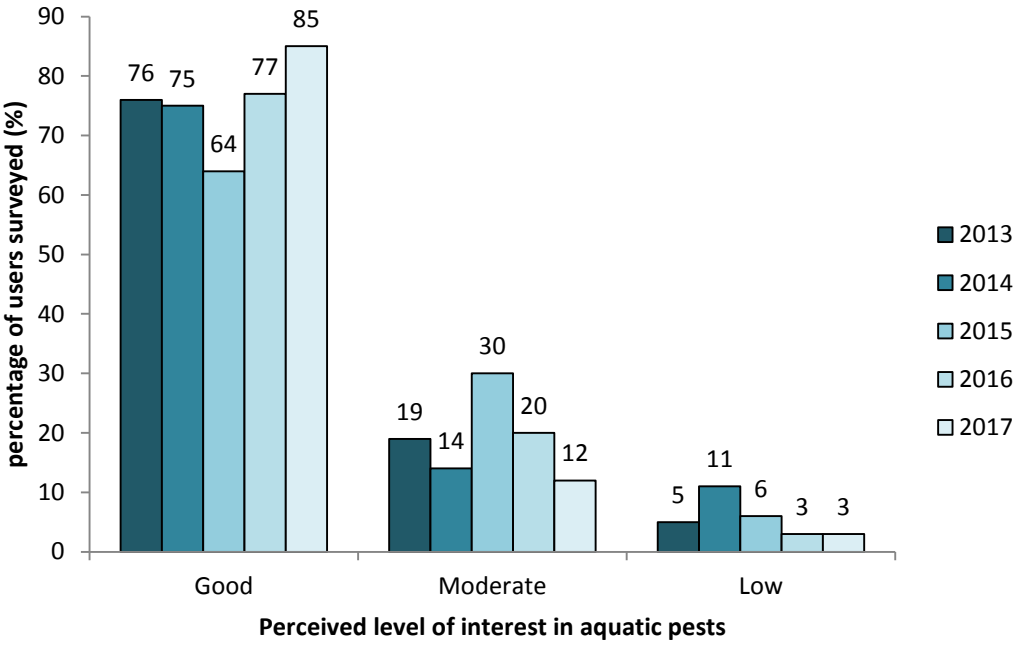

Figure 17 Perceived level of interest in aquatic pest issues amongst lake users (%)

3.1.12 **Do you know what to do if you see a pest fish?**

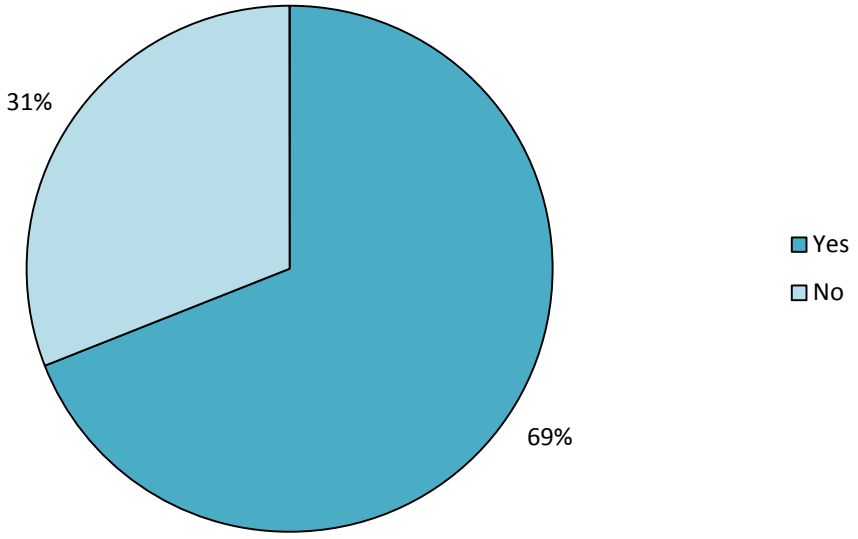

Figure 18 Percentage of people surveyed who knew the procedure to undertake if a pest fish is spotted and/or caught (%)

3.2 Rotomā Surveys

3.2.1 Was vessel checked/cleaned prior to launching?

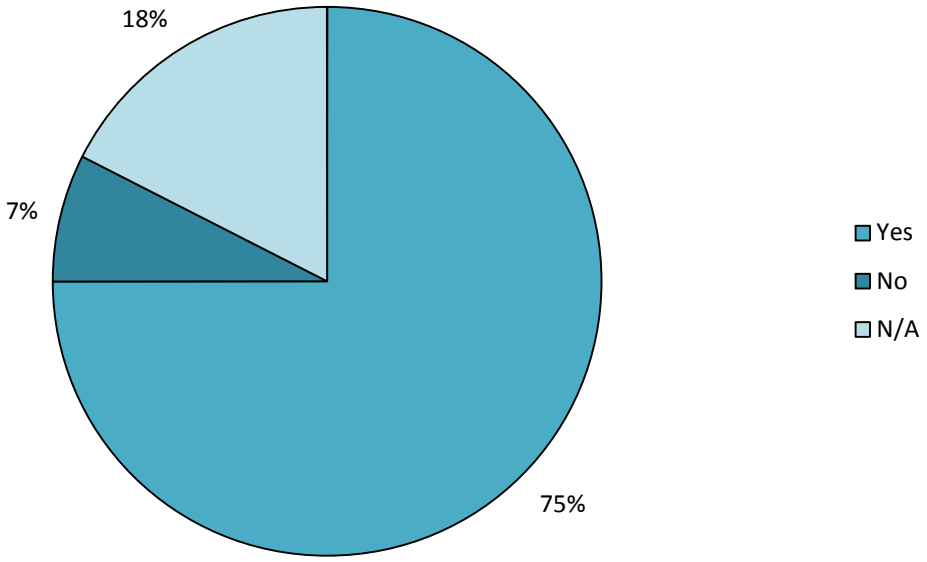

Figure 19 Percentage of users surveyed at Lake Rotoma that were checked/cleaned their vessel prior to launching (%)

3.2.2 Do you know how to check/clean before launching?

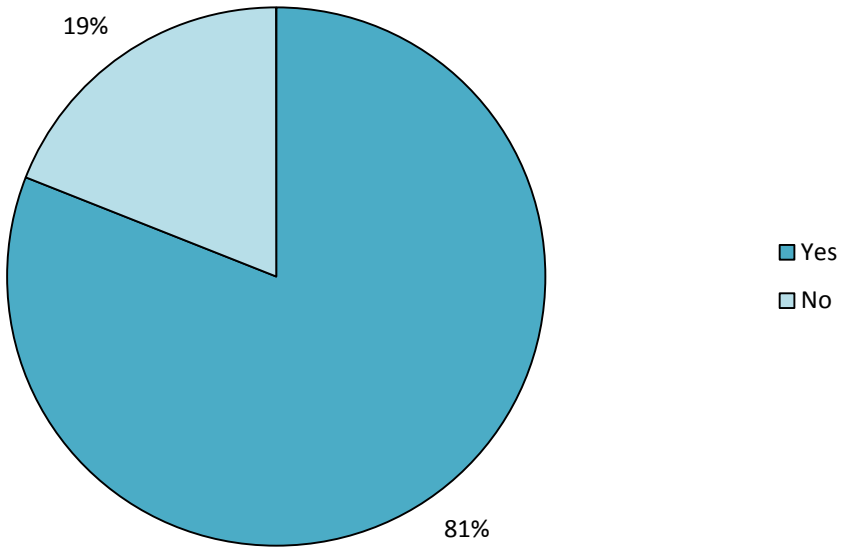

Figure 20 Percentage of user surveyed at Lake Rotoma that knew how to check/clean prior to launching (%)

3.3 River site surveys

3.3.1 Was the vessel checked/cleaned prior to use on this river?

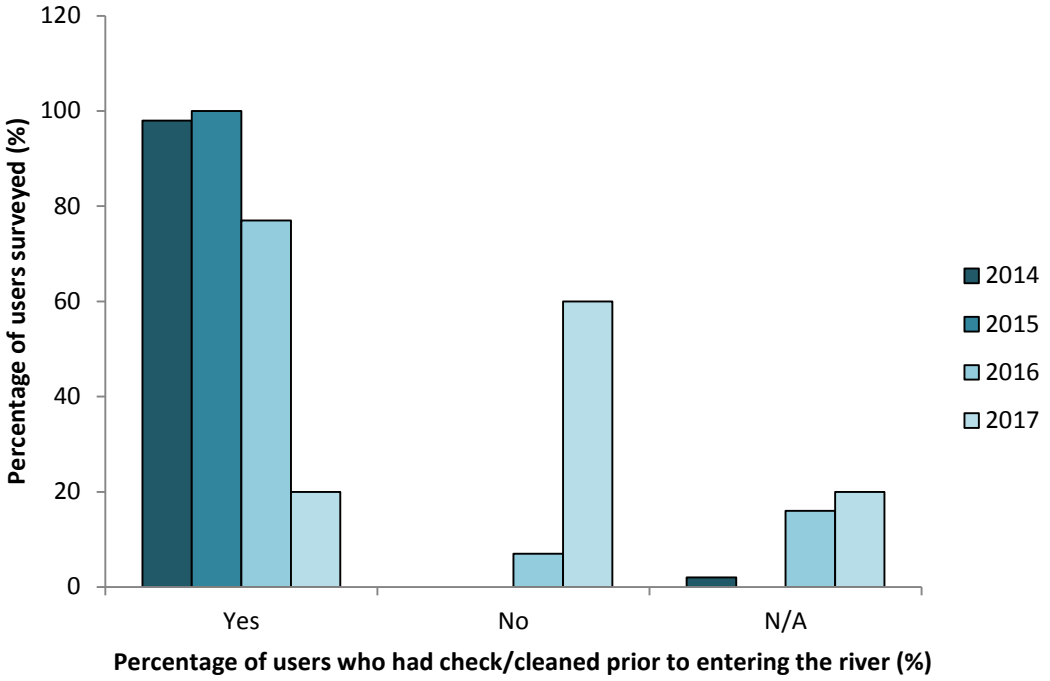

Figure 21 Percentage of river users who had check/cleaned prior to entering the river

3.3.2 Types of vessel/equipment and recreational purpose

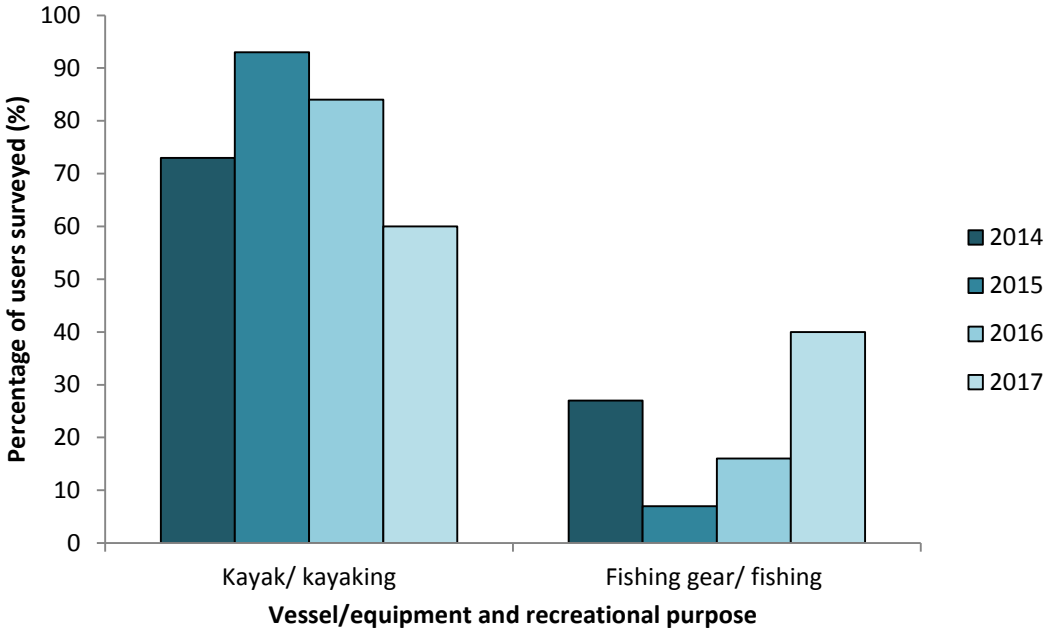

Figure 22 Users different types of vessel equipment and recreational purpose

3.3.3 Origin of owners

Figure 23 Percentage of users surveyed from each district/region (%)

3.3.4 Last water used

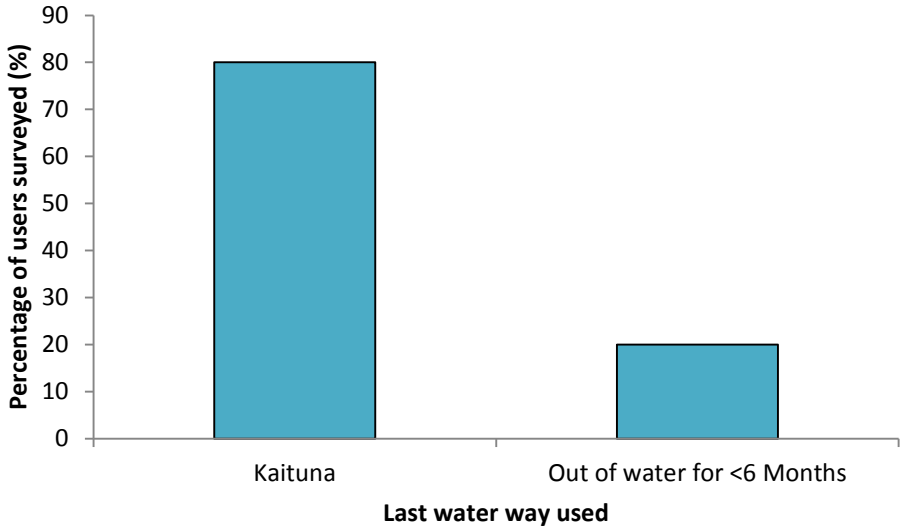

Figure 24 Users surveyed last water body used (%)

3.3.5 Level of didymo awareness amongst river users

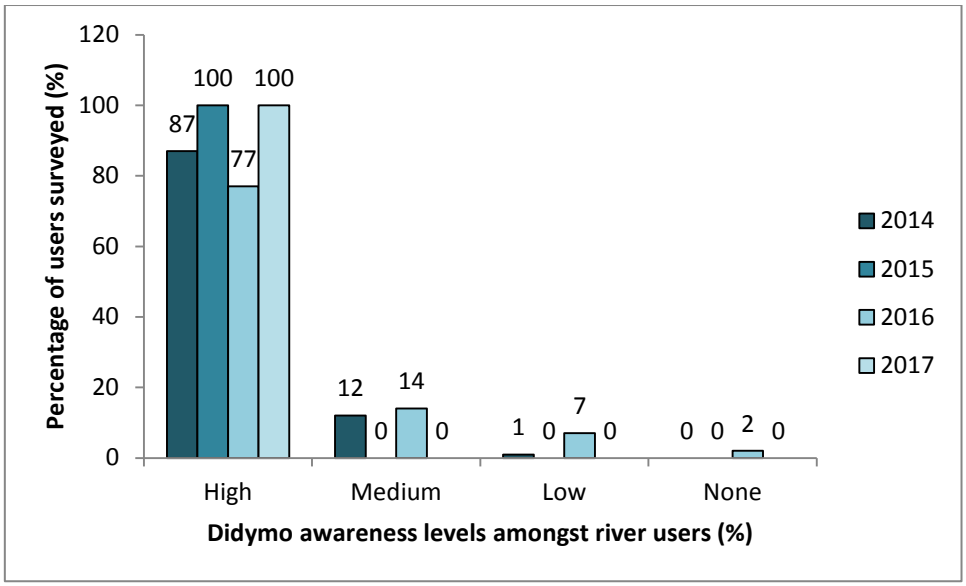

Figure 25 Didymo awareness amongst users (%)

3.3.6 Perceived levels of interest in aquatic pest issues amongst rivers users

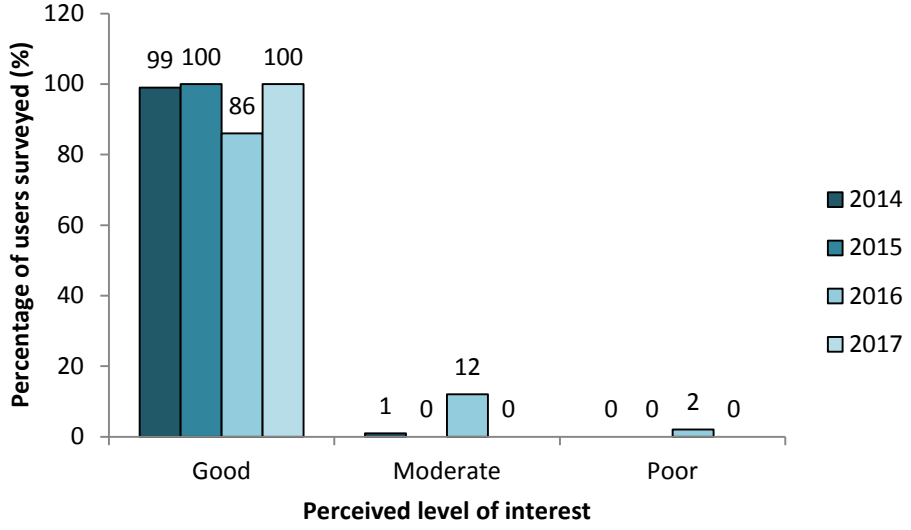

Figure 26 Perceived level of interest amongst river users

3.4 Boat wash surveys

3.4.1 Number of surveys at each boat ramp

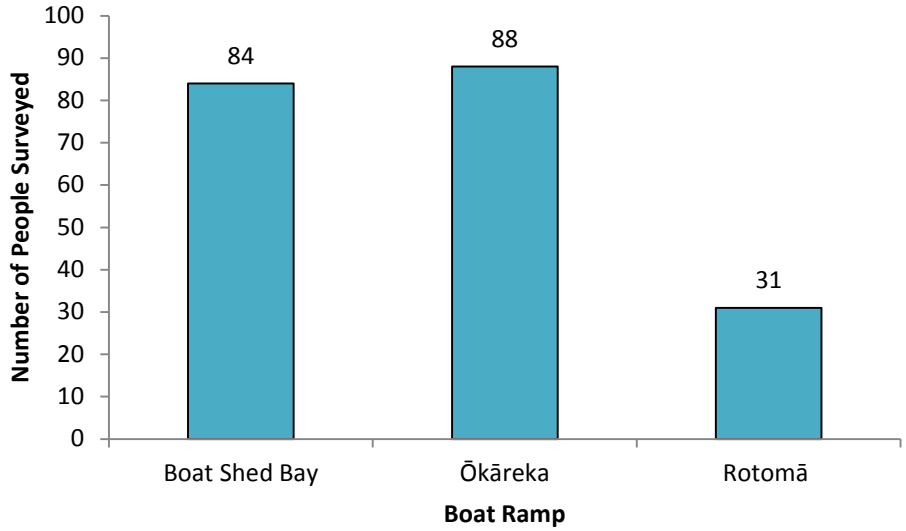

Figure 27 Number of boats washed at each boat ramp

3.4.2 Origin of owners

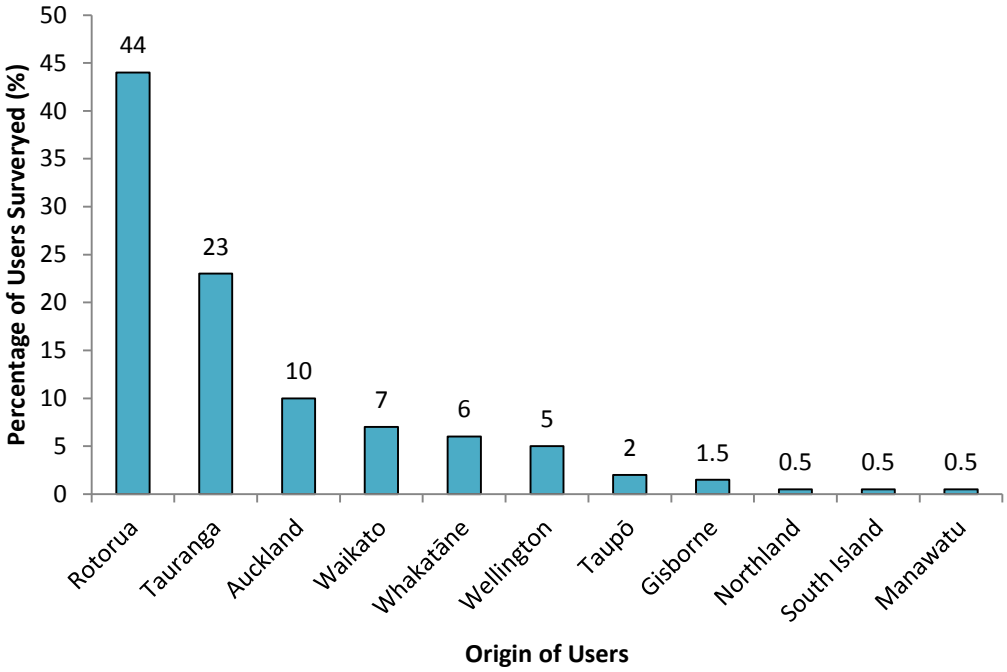

Figure 28 Percentage of boat wash users from each region (%)

3.4.3 Vessel type

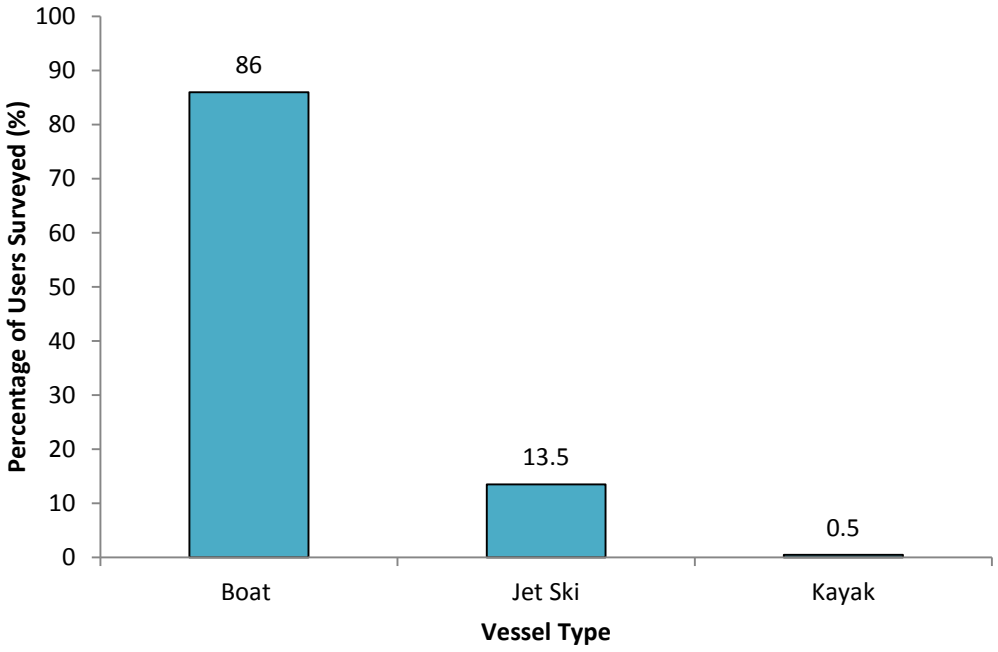

Figure 29 Percentage of each vessel cleaned by the boat wash

3.4.4 Weed incursions at each boat ramp

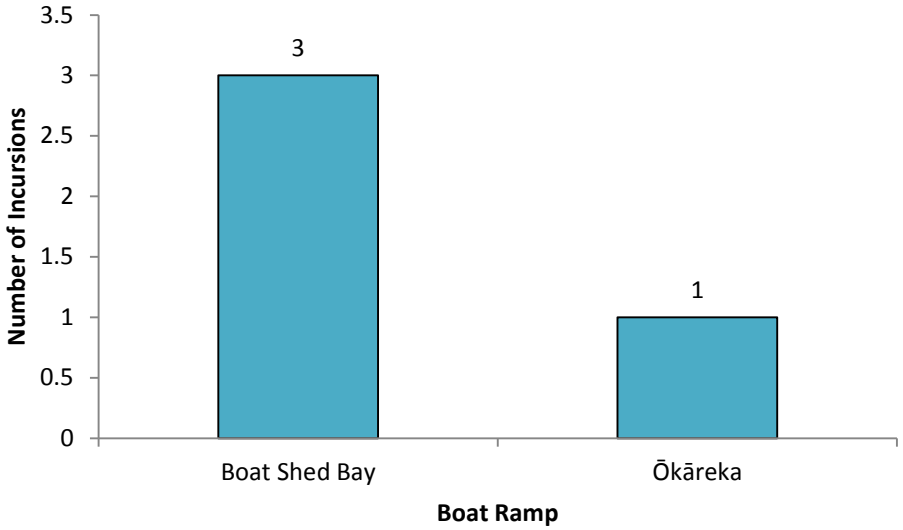

Figure 30 Number of weed incursions prevented by the boat wash

Part 4: Discussion

4.1 Boat ramp surveys

4.1.1 Distribution of surveys

The summer of 2016/2017 saw emphasis placed on larger, more frequently populated lakes and boat ramps. Previous years' recommendations and knowledge of current aquatic pest issues, allowed surveyors to determine which lakes needed to have a higher allocation of time spent at them. It is important to note that the number of surveys collected at each of the targeted ramps does not represent the total number of users at the lake. The survey numbers collected are only indicative of the amount of time spent at each location. A total of 678 surveys were collected over this summer period. Whilst this is down from previous years, it can be seen as a result of not having as many surveyors working and poor weather conditions which affected the numbers of users at the lakes and on boat ramps.

Lake Rotomā is considered one of the most pristine lakes in the Rotorua region due to its water quality and the absence of hornwort. For this reason it was identified as a high priority lake and a large amount of time was spent at this particular lake educating and surveying users there. Unlike previous years, there were no noted incidents of users entering the lake with aquatic pests on their boats or equipment, despite 64% of users surveyed coming from a waterway that was not previously Lake Rotomā. However, it cannot be assumed that each and every lake user had no weeds on their equipment as it was not possible to talk to every user at Lake Rotomā.

Lake Rotoiti is a large lake which is popular with users from both Rotorua and Tauranga. This year surveyors were able to join the harbourmasters on the boats and speak to people whilst they were out and about on the lake. In previous years it has been noted that Okawa Bay and the Hinehopu Ramp have a large amount of weed in and around the loading area. As a result of this, emphasis should be placed on these particular ramps, as many boat trailers become covered in weeds upon entering and exiting the lake.

Lake Tarawera is a highly popular lake for a number of recreational activities and with this there may be a high probability of users spreading weeds to other lakes within the area. Due to parking restrictions at other boat ramps, Boat Shed Bay and Stony Point are two boat ramps that receive a large volume of boat traffic. For this reason a large portion of time was spent surveying users at those boat ramps. Boat shed bay in particular has two boat ramps and a large turning circle which make it a preferred ramp for lake users.

Due to the close proximity of Lake Tarawera to both, Lake Ōkāreka and Tikitapu were visited over the summer period. Lake Ōkāreka is under active managed for hornwort whilst Lake Tikitapu is currently free of it. For this reason, time was spent at both of these lakes discussing the need to clean boats and trailers that have come from, or were previously out on Lake Tarawera.

Lakes Rerewhakaaitu, Ōkaro, Aniwhenua and Matahina were visited on one occasion at the start of summer due to their remoteness. Unfortunately, this year there were no surveys gathered at any of these locations. In previous years it has been noted that many of the users at these lakes only use the one lake and do not travel to other fresh water locations, however, even if this is the case the users should still be educated with correct and relevant information.

Figure 31 Lake Ōkāreka DOC camping ground. Photo Credit Melissa van den Heuvel

4.1.2 Was the Vessel checked/cleaned before launching?

As with previous years, surveyors first established which water body the user had previously used. This enables the surveyor to establish if they posed a high threat to their current water body. It was often found that the user had come from the same waterway, in these cases they were educated on the correct precautions to take should they ever choose to use a different waterway. Whilst there had been a decrease in the number of users who had checked/cleaned before entering the waterway from the previous year (81% to 74%), there was an increase in the number of users who were on their maiden voyage or had had their vessel out of water for six months or longer (Figure 10). Disappointingly, there was also a decrease in the number of users surveyed who knew how to check/clean properly (Figure 11). Users who did not know how to check and clean their vessels or equipment were educated accordingly as well as being provided with Simple Green in 1L spray bottles.

Users were also asked if they had been spoken to about aquatic pest in the Rotorua lakes in previous years. Out of the 683 users surveyed this year, 444 (66%) of them had been previously spoken to, this is an increase from the previous summer (58%). It is important to note that of the 184 users surveyed at Lake Rotomā, 81% (149 users) knew how to check/clean their vessels correctly and only 7.5% (13 users) did not check or clean their vessels prior to launching. In the case where a user had not checked or cleaned their vessels, the surveyors gave their vessels a quick once over to make sure there were no weed fragments present.

This year there were four occasions where users were identified to have weed on their equipment. Three of these were at Boat Shed Bay on Lake Tarawera and the users were identified to have hornwort on their vessels. The other incident was at Acacia Bay at Lake Ōkāreka. This particular user had launched at Tarawera only an hour prior, to find that it was too windy and decided to come to Ōkāreka. Luckily in this case, the weed was spotted and taken off the vessel and was later identified to be *Myriophyllum* aquaticum. This indicates the need for users to be educated about the risk associated with using multiple water bodies on the same or consecutive days.

Throughout the summer period, users were educated strictly on the importance of cleaning and drying their anchor well, as these can be considered a main vector for weed dispersal as they have the ability to remain wet for long periods of time. In cases where drying of the anchor well was not possible, users were encouraged to add biodegradable detergent to the anchor well. Once again, users were educated on the importance of checking and removing weed fragment from trailer and boat carpets as the carpet has the ability to firmly hold weed fragments and fish eggs.

Figure 32 Boat Trailer at Hinehopu with weed fragments on it. Photo Credit: Matthew Liddicoat

4.1.3 Types of vessels and recreational purpose

In consistence with previous years, boats with an outboard motor made up the majority group of users surveyed. Whilst there had been a 3% drop in the number of users within this category, jet ski users have increased from 8% to 11%. Jet skis in particular, have a faster tie down times than boats and as a result of this, the window in which these users could be talked to is considerably smaller than that of a boat. It is common practise to run jet skis out of the water to discharge any water that had been brought in through the intake. This is advantageous not only for the user but by doing this, any weed that had been sucked in, no longer has water to survive in and will eventually become desiccated and die.

Boats, jet skis and trailers pose the greatest risk in terms of transportation of weed fragments. Over 90% of users surveyed were using one or more of these vectors of transportation. The surveyor ensured that time was spent educating these users and making sure that they knew how to remove weeds from their equipment.

The number of users who had kayaks dropped to 4.5% from last summer's 6%. Kayaks and Kayakers can move between waterways at ease and for this reason, they have been identified as a high risk user. They also have the ability to launch anywhere and for this reason, it is considerably hard to survey this group of users. It is advised to put more effort in to reaching this user group especially about the threat of didymo.

Once again the most popular recreational activity was water sports followed by leisure and fishing (figure 13). The leisure category included users who were not undertaking a particular activity and instead were 'pleasure boating'.

4.1.4 Origin of owners and last water body used

The Rotorua lakes are located in areas which are easily accessible from a variety of locations. As with previous years, the majority of users surveyed were from Rotorua (47%) which is a 4% increase from last year. The next majority of users travelled from Tauranga with 23.5% which is a slight decrease from last year.

Areas that are considered to be high risk include freshwater water bodies within the Waikato region (7%), Auckland (8%) and the South Island (1%). These areas have been considered high risk due to pest fish and didymo incursions. Whilst individually these areas do not contribute a large percentage of users, when the totals are added up, they contribute 16% of total users surveyed. As well as the risk of pest fish incursions from water bodies within these areas, Auckland and Waikato have water bodies with a large volume of pest weeds such as hornwort in them. A number of users stated that they travel from their home regions to the Rotorua lakes because of their superior water quality and somewhat absence of aquatic pests.

Users surveyed from the south island dropped by 1% this summer period. These users are classified as 'High Risk' due to the proliferation of didymo throughout rivers in the South Island and the threat of these users transferring didymo water bodies within the North Island. It shall be noted that whilst these users are a threat to lakes and rivers within the North Island, a majority of them had experienced didymo first-hand and for this reason are vigilant when it comes to cleaning their equipment.

Similarly to South Island users, overseas users are also classified as high risk due to their lack of knowledge of biosecurity threats specific to New Zealand and their movement between catchments. As with last summer, these users made up 1% of the total number of users surveyed. Overseas users surveyed this year were provided with as much information as possible to reduce the threat of them transferring aquatic pests from one place to another.

Users (57.5%) had previously been in a Bay of Plenty freshwater way which is an increase from the previous summer. Of these 57.5% of users, over two thirds of them had travelled from a waterway which contains hornwort. This helps to identify where users are potentially transferring pest weeds from. As with previous years, a number of users did not realise that the distribution of pest weeds vary from lake to lake.

Users (18%) surveyed had previously been in salt water and were well aware that salt water kills any fresh water pests. These users often stated that they use salt water between freshwater visits as a way to eliminate their chances of spreading aquatic pests.

Users on their maiden voyage or had had their boats out of water for over six months increased to 15% this year and were brought up to date with 'pest status' within the Rotorua lakes. The 2% of users who had travelled from Lake Taupō were well aware of the threat by aquatic pests due to the successful education by Taupō advocates.

4.1.5 Perceived levels of interest and rated levels of awareness

As with previous years, users were perceived to have high levels of interest towards aquatic pests and the threats that they can have to freshwater bodies within the Bay of Plenty region. Users surveyed who displayed a moderate interest dropped by 8% whilst users who displayed a low level of interest in aquatic pests remained the same as last year at 3%. Users were placed in the moderate and low levels of interest categories when they appeared to be one of the following; not be interested, claim to know everything or unsupportive of the Aquatic Pest Programme. Each surveyor had different perceptions which makes if relatively difficult to compare these results to previous years.

However, throughout the years there has been a general consensus that users displayed good levels of interest in the programme and were supportive of the messages surveyors were trying to get across.

In order to gain users' rated levels of awareness, a series of three questions were asked. The users were asked if they knew what hornwort was, if they knew if there were any pest fish in the lakes and finally if they knew how weeds were spread through water bodies. This system enables the results to be compared to previous years as there is no bias as a result of the different surveyors. Unfortunately, surveys from years prior to 2012 had a different methodology which disables this data from being accurately compared to these results.

This summer there was a 15% drop in the number of users who were identified to have a high level of knowledge about aquatic pests. These were the users that could answer all three of the questions asked correctly. This drop could be a result of a number of users being unaware of the discovery of catfish in Lake Rotoiti. These users often asked a number of questions about catfish once they were informed of their presence and showed a keen interest in the correct protocol to take should they come across pest fish in any of the Rotorua lakes. Due to this lack of knowledge about pest fish in the Rotorua lakes, there was an increase by 18% in users who had moderate levels of pest fish awareness.

Users (98%) surveyed this summer had heard of didymo in one form of another which was a 2% increase from the previous summers result. This result is encouraging and suggests that the threats and risk of didymo is becoming general knowledge within freshwater users. Similarly to the method used to measure user's aquatic pest knowledge, users were also asked three questions about didymo, including if they had heard about it and if they could correctly identify where didymo is located. Users (63%) were considered to have a high level of didymo knowledge which is a significant increase from last summer's result. Encouraging only 2% of users surveyed had no knowledge about didymo. The remaining percentage of people either knew about didymo but did not know where it was located or did not know that it was found in the South Island and in rivers. Whilst it is good that these users have some knowledge about didymo, as they could not answer where didymo was found, there is the risk that they do not fully understand the risks associated with it.

Comments were often made by members to the public in regards to water quality within lakes and concerns about the levels of pest weeds in certain areas of some lakes. For this reason, a question was added to the survey which asked if users thought that water quality within the lakes had improved. Of the 683 users surveyed this summer, 58% believed that water quality had improved whilst only 8% believed that it had not improved. The remaining 34% were unsure if there had been a change in water quality or stated that if there had been any change, they had not noticed.

4.2 Pest fish awareness

This summer a large emphasis was placed on educating users about the discovery of catfish in Lake Rotoiti, which has been the first summer where this in depth education has taken place. Many users (76%) were unaware that pest fish such as catfish had been found within the Rotorua lakes, as they were largely pest fish free in previous years. However, it was encouraging that 69% of the total users surveyed, knew the correct procedures to take if they have a pest fish sighting. As with previous years it was disappointing to hear from users that they had either seen or caught what they considered to be a pest fish but they were unaware of the correct procedures to take and therefore did not report their sightings to the correct agencies. Due to this response, advocates focused strongly on advising lake users on the correct procedure to undertake if they see a pest fish.

As there are now confirmed populations of catfish in Lake Rotoiti there is now the immediate threat of populations establishing in the remainder of the Rotorua lakes. For this reason, future emphasis must still be placed on pest fish and educating all users on the threats of catfish spreading throughout water bodies.

4.3 Boat wash

During the summer of 2016 and 2017, the portable boat wash station was set up for a total of 15 days at three different lakes within the Rotorua region. The aim of this boat wash is to reduce the spread of aquatic pests by not only cleaning vessels but also educating users and creating awareness amongst lake users and the general public.

Vessel owners and operators were encouraged to use the free of charge wash down station to remove any weed fragments before entering or exiting a lake (dependent on the weed status of the lake). After going through the boat wash, users were then given an information pack promoting the 'Check, Clean, Dry' campaign. Once the vessel had gone through the boat wash and was provided with the information pack, the operator completed a boat wash survey (Appendix 4).

As a result of the lack of space at some boat ramps, it was only possible to set up the boat wash station at Acacia Bay (Lake Ōkāreka), Boat Shed Bay (Lake Tarawera) and Matahī Spit (Lake Rotomā). The overall response by vessel operators and members of the public alike were very positive. People showed a curiosity towards the boat wash and an interest in what it was trying to achieve. The boat wash could be used as a starting point in communications with users and helped engage members of the public.

On average, the boat wash was used by 14 boats a day and on the busiest day a total of 21 boats went through. Overall, there was a total of 203 boats that went through the boat wash. Whilst this is a decrease from last summer, the boat wash was out for 10 days less than the previous year.

Lake Ōkāreka proved to be the busiest lake for the boat wash this summer with 88 vessels surveyed closely, followed by Tarawera with 84 vessels. Lake Rotomā had 31 vessels through the boat wash. The small number of boat washes at Lake Rotomā may be a result of its location and the fact that a number of people launching at Matahī Spit originated from Whakatāne or Kawerau and the last water body their vessel was in was the Ocean. In total, 44% of users surveyed by the boat wash originated from Rotorua followed by Tauranga (23%). This is a similar trend to what has been observed within the results from the APCG survey.

This year there was a drop in the number of users who were identified to have pest weeds on their boats or trailers with a total of four incursions taking place. Of these four incursions, three were at Boat Shed Bay as they were leaving the lake and the final one was at Lake Ōkāreka. The incursion at Lake Ōkāreka is of concern as this lake is under active management for hornwort. It has been found that boats coming out of Lake Tarawera and especially Boat Shed Bay have weeds on them, as a large quantity of weed often washes up onto the boat ramp.

Whilst it is important to discuss the users that used the free boat wash facility, it is vital to remember that some users chose not to use it for a variety of reasons. Some users stated that the boat would next be used in the ocean or that they like to clean it down at home. On the other hand, there were users who were in a rush to get out or into the lake and did not wish to be held up with the boat wash. Cases like this were disappointing to see as it only takes a few minutes for boats to go through the wash down.

Overall, the boat wash is very effective in removing weed fragments from both trailers and vessels. As well as this, it creates a level of curiosity and awareness that could not be achieved with summer advocates alone. Technical information and recommendations in regards to the running of the boat wash can be found in Appendix 9.

Figure 33 *Boat Wash set up at Boat Shed Bay, Lake Tarawera. Photo Credit: Melissa van den Heuvel*

4.4 Other issues for discussion

Over the 2016/2017 summer it was found that generally users who were from the Rotorua area, or those who frequently used the lakes in the area, were better informed about aquatic pests, as they had been spoken to a number of times by past aquatic pest advocates. Whilst there was a number of people who claimed that they had been spoken to before and already know about the different pest status's of the lake, it was found that these users in particular were not aware of the current pest situation and required educating.

During the course of the summer, a significant number of BOPRC 'Stop the Spread' merchandise was distributed to users who were genuinely interested in the cause. On many occasions members of the public were spotted wearing this merchandise around boat ramps and camp ground. This is a great outcome as it gets the message out to a larger number of people and makes the public more aware of the slogans which may help them remember to 'Check, Clean, Dry' in the future.

4.5 Rotomā surveys

As previously stated, Lake Rotomā is one of the most pristine lakes within the Rotorua lakes region. This summer, over 28% of all surveys collected were taken at Lake Rotomā and as with the previous years, there was enough data collected at Rotomā to analyse it in further detail and furthermore compare it to previous results.

It was found that of all the users surveyed, 81% answered that they knew how to check/clean their vessel or equipment prior to launching into the lake. Furthermore, 75% of all users surveyed at Lake Rotomā checked/cleaned their vessels before launching, whilst it was found that unfortunately 18% of users did not check or clean prior to launching. This is of concern due to the fact that Rotomā is free of hornwort.

As a result of some users not checking or cleaning in previous years, two weed cordons have been installed, one at Merge Lodge and one at Matahī Spit. These weed cordons dictate where users can launch their vessels and prevent users from launching along beaches etc. Each boat ramp and surrounding areas are well sign posted and the beaches are regularly checked for weeds.

The lack of motivation by users to undergo the check/clean process is alarming. Many of these users are well aware of the procedures that need to have taken place before entering a lake, however, despite their knowledge, did not do the right thing before entering the lake.

4.6 River Site Surveys

4.6.1 Was the vessel checked/cleaned before launching?

River users were directly asked if they had checked/cleaned prior to launching into the river. Of those surveyed, only an alarming 20% had undertaken the correct procedure prior to launching. However, as with the previous year, there was a N/A category which included any user who had their vessel out of water for over six months and this category made up another 20% of users surveyed. This, unfortunately, means that of all the river users surveyed, 60% of them did not undertake the correct procedure before launching. This lack of compliance is alarming and ongoing didymo sampling which is undertaken by DOC will determine the outcome of these results.

4.6.2 Type of vessel and its recreational purpose

Kayaks and kayakers made up the majority of users surveyed at 60% and for this reason is the most popular activity for users surveyed in the Rotorua rivers. The other 40% of users surveyed were fishing. Unlike boats and trailers, kayaks and fishing equipment do not have many areas where clumps of weed can accumulate.

White water kayakers have a close and well connected community and for this reason they are encouraged to share their good cleaning habits with those new to the sport.

4.6.3 Origin of owners and didymo awareness

Users (60%) of users surveyed at rivers this year originated from overseas and users from Rotorua and Auckland made up the remaining 40%. As the majority of surveys were undertaken at the Kaituna River, there is a large level of bias which makes this data hard to compare to the previous years. Overseas users pose a significant risk to freshwater rivers, as they usually do not know about the threat didymo has on New Zealand's ecosystems. However, this year there was a high level of didymo awareness between all users surveyed. This suggests that despite the fact that the majority of the users surveyed originated from overseas, they had all heard about didymo and could correctly identify where it was found. The fact that 100% of users were aware about didymo, makes it disappointing that 60% had not undertaken the correct checking and cleaning procedure before launching on the river.

Figure 34 Kaituna River. Photo Credit: Xia Stevens

4.7 Retail and tourism awareness

The Bay of Plenty area is a popular destination for both domestic and international tourists. Both retail and tourism outlets are visited to gain information about the large range of freshwater activities within the region. It has been found to be successful to provide information about freshwater pests to these sectors, as it provides information to the public all year round. This year, information was provided to 38 retail outlets as listed in Appendix 6. Due to restraints such as weather and time, these sites were visited before the busy holiday period.

As with previous years, a high level of focus was placed on holiday parks, outdoor retail shops, backpackers and high risk tourism operations. This focus is put in place to target main groups of people using the Bay of Plenty waterways. Backpacker accommodation is very important to target, as people staying at this form of accommodation often travel widely to remote areas of wilderness which often have pristine waterways. Therefore, these users have the potential to become vectors of didymo cell dispersal. On the most part, motels and hotels were not visited due to their lack of boat parking space and as a result from negative feedback in previous years.

Holiday parks and outdoor retail chains (e.g. Hunting and Fishing, Top 10 Holiday Parks) were very receptive to the information being given out and a vast majority of them are proactive in carrying out aquatic pest education with their guests. A number of holiday parks have boat wash down stations which are made available to their guests.

As with previous years, high risk tourism operators were once again visited. They were reminded of the importance of cleaning gear and vessels between waterways, along with being updated with new information. Brochures and posters were provided for their operating premises and they were encouraged to talk about aquatic pests with clients.

4.8 Event and decontamination awareness

Speaking to event organisers and competitors at briefings, offered the change to not only raise awareness of aquatic pest risk to lake health, but also allows a means of providing information about decontaminating vessels and equipment. All of the event organisers that were talked to this summer, were more than willing to promote didymo and aquatic pest awareness and a number of them made it a condition in the competitor's entry forms that they must undertake decontamination steps in order to be allowed on the lake. Events can bring large captive audiences to a single location which makes them an ideal medium to talk to, as there are a large number of users in a relaxed location. Many of the competitors taking part in these events may not usually use the Rotorua lakes and for this reason may arrive with very little knowledge of our specific freshwater biosecurity issues and requirements.

As with the previous years, the majority of the event's organisers spoken to were receptive to the messages provided by the summer advocates, to help eliminate the risk of spreading pests. Emphasis has been put onto event organisers to make it their responsibility for setting up and manning decontamination stations. All of the event organisers knew the procedures they must follow in order to reduce the risks or any incursions.

Organisers of the Blue Lake Rowing Regatta make it compulsory for competitors to check/clean all boats before they are allowed to enter the competition. They did this by making competitors sign off they had done so and furthermore placing a sticker on the equipment indicating that the gear had been decontaminated. This is a great idea as it helps event coordinators ensure that they are eliminating the risk of causing an incursions.

Organisers of the Rotomā Sea Scout Sailing Regatta, Half Iron Man, Blue Lake Multisport and Blue Lake Open Water Swim were very receptive of the messages being delivered by the Bay of Plenty Regional Council, including the organisation of decontamination gear/dip stations. These events were also given some merchandise that could be put in participant's race bags or used as spot prizes. All of these events bar the Half Iron Man, provided their own volunteers to oversee the station. Unfortunately the Half Iron Man were not willing to have a member of their team overseeing the 'dip station' as none of the competitors had used it in previous years. It was particularly disappointing as it was stated on their website that a dip station would be available to participants who had wet wetsuits which had been in freshwater bodies other than those in the Rotorua lakes prior to the event. Bay of Plenty Regional Council students oversaw the dip stations on this occasion, however; it is encouraged and recommended that in the future, the overseeing of dip stations should be the event organisers' responsibility.

All event organisers were made aware of the risks and procedures needing to be undertaken as it is one of the conditions they agree to when applying for the lake/partial lake closure (Figure 37). These events are also provided with a Bay of Plenty aquatic pest event decontamination protocol (Appendix 10).

The majority of event organisers and competitors were friendly and supportive of what the Aquatic Pest Awareness Programme was doing. A number of the people spoken to had competed in events for many years and are passionate about keeping water quality and lake health high.

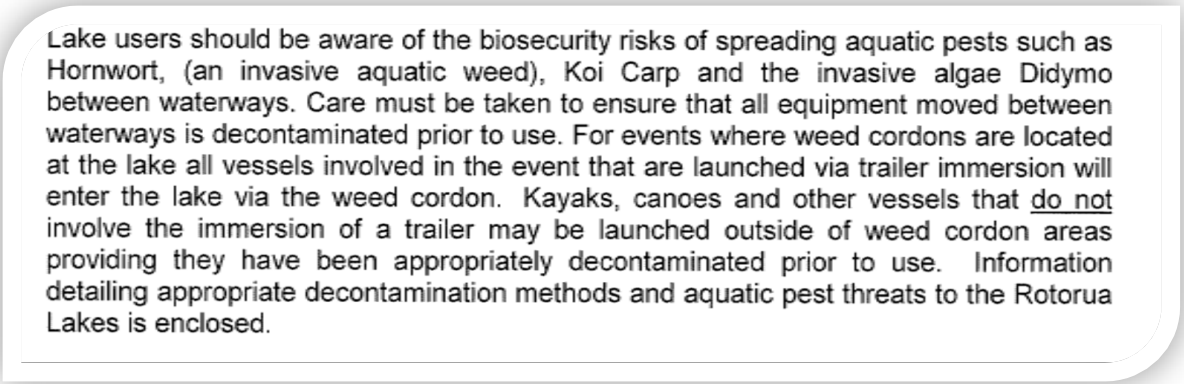
Lake users should be aware of the biosecurity risks of spreading aquatic pests such as Hornwort, (an invasive aquatic weed), Koi Carp and the invasive algae Didymo between waterways. Care must be taken to ensure that all equipment moved between waterways is decontaminated prior to use. For events where weed cordons are located at the lake all vessels involved in the event that are launched via trailer immersion will enter the lake via the weed cordon. Kayaks, canoes and other vessels that do not involve the immersion of a trailer may be launched outside of weed cordon areas providing they have been appropriately decontaminated prior to use. Information detailing appropriate decontamination methods and aquatic pest threats to the Rotorua Lakes is enclosed.

Figure 35 Clause number 12 on full/partial lake closure conditions

This year the advocacy students organised to go to Otonga Primary School for one day and give a talk to three class rooms about aquatic pests. The BOPRC students set up games and activities educating students about pest weeds and the damage they can do to Rotorua fresh waterways. Instructions to these activities can be found in Appendix 7.

Part 5: Conclusions

The Rotorua lakes are a significant asset to both the Bay of Plenty region and the country. For this reason the health of the lakes and their water quality and biodiversity are worth protecting for the enjoyment today and future generations. Due to the number, proximity and closeness of the lakes, they are extremely susceptible to the invasion of aquatic pests by lake users.

The main aquatic pest weeds within the Rotorua lakes region have been identified as hornwort, egeria, elodea and lagarosiphon. These four weeds contribute to water degradation and affect native community systems, which can lead to a loss of native species. Several recreational activities have been identified to be the main means in which these weeds spread between lakes. These activities include but are not limited to fishing, kayaking and boating. Pest weeds can spread between water bodies by becoming caught on trailers, vessels or equipment associated with those activities. Pest fish eggs from the likes of koi carp and catfish are able to 'hitch-hike' and can remain viable on damp weed fragment.

In 2004, a freshwater algae called didymo was discovered in the South Island and had since spread through numerous freshwater rivers within the South Island. Although it is not currently present in the north island, didymo has the capability to spread via microscopic cells that are undetected by the human eye. Didymo has negative impacts on rivers ecology and aesthetics; it also negatively impacts the interests of a number of commercial endeavours and recreational users.

Throughout the summer of 2016 and 2017, the aquatic pest summer awareness programme aimed to identify levels of public awareness and educate recreational users about didymo, invasive weed and fish species. A total of 683 surveys were taken at lake boat ramps and river access points throughout the region this summer.

The Aquatic Pest Awareness Programme is reaching many of those most at risk of causing incursions of invasive species in the Bay of Plenty region. Freshwater users appreciate the work conducted by BOPRC around the Rotorua lakes and rivers and users frequently make positive remarks about the work being undertaken. A positive mind-set among recreational users to 'Check, Clean, Dry' all vessels and equipment will help prevent didymo incursions within the North Island. Similarly, 'Stop the Spread' reminds users of the procedures that must be undertaken when moving between waterways.

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Appendices

Appendix 1 - Department of Conservation brochure

THE THREAT OF AQUATIC PESTS

Threats to the Rotorua lakes include pest fish, aquatic weeds and algae. These have an impact on all wildlife and users.

- They create poor conditions for native fish, birds and plants.
- Increased weed at the lake edges makes it unpleasant for swimmers.
- Fishing lines get caught on lake weed.
- Surface-reaching weeds block boat navigation pathways.
- In some instances they cause the collapse of valuable trout fisheries.

By keeping our lakes free of aquatic pests, everybody can continue to enjoy the amazing recreational opportunities the lakes offer.

Didymo

At present the algae *Didymosphenia geminata*, more commonly known as didymo or 'rock snot', is not known to be present in the North Island.

Although didymo is not a significant risk to human health, it can form massive blooms on the beds of rivers, streams and lake edges. This can displace other plants, fish and invertebrates by reducing suitable habitats. It turns pristine waterways into massive beds of what looks like 'rock snot'.

Didymo can be spread via a single drop of water so it is essential to **Check, Clean** and **Dry** all equipment between waterways to prevent didymo spreading into the Bay of Plenty. Freezing any item until solid will also kill didymo.

Note: Didymo is not visible to the naked eye until it blooms.

To find out more about didymo and cleaning methods, go to the Ministry for Primary Industries website: www.biosecurity.govt.nz/pests/didymo

The law

Did you know that according to the Conservation Act 1987, Biosecurity Act 1993 and Freshwater Fish Regulations 1993, it is illegal to introduce any aquatic life including fish, plants or aquarium contents into any waterbody. Offences can carry fines from $5,000 to $100,000.

PEST FISH

There are no known wild populations of koi carp, rudd or catfish in Rotorua. Once pest fish are established in a lake it is practically impossible to eradicate them, so DOC, BOPRC and RDC are working together to maintain this pest fish-free status. Please contact us if you think you've found any of the following:

Catfish

- Their most distinctive feature is a large head with eight long, whisker-like barbels around the mouth.
- Catfish grow to 50 cm long and weigh up to 3 kg.
- They are dark brown to green on the back with a pale underside.
- Catfish are found throughout the Waikato River system, including Lake Taupo.
- They are predators and scavengers and if they establish in the Rotorua lakes area, may have a significant effect on native fish and trout.
- They can survive a short time out of the water as long as they remain wet.

Rudd

- Rudd are stocky, deep-bodied fish that grow to about 25 cm long and 500 g in weight.
- They have an olive green back, silver green sides and silvery white belly.
- Rudd feed voraciously on insects, aquatic plants and other fish, competing with other species for food and damaging native fish habitat.
- Rudd lack stout spines on the front edge of their upper fin which distinguishes them from goldfish.

Koi carp

- Koi carp are easily identified by their colour – they are usually orange but can be white, black, gold or a combination of all four. They can be distinguished from goldfish (which are in the lakes) by two pairs of barbels around the mouth.
- Koi carp are large (up to 75 cm long), commonly exceed 5 kg and occasionally reach 10 kg.
- Widespread in the Auckland and Waikato regions, they are present in the Waikato River system.
- They disturb bottom sediments in the search for food, muddying the water and creating poor conditions for native freshwater fish, trout, plants and waterfowl.

AQUATIC WEEDS

The Rotorua lakes have a history of problems associated with introduced aquatic weeds.

Accidental and sometimes deliberate transfers of both nuisance weeds and algae into the lakes threaten the ecology of the region's lakes, rivers and streams. Aquatic weeds can form large surface-reaching beds, often smothering native plant communities and fish habitat, and diminishing aesthetic and recreational values.

Not all lakes have all weeds (see map) and it is important not to spread new weeds to previously unaffected lakes. Only a small fragment of weed is needed to transfer the problem from one lake to another. So, always:

Check, Clean, Dry
all items before entering, and when moving between, waterways.

Canadian pondweed

(*Elodea canadensis*)

Less aggressive than other waterweeds seen here but it still clogs waterbodies. This is the only oxygen weed that can be sold for fish tanks.

What to look for:
The leaves, arranged in groups of three, are less than 10 mm long.

Oxygen weed

(*Lagarosiphon major*)

What to look for:
Leaves are arranged in a spiral around the stem.
The leaves are curved backwards and occur singly.

Hornwort

(*Ceratophyllum demersum*)

New Zealand's most serious submerged waterweed.

What to look for:
The tip of the stem looks like a young pine tree. Hornwort can form free floating dense growths with stems up to 10 m long. The leaves are narrow, 10–40 mm long and have small teeth on one side. The leaves grow in distinct whorls from the main stem.

Dense oxygen weed

(*Egeria densa*)

The largest species of oxygen weed.

What to look for:
Leaves are arranged in groups of four or five and are closely spaced on the stem. The leaves are 30–40 mm long.

Help protect the Rotorua lakes from aquatic pests

For more information

For further information about recreational activities and conservation around the Rotorua lakes visit:

- Rotorua Visitor Information Centre, 1167 Fenton Street, phone 07 348 5179
- DOC website: www.doc.govt.nz
- Rotorua Office, 99 Sala Street, phone 07 349 7400

Check, Clean, Dry

Stop the spread of didymo and other freshwater pests.

Remember to Check, Clean, Dry all items before entering, and when moving between, waterways.

CHECK CLEAN DRY

Cover: Lake Tarawera

newzealand.govt.nz

Department of Conservation *Te Papa Atawhai*

The Rotorua lakes and reserves

Rotorua's 13 lakes are wonderful. Residents and visitors enjoy a range of recreation opportunities year-round, from waterskiing, kayaking and boating to swimming, sailing and trout fishing.

The lakes are a stronghold for the threatened New Zealand dabchick and the rare black-billed gull. More common species include New Zealand scaup and shags. Native fish (such as bullies, kōaro and smelt) and kōura can also be found here. Many of the lakes also host exceptional recreational trout fisheries.

A range of native aquatic plant communities are present, particularly in clean lakes such as Okataina/Te Moana i kataina a Te Rangitakaroro and Rotomā. These plants provide shelter for young fish, feeding grounds for waterfowl and food for animals such as kōura. However, in some lakes aquatic weeds have smothered out many of the taller native species.

Scenic reserves

There are many freely-accessible scenic reserves around the Rotorua lakes region. DOC protects the indigenous plants, animals and natural and scenic values in these reserves while still encouraging people to use and enjoy them.

Wildlife refuges

These special areas are set apart to protect the birds within them. Sulphur Point (Lake Rotorua/Te Rotorua nui ā Kahumatamomoe) has a 'No boating' restriction.

Predator-free islands

Māori-owned Mokoia Island in Lake Rotorua is free of rodents and predators. It has taken many years to achieve this status and it is vital that it remains pest free to protect rare native plants and animals. Public access to Mokoia Island is controlled because of the danger of rodent re-introduction. Landing is by permit only and quarantine regulations apply.

Help protect our lakes

Aquatic pests can be spread from lake to lake by lake users.

Some Rotorua lakes are free of the worst aquatic pests. However, they may be easily introduced. A small weed fragment can be accidentally transferred on equipment used in another lake. Pest fish eggs can attach to weed fragments, and it only takes a single drop of water to transfer algae such as didymo.

When entering the Rotorua lakes (especially from the Waikato River system, which includes Lake Taupo and the hydro lakes) and when moving between the Rotorua lakes, it is important that you:

- Inspect trailers, engine wells, anchors, propellers, fishing gear and other wet equipment to ensure they are not accidentally carrying either weed fragments or pest fish species.
- Look out for unusual fish in the lakes. If you suspect you've seen either catfish or koi carp in Bay of Plenty waterways, please immediately contact DOC, phone 07 349 7400 or Bay of Plenty Regional Council, phone 0800 884 880.

To stop aquatic pests establishing in the Rotorua lakes, remember to **Check, Clean, Dry** all items before entering and when moving between, waterways.

- ***Check:*** Remove all obvious clumps of weed and look for hidden fragments on all equipment.
- ***Clean:*** Soak and scrub all items for at least 1 minute in either: hot (60°C) water, 2% (200 ml/10 L water) solution of household bleach, or 5% solution of dishwashing detergent (500 ml/10 L water).
- ***Dry:*** If cleaning is not practical, after the item is completely dry to touch, wait an additional 48 hours before use in any other waterway.

Who does what?

Responsibility for managing the Rotorua lakes is shared by the following agencies.

The Department of Conservation (DOC)

DOC administers areas of lake foreshore, mostly as scenic reserves. DOC is also responsible for the protection of New Zealand's native freshwater fish and their habitat.
Contact DOC Rotorua, phone 07 349 7400.

The Rotorua District Council (RDC)

RDC maintains public boat ramps and jetties on some reserves for lake access and removes weed accumulated on the shoreline of reserves after storms. RDC is also responsible for any effects of activities that take place in the lakes. You must apply for permission from RDC to close off, or hold an event, on any part of a lake.
Contact RDC, phone 07 348 4199.

Bay of Plenty Regional Council (BOPRC)

BOPRC is responsible for protecting water resources under the Bay of Plenty Regional Policy Statement. The council issues permits and monitors the state of water resources (excluding fisheries). BOPRC is also responsible for navigation safety and provides harbour master services on Rotorua's lakes.

To enjoy safe boating on the lakes see the BOPRC brochure *Lakes Guide for Recreational Users* or for general enquiries, phone 0800 884 883.
Contact BOPRC, phone 0800 884 880.

Fish and Game New Zealand (Eastern Region)

Fish and Game New Zealand has responsibility for sport fisheries and game bird hunting, and can advise on fishing areas and regulations. Fish and Game has trout fishing information pamphlets for many of the Rotorua lakes.
To obtain a fishing licence, phone 0800 licence (0800 542 362) or go to http://eastern.fishandgame.org.nz/

Te Arawa Lakes Trust

Te Arawa Lakes Settlement Act 2006 saw the transfer of 13 lake beds to Te Arawa Lakes Trust. The Rotorua lakes are taonga and are linked traditionally, culturally and spiritually to Te Arawa.
Contact Te Arawa Lakes Trust, freephone 0508 Te Arawa (0508 832 729).

NEW ZEALAND CARE CODE

- Protect plants and animals
- Remove rubbish
- Bury toilet waste
- Keep streams and lakes clean
- Take care with fires
- Camp carefully
- Keep to the track
- Consider others
- Respect cultural heritage
- Enjoy your visit

Toitu te whenua/ leave the land undisturbed

Appendix 2 – Aquatic Pest Coordination Group Survey

1 *Do you know what hornwort is?* ☐ Yes ☐ No

2 *Do you know if there are there any koi carp/catfish in these lakes?* ☐ Yes ☐ No

3 *Do you know how aquatic weeds are spread around the lakes?* ☐ Yes ☐ No

Level of awareness of aquatic pest issues?

☐ None ☐ (1) Low ☐ (2) Medium ☐ (3) High

Have you seen any pest fish?

☐ Yes ☐ No

Do you know what to do if you see any pest fish?

☐ Yes ☐ No

Are you familiar with the Check, clean dry campaign?

☐ Yes ☐ No

1 *Have you heard of Didymo?* ☐ Yes ☐ No

2 *Do you know where is it found?* ☐ (2) Yes- South Island ☐ No

☐ (3) Yes- Mainly in rivers

Level of awareness of Didymo?

☐ None ☐ (1) Low ☐ (2) Medium ☐ (3) High

Do you know how to reduce the risk of spreading aquatic pests?

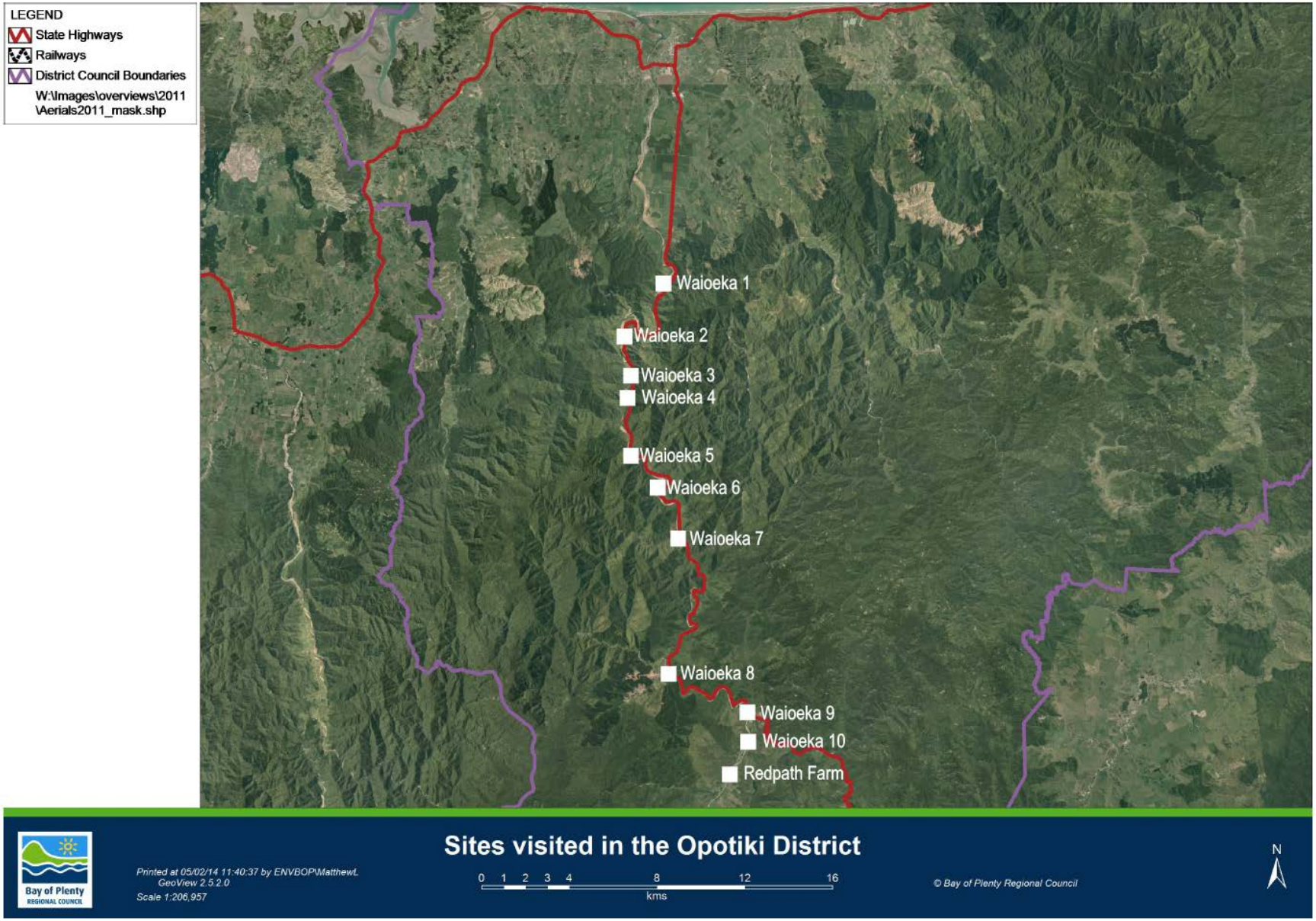
☐ Yes ☐ No

Do you think water quality in the lakes has improved?

☐ Yes ☐ No

Comments:

Appendix 3 - Sites visited in the Bay of Plenty regions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Redpath Farm
Sites visited in the Opotiki District
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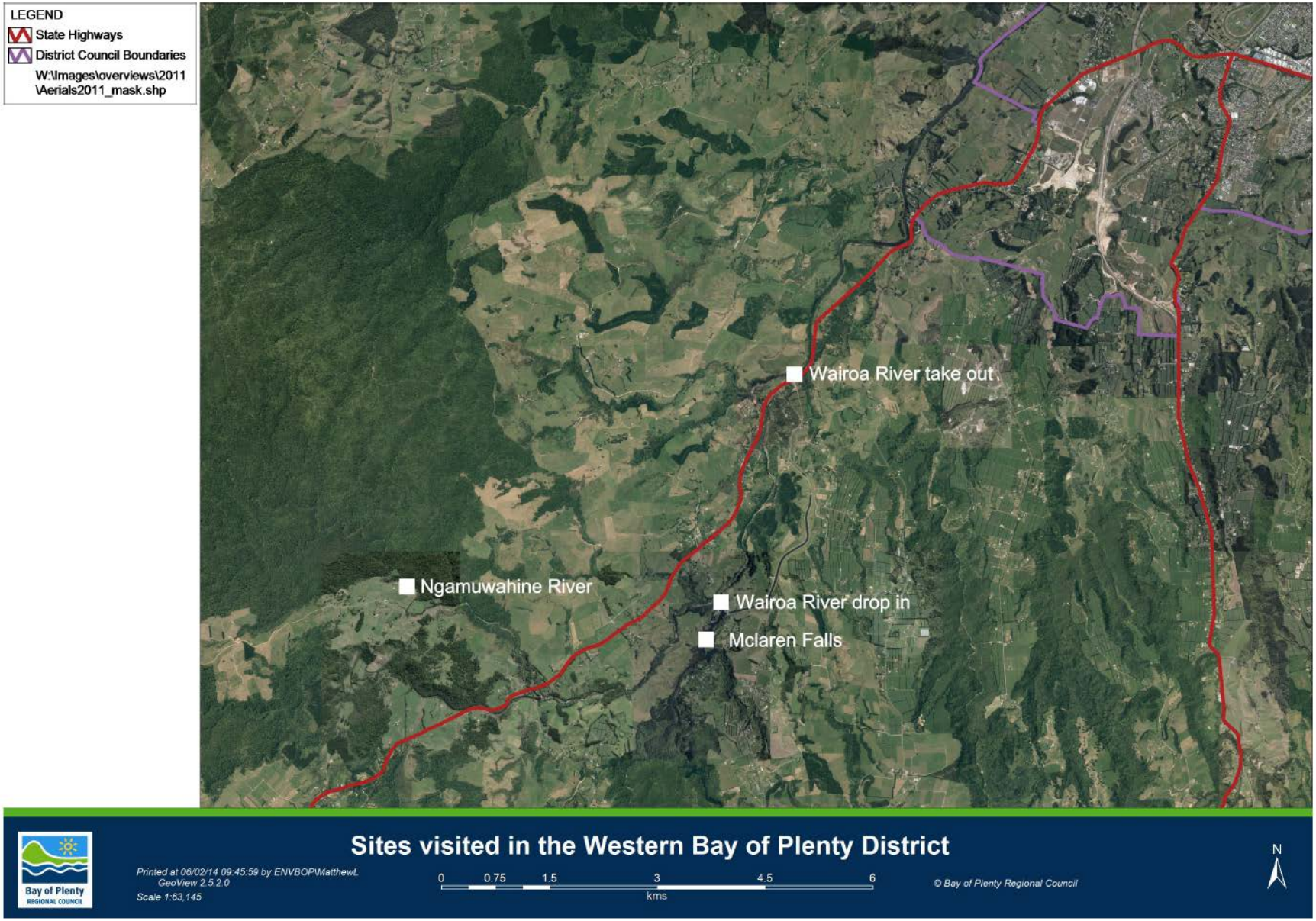
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Ngamuwahine River
Wairoa River drop in
Mclaren Falls
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© Bay of Plenty Regional Council
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Bay of Plenty
REGIONAL COUNCIL

Appendix 4 – Boat wash survey

Date: ..... Location: .....

Weather: ..... Vessel: Boat / Jet ski / Kayak

Place of residence: .....

Purpose of voyage: Fishing / Water sports / Other

Water source previously come from: Lake / Sea / River

Location: .....

Do you know about aquatic weeds / fish: Yes / No

Do you clean your vessel prior to changing water sources: Yes / No

Aquatic weed found on vessel: Yes / No

Type: .....

Appendix 5 – Regional Grouping for the origin of lake/river users

Rotorua region

Rotorua
Tarawera
Ngongotahā
Rotomā
Tarawera
Rerewhakaaitu
Rotoiti

Whakatāne region

Whakatāne
Kawerau
Matatā
Galatea
Edgecumbe
Ōhope
Ōpōtiki

Tauranga region

Tauranga
Te Puke
Pukehina
Pāpāmoa
Maketū
Katikati
Mount Maunganui
Waihi

Waikato region

Tokoroa
Hamilton
Matamata
Te Awamutu
Reporoa
Morrinsville
Thames

Wellington

Wellington
Hutt Valley
Masterton

Hawkes Bay region

Gisborne
Hastings
Napier

Whanganui/Manawatu region

Horizons

Northland

Auckland

Taranaki

South Island

Overseas

Australia
Canada
Unites States of America
Other

Appendix 6 - Retail outlets visited

Rotorua sites	**Name**
Camping grounds	All Seasons Holiday Park
	Blue Lake Holiday Park
	Cosy Cottage Holiday Park
	Holdens Bay Holiday Park
	Ōkataina Lodge
	Rotorua Family Holiday Park
	Rotorua Top 10 Holiday Park
	Rotorua Thermal Holiday Park
	VR Holiday Park
	Waiteti Trout Stream Holiday Park
	Willow Haven
Retail outlets	Bill Davies Outdoor Sports World
	Dive HQ
	Hamills
	Hunting and Fishing
	i-Site Rotorua
	Kathmandu
	Lake Tarawera Water Taxi
	Macpac
	O'Keefes
	Outdoorsman Headquarters
	Redwoods Information Centre
	River Rats
	Rotoma's Trading Post
Tauranga Sites	**Name**
Tourism	Tauranga i-Site
	Te Puke i-Site
Retail Outlets	Bivouac Outdoors
	Burnsco Mount Maunganui
	Burnsco Tauranga
	Hamills
	Hunting and Fishing
	Macpac
	Sportsworld Te Puke
	Top Catch
Whakatāne Site	**Name**
	Hunting and Fishing
Ōpōtiki Site	**Name**
	Ōpōtiki Bait and Tackle
	Hickeys Sport
	i-Site Ōpōtiki

Appendix 7 - Stop the Spread game instructions

Interactive “Stop the Spread” games for children

Invasive weed and pest fish tag

Kids play tag in 15 x 15 m plot using a spray bottle to symbolise the cleaning of boats and trailers. Depending on the size of the group, one to five children are the taggers and wears a Stop the Spread t-shirt and uses a spray bottle filled with water to tag the other children. All of the other children carry a lanyard with an image of an invasive weed or fish. When tagged, the child hands over the lanyard to the tagger and sits down until all of the other children have been tagged. The last child standing is the winner and one of the next taggers.

Required items: lanyards with images of fish and weeds, spray bottles filled with water, Stop the Spread t-shirts, traffic cones or flags to mark the boundaries.

Didymo fishing

A large bucket is filled with warm/hot water in which tea bags and cotton wool are mixed with dishwashing liquid. This gives the cotton wool a slimy texture and a yellow-brown colour similar to didymo. This mixture is emptied into a large clear container with water containing plastic magnetic fish. Children take turns trying to catch the fish with plastic rods which is difficult due to the “didymo”. This illustrates the negative effects didymo has on streams for human use.

Required items: bag of cotton wool, tea bags, dishwashing liquid, bucket, large clear container, plastic magnetic fish and plastic fishing rods.

Appendix 8 - List of Ministry for Primary Industries and Bay of Plenty Regional Council products distributed

From Bay of Plenty Regional Council

- "Clean your Boat…" fluorescent propeller flags
- "Clean your Boat…" floating key rings
- "Clean your Boat…" t-shirts
- "Clean your Boat…" hoodies
- "Clean your Boat…" swim bags
- "Clean your Boat…" drink bottles
- "Clean your Boat…" ponchos
- "Clean your Boat…" sunglasses, shammys
- "Clean your Boat…" tie downs
- "Clean your Boat…" cooler bags
- Pest Patrol trout bags
- Department of Conservation 'Help Protect the Rotorua Lakes from Aquatic Pests' brochure
- "Clean your Boat…" A5 pamphlet
- "Clean your Boat…" and coastguard DLE pamphlet

From Ministry for Primary Industries

- 250 mL and 1 L spray bottles used for cleaning vessels and equipment
- 20 mL sachets of detergent for decontamination process
- Pocket "how to clean…" booklets
- Didymo Posters (various designs in A3 and A4)
- "Protect your Patch" brochures
- Check, Clean, Dry temporary tattoos
- Check, Clean, Dry bumper stickers
- Check, Clean, Dry corflute signs
- Check, Clean, Dry pens
- Check, Clean, Dry key rings
- Protect our Waterways posters (various A3 and A4 sizes)

Appendix 9 - Boat Wash function and recommendations

Operational weekends/day

- The holiday period (23 December–9 January) was the busiest with the most people out and about on the lakes.
- It is ideal to start operating the weekend before Christmas, operating only on the weekends and then working fulltime from Boxing Day until the end of the holiday period.
- After the holiday period, it is recommended to work only weekends, public holidays and events.
- When at lakes which target boats upon exiting the water, it is best to set up later in the morning and stay until later in the afternoon. Often, the majority of boats exit these lakes around 5:00 pm or 6:00 pm
- When at lakes where decontamination prior to entry is necessary, aim to be set up by 8:30 am-9:00 am.

General

- A knapsack is handy when decontaminating kayaks, anchor wells and hatches. It is recommended to have one of these handy whilst operating the boat wash.
- The ramp width requires adjusting to allow jet ski trailers to pass over the boat wash. If not adjusted correctly, there is the potential for them to fall off the ramps and drop onto the tray.
- An emphasis on the alignment of ramps and cones is required when setting up. Vehicles and trailers are required to approach the ramp in a straight line, or there is the potential risk for boat, trailer or boat wash damage to occur. Recommend having a measuring tool or a length of rope at the comfortable maximum distance of 2.5 m.
- The entire boat wash set up can be done by one person, however, two are generally required to remove and replace the tray.
- The remote is very handy to use as it allows for the operator to stand in front of the vehicle to guide them onto the ramp whilst also operating the boat wash.
- The giveaway packs are very useful as they work as an indicator when approaching lake users. The giveaway packs are a useful introduction tool and are appreciated by all.
- Often, more washes took place on quieter days as users were not as rushed to enter/leave the lake and there was more time to talk to users and encourage them to go through the boat wash.
- On busier days, it is recommended to not hinder anyone while they are loading or preparing to unload. They can become annoyed and abrupt, it is best to approach people upon arrival, at jetties or after the departure from the boat ramp

Appendix 10 - Letter to events for biosecurity protocol

22/09/2016

Bay of Plenty Regional Councils Biosecurity protocol for prevention of aquatic pest species incursions during events.

Read and abide by this protocol in order to partake in events in Bay of Plenty waterways. Failing to properly clean and decontaminate vessels and equipment before entering any Bay of Plenty waterway is a significant risk. It is an offence under section 52 of the Biosecurity Act to knowingly communicate a pest or unwanted organism e.g. transport it from one waterway to another. The penalty upon conviction, for an individual person, is imprisonment for a term not exceeding five years and/or a fine not exceeding $100,000.

Introduction

Bay of Plenty Regional Council (BOPRC) is responsible for managing pests named in the Regional Pest Management Plan for the Bay of Plenty Region 2011-2016 (RPMP). Council use powers under the Biosecurity Act 1993 to ensure compliance with the RPMP and to protect the regions natural environment from pests.

The Bay of Plenty region contains a number of lakes and rivers which are popular places for people to recreate and provide habitat for native plant and animal species. Pests can degrade the quality of our waterways and impact on native species and people's enjoyment.

High risk activities and species.

The Bay of Plenty is free of a number of pest species, and while some exist within the region, many lakes and rivers remain free of these problematic species. A number of pests are present in New Zealand, the goal of the RPMP is to prevent further pest establishment in the Bay of Plenty.

Particular attention needs to be given to those users who enter Bay of Plenty waterways soon after using Lake Taupō, the Waikato River and all its hydro lakes, and many water bodies in the Auckland region were a number of aquatic pests reside.

Vessel cleaning and decontamination before entering Bay of Plenty waterways

All vessels and equipment used as part of any event in the Bay of Plenty region must:

1) Be thoroughly cleaned before entering and/or moving between water bodies, remove visible live and dead animal and plant material from trailers, anchor wells, nets, waders, fishing equipment or any other spaces or items potentially housing a pest species.
2) Decontaminate all equipment before entering any Bay of Plenty waterway, instructions for the correct decontamination procedure can be found at http://www.biosecurity.govt.nz/files/pests/didymo/2010-freshwater-pests-leaflet.pdf or by contacting a member of BOPRC's Biosecurity team.
3) Ensure all jet skis or jet boats have had their jet unit flushed prior to entering the lake. Jet units are particularly risky in terms of pest spread.
4) Ensure all boat trailers are clean, all cavities drained and free of any living or dead plant or animal material. Pest species, particularly pest fish can use these spaces and can be easily transported, particularly if trailers are left submerged in water bodies for extended periods.

BOPRC's RPMP rules regarding the transfer of aquatic pests

Rules apply in regard to aquatic pests within the Bay of Plenty region, BOPRC are authorised under the Biosecurity Act 1993 (the Act) to ensure compliance with these rules. Failing to properly clean and decontaminate your vessels and equipment prior to the event could amount to knowingly communicating a pest, a breach of RPMP rules, those responsible will be prosecuted under the Act.

Offences:

1) **A breach of any RPMP rule is an offence under section 154 of the Biosecurity Act 1993. With individuals liable on conviction of a fine up to $5,000.**

RPMP rules, statutory obligations regarding pest species

Rules specific to aquatic pest species are dependent on their classification, below is a list of aquatic pest species managed under the RPMP and for whom the rules and statutory obligations apply.

RPMP classification	Aquatic pest species
Agency Pests	Didymo, Hydrilla, Salvinia, Water Hyacinth
Exclusion/Eradication Pests	Alligator weed, Marshwort, Senegal tea, Spartina, Water poppy, Brown bullhead catfish, Koi carp, Perch
Containment Pests	Egeria Densa (Brazilian waterweed), Hornwort, Lagarosiphon major (Oxygen weed), Yellow flag iris, Rudd, Tench
Restricted Pests	Elodea canadensis (Canadian pondweed), Mexican water lily, Parrots feather, Gambusia

The intentional spread of any of the species listed above is an offence, below is a summary of the plan rules and statutory obligations related to the RPMP.

RPMP Rules:	Rules
No person shall move or interfere with any article or substance left in place by an Authorised Person for the purpose of monitoring, controlling or eradicating any pest plant or pest animal.	Section A(1), B(1), C(1), D(1), E(1) F(1), G(1)
No person shall move, or allow to be moved, any machinery, vessel, organism, risk goods or other goods that is contaminated with any pest.	Section B(2), C(3), D(6), E(3)

Statutory obligations:	
No person shall knowingly communicate, cause to be communicated, release, or cause to be released, or otherwise spread any Exclusion and Eradication pest plant or animal	Section A(2), B(3), C(4), D(7), E(4), F(2), G(2)

For more information on Aquatic pests visit http://www.boprc.govt.nz/environment/water/aquatic-pests/ or contact a Regional council Biosecurity officer on 0800884880.

Appendix 11 - General comments and observations

1 Summer students should contact the Water Administration Officer at the Rotorua office when looking for events to attend. They are responsible for lake closures and have not only event information but contact details as well.

2 Make contact with event organisers as early as possible. This ensures they have plenty of notice and sufficient time to contact participants if necessary.

3 Provide event organisers with didymo information, and some free merchandise (T-shirts, key rings, swim bags etc.) to either use as spot prizes for competitors or for themselves. Organisers are often responsible for several events each year and when they wear our user merchandise, the slogans and messages are seen by a large number of people.

4 Arrange with organisers, the opportunity to speak about aquatic pests and cleaning vessels at event briefings and try to encourage them to be more proactive by carrying out decontamination themselves. Ask about putting aquatic pest and didymo information brochures in event packs.

5 If event registration is the day prior to the event itself, ask that a decontamination station be set up (e.g. if it involves wetsuits) and supervised by members from their organisations.

6 Large amounts of merchandise are required for survey packs, event organisers, retail outlets, tourist accommodation and other contacts. Conducting regular stock counts and ordering in stock that is running low, ensures enough stock is available for the weeks ahead. This is especially vital coming up to Christmas and New Year, as this is the busiest survey period.

7 Ordering collateral from the Ministry for Primary Industries (MPI) should be done as soon as possible. Sometimes MPI run out of merchandise which makes it very hard to distribute materials to the required places.

8 Distribute brochures to retail outlets and tourist accommodation early in the programme. This ensures they are stocked prior to the busiest time of the year.

9 Camp grounds and holiday parks are especially important places to distribute brochures and posters to, as they are places that people often choose to stay with their boats. It is also recommended to have the holiday park owners educated so if someone does arrive with a boat etc. they can help educate them on the cleaning process.

10 Backpackers often tramp in the South Island then travel up to the North Island with the possibility of having contact with a large number of waterways in a short period of time. Therefore, they are potentially a high risk vector for didymo dispersal. Ask backpacker hostel owners for permission to put posters on notice boards and take a pile of didymo brochures directed at those that tramp.

11 Encourage motel owners to put posters in communal areas.

12 Ask owners of fishing outlets or boat show rooms to hand out a brochure with every fishing license/fishing rod/boat sold.

13 Many people that were spoken to over the summer period had questions about boating rules and where ski lanes were at lakes. It is a good idea to put the Rotorua lakes Map brochure into the packs (they also include boating rules).

14 If someone that has been approached states that they have been talked to in previous years, it is a good idea to still try and engage them. It is possible to ask them if they would mind being updated about biosecurity issues within the region. These users often have very poor awareness or have forgotten information from previous years despite having the merchandise.

15 When conducting river surveys, try not to attend the Wairoa River on too many occasions as you will find repeat users. One visit at the beginning, once in the middle and once at the end of summer is necessary.

16 Different packs should be made for river users. These packs should focus more on didymo and less about aquatic weeds. This is because many of them only use rivers so it is better for them to have the didymo knowledge more strongly reinforced.

17 Choose busy weekends such as public holidays to visit more remote rivers (e.g. Waioeka) and lakes (e.g. Aniwhenua and Matahina). This will increase the chance of meeting people, rather than travelling long distances for few or no surveys. Although it is recommended to only visit these locations once or twice during the summer period.

18 Murray Redpath has a farm that the Waioeka River runs through. He has good didymo awareness and has a decontamination station set up for fishermen using the river. It is recommended to provide him with 'Simple Green' if necessary and offer him some free merchandise.

19 Have the Rotorua Lakes Council (RLC) phone number handy as many users will ask about RLC related issues such as about rubbish and dogs.

20 Encourage organisers to be more proactive with regards to invasive pest awareness at events. The aim is for organisers to contact us about wetsuit decontamination and for them to run the stations. We can supply the equipment for this purpose. Some organisers have included decontamination as a condition for entering their event which is promising.

21 Awareness of pest weed, fish and didymo issues need to be more strongly advocated at the lakes without hornwort (Ōkāreka, Ōkataina, Rotomā, Tikitapu). Particular attention needs to be paid to users of these lakes to ensure they are made aware of the pristine nature of the lake and the importance of checking equipment, especially if they were last in the Waikato region.

22 When surveying at ramps with weed cordons, regular checks along the beach within the cordon should be carried out. This will ensure that unwanted pests can are detected as early as possible. Regular checking of parked trailers is also recommended.

23 Lake Rotomā should be focused on more than the other lakes due to the lack of hornwort and egeria. Especially after an ongoing westerly, as a lot of people travel from Hinehopu and Gisborne Point where a lot of weed often washes up.

24 When it suddenly becomes windy at Lake Tarawera, it is a good idea to sit at either Lake Ōkāreka or Lake Tikitapu to ensure any users coming from Lake Tarawera are not moving lakes with weed on their equipment or trailers.

25 It is a good idea to log hourly at each lake/boat ramp. This way it is easy to establish why data may be skewed to one conclusion and why some sites have more surveys than others.

26 If the Department of Conservation (DOC) has a student, it is advised to work closely with them. This way tips can be shared and ideas and concerns can be bounced off each other. As well as this, it increases the total number of surveys and reaches a larger audience.

27 Start writing the report at the start of summer when the weather does not permit going out to the lakes. This way it is not so time consuming at the end of summer and allows for students to become educated about the different pest weeds and fish.