Meeting: Regional Council

Meeting Date: 1 August 2024

Supporting Documents

Agenda Item 10.7 Regional Pest Management Plan: Partial Review

Appendix Three: Cost Benefit Assessments to support amendments proposed through Regional Pest Management Plan review 2024.

Part One

Cost benefit analysis

CAULERPA SEAWEED

Common name: Caulerpa seaweed

Latin name: *Caulerpa brachypus, Caulerpa parvifolia*

Family: Caulerpaceae

National Pest Status: Unwanted organism under the Biosecurity Act

Introduction

Caulerpa (*C. brachypus, C. parvifolia*) was first discovered at Aotea Great Barrier Island NZ in July 2021. Since then, it has been found at Ahuahu (Great Mercury Island), Te Rawhiti Inlet in Northland, Waiheke Island and Kawau Island. It is not known where or when Caulerpa first arrived in New Zealand waters, but the amount found suggests it has been in New Zealand for several years. Both species are classified as Unwanted Organisms under the Biosecurity Act.

Controlled Area Notices (CAN) are in place at Aotea (Great Barrier Island) encompassing the entire western coastline to 40 metres depth, Ahuahu (Great Mercury Island) encompassing the western coast from Maunganui Point to Ahikopua Point and Te Rawhiti Inlet between Whau Point (south-eastern tip of Te Ao Island), Poroporo Island (southern shore), and Tokatokahau Point (northern tip). CANs consist of rules imposed by the Ministry for Primary Industries such as anchoring and fishing restrictions.

Mana whenua have imposed rāhui on Aotea (Great Barrier Island), Ahuahu (Great Mercury Island)and Te Rāwhiti Inlet in Northland, with the same restrictions.

There are no identified populations of Caulerpa in the Bay of Plenty region.

No effective broad acre control has been identified although numerous methods have been assessed but control rarely exceeded 90%. Because of reproductive capability, 100% control is required for successful management. Early identification and action for discrete areas can be successful.

Caulerpa is a marine alga (seaweed) with green fronds growing upwards to 10 centimetres with long and colourless rhizoids growing down. The two species are closely related and appear identical. It grows below the tideline between 2 metres and 40[1] metres deep as a dense mat and can adapt to low salinity (>20 psu of seawater 35 psu).

Caulerpa is globally recognised as a highly invasive species posing a threat to endemic marine ecosystems with potential to out-compete native species for light, food or space, creating a monospecific mat meadow. It is likely that herbivorous fish will make no measurable impact on the

[1] Initially thought to be restricted to depths up to 10 m, Caulerpa has been found at more than 40 m in depth (NIWA, 2022).

Caulerpa cover[2]. It responds with accelerated growth to increased phosphorus (P) levels in water hence urban and rural runoff containing elevated P will enhance growth.

Caulerpa spreads by fragmentation. Even a small, broken off fragment can form a new plant. Distances between colonies can be great due to transport on boat anchors and fishing gear. There is little information on sexual reproduction for C. brachypus and C. parvifolia.

The genus (Caulerpa) is currently intensively researched for food and medicinal properties.

Organism Impact Assessment

Table 1: Organism Impact Assessment

Category	Current	Potential	Comment	Source
Environment				
Marine environment	-	H, DD	The formation of permanent meadows can induce a long-term impact.	Francour et al (2009).
	-	H, DD	Research shows scallops and kina have been negatively impacted. Other food species not investigated.	Middleton, NIWA (April 2023)
	-	H, DD	Overseas research (Harmelin et al, 1999) into C. taxifolia shows 30% reduction in biodiversity and a 50% reduction in fish biomass over six years. These losses will impact on other species that depend on fish for food (i.e. seabirds).	No investigation identified.
	-	H, DD	Potentially places Tauranga Harbour at a higher risk because of elevated P levels from urban runoff.	
Species diversity	-	H, DD	Like invasive Caulerpa species found overseas, those found in New Zealand form large monoculture mats, outcompeting native seaweeds and seagrasses, smothering shellfish beds, reducing the diversity of	NIWA

[2] Southeast Florida was subjected to a C. *brachypus* invasion in 2003. C. brachypus quickly became the dominant chlorophyte with >60% cover. The growth was found to be P limited with strongest growth where land-based nutrients (storm water, farm runoff, sewerage) were available. Water temperatures less than 13°C caused some die back. Herbivorous fish made no measurable impact on C. *brachypus* cover (Lapointe et al, 2010).

			fauna and impacting severely on the marine food web. More research is needed on the species found in New Zealand.	
	-	H, DD	Overseas research into C. taxifolia shows 30% reduction in biodiversity and a 50% reduction in fish biomass in six years.	Harmelin et al. (1999)
Threatened species	-	M, DD	Potential for loss of species due to the loss of diversity. NZ species at risk yet to be identified.	
Economic				
Tourism	-	M, DD	Sport fishing, commercial marine tourism activities e.g. marine seascapes viewed by diving/ snorkelling. This will have a larger impact on communities more reliant on an attractive marine environment.	Harmelin et al. (1999).
Fisheries	-	H, DD	Impact on fish stocks and on marine biodiversity – dramatic reduction found to have occurred in other sites (estimated at up to 50% of Fish Biomass in the Mediterranean).	Harmelin et al. (1999).
	-	H, DD	Current fishing sector in Bay of Plenty economy worth $63.7 m (2023). In Opotiki $26 m (5.5% of Opotiki GDP). The loss of fish species and abundance will impact on the economics of local inshore fisheries, possibly at level of 50% or more. Aquaculture is likely to experience higher costs for transporting gear and maintaining infrastructure.	Infometrics GDP figures.

Seafood processing		DD	Reduction aligned with reduction in fisheries.	NRC (2024).
Ship building/vessel servicing		DD	Unknown impacts.	NRC (2024). Northland region estimated a cost of $7m-$21m in the first 10 years of the Bay of Islands Caulerpa incursion.
International trade	-	DD	Reputational damage to New Zealand. Potential cost to NZ trade if Caulerpa-free countries refuse delivery of produce from New Zealand ports. This cost would be particularly high for Tauranga and would have flow-on effects through the regional economy	For example, The Guardian 23/11/23. *The fast-growing invasive seaweed choking New Zealand's coastline.*
Social/Cultural				
Human health	-	DD	Nil identified.	
Recreation	-	H, DD	Recreational fisheries through loss of fish biomass, loss of diversity for diving and snorkelling activities. 1,500-plus recreational boats resident in the region.	Harmelin et al.
	-	H, DD	Amenity values associated with enjoying the marine environment and landscape.	
Māori culture	-	M, DD	Loss of shellfish beds, loss of diversity of fauna.	Opo Ngawaka, Chair, Ngati Rehua Ngatiwai ki Aotea Trust (Waiheke Local Board, 2023) Biosecurity NZ (2024)
	-	H, DD	Disproportionate impact on mana whenua, with mana and identity irrevocably diminished.	
	-	H, DD	Loss of mauri of sites and areas of high cultural value	
	-	H, DD	Loss of breeding habitat for inshore fish species.	

	-	H, DD	There are indications that taonga species (Tipa and Kina) have been negatively impacted in areas of dense Caulerpa.	Middleton, NIWA (April 2023)

L = Low, M = Moderate, H = High impact, DD = Data deficient

Analysis of benefits and costs

The baseline

National surveillance for Caulerpa is undertaken as part of the Marine High Risk Surveillance programme and is currently funded through the NZ Government (Ministry for Primary Industries).

Regionally, the Tauranga Harbour is intensively surveyed (100 days per year) for marine pests, and offshore close islands such as Tuhua and Motiti are surveyed five times per year. The Bay of Plenty Regional Council works in partnership with the University of Waikato (Coastal Marine Field Station, Sulphur Point, Tauranga). The surveillance is done by the Bay of Plenty Regional Council's dive team. The dive team comprises 6 divers, making up 4 full-time equivalent positions. The divers spend about 20 percent of their time in the Bay of Plenty waters, and the balance of time providing biosecurity diving services to other regional councils.

In February 2024 the New Zealand Government announced a $5 m fund to accelerate the development of removal techniques (NZ Govt, 2024). The findings from the actions associated with this fund will be useful in informing the Bay of Plenty approach to regional incursions.

While funding is currently through the NZ Government, it is likely that as Caulerpa spreads the government will withdraw funding and the ongoing responsibility will be passed to regional councils, though how Caulerpa will be managed in the long term is yet to be decided.

Biosecurity NZ (2024) advise that to prevent establishment outside the current infested area, management strategies should include establishing geographic limits, regular surveillance of high-risk sites, response plans for infestations outside the area, regulations to manage spread by human pathways, and investment in communications and compliance.

The following cost benefit analysis is both qualitative and quantitative, drawing on quantitative information when it is available. Based on the National Policy Direction guidance, a medium level of analysis is appropriate (refer Appendix 1). Accordingly, the assessment uses both qualitative and quantitative information. Two scenarios are assessed:

1. Surveillance and exclusion
2. Sustained control

Option 1: Surveillance and exclusion

The objective of the exclusion programme is '*to prevent the establishment of the subject, or an organism being spread by the subject, that is present in New Zealand but not yet established in an area*.' (NPD, 2015).

The exclusion programme covers species that Bay of Plenty Regional Council has opted to be the lead agency or partner for managing new incursions into the region. The pest must not currently be present in the region (RPMP, p.33).

Under Rule 6 (RPMP) '*No person shall… (2) Move, or allow to be moved, any live pest listed in this RPMP, or any machinery, vessel, organism or goods that are contaminated with any pest listed in [the] RPMP.* In the case of Caulerpa, this would include anchors and fishing gear.

Rule 8 will apply, where: *All persons must notify Council once they become aware they have received products contaminated by marine pests.*

Under this option the Council may impose CANs to stop the spread of incursions and carry out management actions to contain and remove identified infestations.

Costs

It is anticipated that all costs would be covered by the Bay of Plenty Regional Council. Costs of exclusion are largely based around surveillance, but include a cost for addressing minor incursions. Including Caulerpa as an exclusion pest would require an additional 20% over and above current resourcing. This would cover surveillance, monitoring and minor incursion response. A breakdown of these costs is provided in Appendix 2. Divers would continue the surveillance that is currently occurring, with priority for the Tauranga Harbour (surveyed 100 days per year) and close inshore islands (Tuhua and Motiti 5 times per year).

Rules and restrictions for anchoring and fishing activities would apply in areas where Caulerpa was discovered. Ensuring compliance will carry monitoring and enforcement costs.

There will be costs associated with education and communication, ensuring people know about the importance of keeping fishing gear and anchors free of seaweed, but these are likely to be included in the current activities of this type (e.g. summer ambassadors on the water).

Benefits

The benefits of successfully excluding Caulerpa from the region are the avoidance of the effects listed in the Organism Impact Assessment (Table 1). Based on overseas experience with *C. taxifolia*, the environmental, economic, and socio-cultural costs of Caulerpa are high and ongoing.

There is no published research on the full costs and benefits in the New Zealand context. The general environmental impacts are known and can be seen in the Auckland, Northland and Waikato regions. The extent to which a major Caulerpa incursion will impact on economic, social and cultural wellbeing is unknown.

The 260km of Bay of Plenty coastline is a route for recreational vessels travelling between home and holiday areas, with 1,500-plus resident recreational boats excluding trailered boats. The Port of

Tauranga is a conduit for imports and exports. The Tauranga Harbour has 3 haulout facilities and hardstands used by boats from Opotiki to Auckland and beyond. The diversity and volume of marine life along the coast and around the outlying islands, including the Motiti Protection Areas, are at risk.

Risks to success

Clause 6(2)(g) of the National Policy Direction (NPD) requires that the analysis consider the risks to success. The following section identifies and assesses the risks as required under clause 6(3)(a) of the NPD.

The following table summarises the risks, assesses the likelihood that the risk will eventuate (low, moderate, high), and the potential impact on the success of the objective (low, moderate, high).

Table 2: Risks of not achieving the exclusion objective

Risk	Likelihood	Impact	Risk detail	Potential for mitigation
Technical and operational risks of the option (i.e. outcome risk)	M	M-H	Surveillance is inherently difficult and resource intensive, relying on good identification of priority sites. For a marine pest such as Caulerpa, weather and sea conditions dictate what can be achieved (e.g. wind, waves, swells, and clarity of the water column. Similarly, the limits to diving at the depths where Caulerpa can establish (e.g. 30+m) will hamper the surveillance effort. Missing an incursion establishing, even by a relatively short timeframe, is likely to be the difference between the ability to contain it and not. Identifying Caulerpa populations early to enable removal places reliance on surveillance frequency. Caulerpa establishment and growth are driven in part by water temperature. Warm waters occur through summer when boat activity is at its greatest, meaning the high-risk period may	Incursion risk mapping Increased monitoring of priority sites based on risk factors may enable early detection. Increased risk will initiate higher levels of surveillance in the region. New means of surveillance such as underwater drones could reduce costs and increase efficiency. Collaboration with local communities including tangata whenua (Biosecurity NZ, 2024). Continue to support the Waikato Region with the dive team. Additional resources for surveillance and monitoring and enforcement through summer when risks are higher.

			overextend surveillance capability. Caulerpa is in the neighbouring Waikato region, so potentially easily transported by boats, or by tidal currents.	
Extent to which the option will be implemented and complied with (i.e. regulatory risk).	M	M-H	The Bay of Plenty has 260km of coastline. Many commercial and recreational boats travel along the east coast between Northland and Bay of Plenty. The potential to spread is through anchoring and fishing gear. Some boat owners may not understand the implications of the pest, and not take adequate care to ensure they do not transport Caulerpa.	Engagement with boat clubs and Coastguard to ensure boat owners and operators are aware of the issue and understand the risks.
Compliance with other legislation will adversely affect the implementation of the plan (i.e. legal risk)	L	L	A deficiency in capability to comply with the clean hull regulations means boats will be travelling from areas with Caulerpa to the Bay of Plenty region. Travel distances e.g. from Auckland to Tauranga,are necessitate anchoring on the way. These boats may be carrying Caulerpa on anchoring/fishing equipment.	Engagement with boat owners to ensure good practices.
Public or political concerns will adversely affect implementation of the option (i.e. socio-political risk)	M	H	Expect that Central Government funding will cease, and the ongoing management will fall on the regional council. The risk is the loss of funding through the regional council.	
Other material risk			Nil identified.	

Option 2: Sustained control

Should an incursion occur, Caulerpa will be managed by sustained control. The objective of sustained control is '*to provide for ongoing control of the subject to reduce its impacts and its spread to other properties*' (NPD, 2015).

Sustained control is appropriate '*Where a pest is well established and preventing its spread is no longer a realistic objective, management of the pest focuses on reducing the general impacts of the pest* (RPMP, p.79)

Under Rule 6 (RPMP) '*No person shall… (2) Move, or allow to be moved, any live pest listed in this RPMP, or any machinery, vessel, organism or goods that are contaminated with any pest listed in [the] RPMP.* In the case of Caulerpa, this would include anchors and fishing gear.

Under Rule 8 (RPMP) '*All persons must notify Council once they become aware they have received products contaminated by marine pests.'*

Costs

Costs of sustained control include costs of surveillance, but must also include costs for managing recent and existing incursions. Full costs are likely to fall on the Bay of Plenty Regional Council. The dive team of 4 FTE would spend 75% of their time in the Bay of Plenty region[3] at a total cost of $336,000.[4] In addition to the surveillance costs, an estimated annual sum of between $250,000 and $1 million would be required to address minor incursions.

Rules and restrictions would apply for anchoring and fishing activities in areas where Caulerpa has been discovered. In some cases, Controlled Area Notices would restrict where boats could anchor and fish, and at the very least they will require actions to ensure fishing gear and anchors are clean of seaweed. Ensuring compliance will potentially carry monitoring and enforcement costs.

As with the exclusion option, there would be ongoing costs of education and communication, ensuring people know about the importance of keeping fishing gear and anchors free of seaweed, but these are likely to be included in the current activities of this type (e.g. summer ambassadors on the water).

Benefits

The benefits of the sustained control option depend to what extent Caulerpa can be controlled. While exclusion avoids all the costs associated with loss of the environment, sustained control accepts some of those costs. The level will depend on the degree of investment in sustained control and the effectiveness of the tools available.

Risks to success

Clause 6(2)(g) of the National Policy Direction (NPD) requires that the analysis consider the risks to success. The following section identifies and assesses the risks as required under clause 6(3)(a) of the NPD.

The following table summarises the risks, assesses the likelihood that the risk will eventuate (low, moderate, high), the potential impact on the success of the objective (low, moderate, high).

[3] The balance of the divers' time would be on surveillance in the Waikato region.
[4] Assuming an annual rate of $112,000/diver including all costs of employment.

Table 3: Risk of not achieving the sustained control objective

Risk	Likelihood	Impact	Risk detail	Potential for mitigation
Technical and operational risks of the option (i.e. outcome risk)	M	H, but localised	Operational tools are not effective enough to reduce impacts or prevent further invasions. Caulerpa may grow undiscovered despite the surveillance programme, becoming too large (area) to successfully manage. Identifying Caulerpa populations early to enable removal places reliance on surveillance frequency. Caulerpa establishment and growth are driven in part by water temperature. Warm waters occur through summer when boat activity is at its greatest, meaning the high-risk period may overextend surveillance capability. The nature of the pest may mean that containing the spread is not possible with currently available technologies.	Priority sites based on risk factors may enable early detection. High level of education and communication encouraging community engagement to support and report. Additional resources for surveillance and monitoring and enforcement through summer when risks are higher. Collaboration with local communities, including tangata whenua (Biosecurity NZ, 2024). Continue to support research into technologies to contain Caulerpa.
Extent to which the option will be implemented and complied with (i.e. regulatory risk).	M	M-H	Dependent on a high level of ongoing funding. Availability of effective (and affordable) control methods. Dependent on a high level of compliance by boat owners and operators.	Ensure good level of communication with funders and set realistic expectations regarding funding. Engagement with boat clubs and Coastguard to ensure boat owners and operators are aware of the issue and understand the risks. Providing public moorings to negate

				the need for anchoring in popular spots may be a useful tool to stop spread (Biosecurity NZ, 2024).
Compliance with other legislation will adversely affect the implementation of the plan (i.e. legal risk)	L	L-M	If compliance with clean hull regulations requires travelling sufficient distance to require anchoring there may be a risk.	Engagement with boat owners to ensure good practices.
Public or political concerns will adversely affect implementation of the option (i.e. socio-political risk)	M	H	Expect that Central Government funding will cease, and the ongoing management will fall on the regional council. The risk is the loss of funding through the regional council.	
Other material risk			Nil identified.	

Conclusion

New Zealand is a small island nation. Caulerpa poses a highly significant threat to recreational and economic activities, to biodiversity, marine habitat, and mana whenua across the north of New Zealand, and in the Bay of Plenty region. Recreational threats include the recreational fishery and under-seascape. Economic activities threatened include international trade restrictions and direct threats to mussel and oyster farming where the potential for accelerated growth of Caulerpa in these nutrient rich waters may create a 'dead zone' whereby the death and decay of Caulerpa will absorb oxygen from the water and a subsequent release of the nutrients will complete the cycle. The monoculture Caulerpa mats do not favour the survival of bivalves that form the basis of the marine food web including domestic harvest (mana whenua).

Despite these threats and the overseas experience, there is little New Zealand-specific information, largely because the discovery of Caulerpa is relatively recent. Although there is a high level of uncertainty around costs of excluding and/or controlling Caulerpa, given the speed with which Caulerpa grows and the values at stake (many of which still require investigation to understand the full impact), investment in exclusion in the first place may enable an opportunity to find efficient means of management.

A high level of surveillance will assist in identifying early populations and help keep sustained control costs at lower levels. It is unknown whether an incursion can be entirely avoided.

Beside the high and ongoing costs of an incursion (measured in loss of the environmental, economic and socio-cultural wellbeing), the financial costs of a policy response to exclude Caulerpa from the region seem relatively small.

Appendix 1: Level of analysis assessment

The Guidance Document for the National Policy Direction for Pest Management 2015 (NPD) requires that the following four criteria be assessed to determine the level of cost-benefit analysis appropriate to each pest management situation. The criteria and assessment matters are set out below.

Assessment criteria 1: The likely significance of the pest or the proposed measures

The significance of this pest is high. It will have a significant impact the marine environment, and through that will impact on commercial and recreational fisheries, on in-water activities such as diving and snorkelling, and on the socio-cultural values associated with the marine environment. It is expected to have a disproportionate impact on Maori and their values. The pest is highly significant.

Assuming the surveillance programme is successful, the costs of management will be relatively low. Currently surveillance costs are part of a wider surveillance programme for marine pests. Where incursions occur the costs will increase, but again assuming that surveillance enables those to be identified in a reasonably short timeframe (when the pest is in a small and discrete area), the costs will be moderate. However, multiple incursions may occur over time given that Caulerpa is present in neighbouring regions (Waikato, Auckland). The costs may be highly significant.

There is little doubt as to the significance of Caulerpa contributing high risk to the economic and biodiversity values. Data deficiencies as to the risk of missing Caulerpa populations during surveillance remain high.

Overall, both the impacts of the pest and the longer-term potential costs of control are highly significant.

Assessment criteria 2: The likely costs relative to likely benefits

Caulerpa incursions will have high, ongoing, and increasing environmental, economic, and socio-cultural costs. These costs are expected to be very high relative to benefits (for example the loss of 50% of fish biomass). This relationship of benefits relative to costs suggests a moderate level of assessment would be appropriate under this criterion.

Assessment criteria 3: Uncertainty of the impacts of the pest and effectiveness of the measures

The impacts of the pest are largely known. Caulerpa infestations have occurred in other parts of the world, and in New Zealand (Northland, Auckland, Waikato). Caulerpa is globally recognised as a highly invasive species posing a threat to endemic marine ecosystems with potential to out-compete native species for light, food or space, creating a monospecific mat meadow.

Data deficit plays a major role in increasing the uncertainty of Caulerpa and effectiveness of measures to manage this pest. Again, the limitation on surveillance (weather and sea conditions) and the narrow window for effective intervention all increase uncertainty.

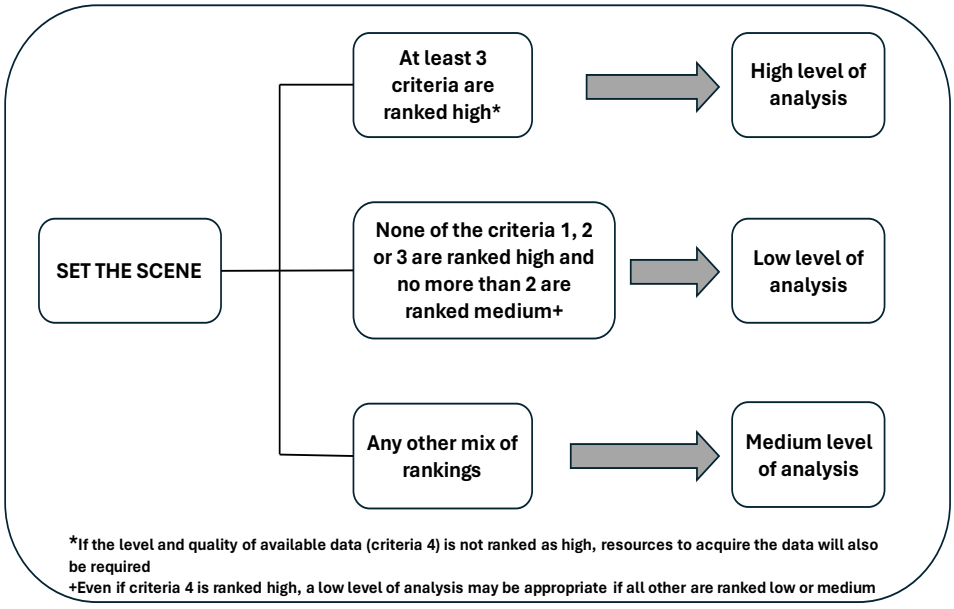
Overall, while the effects of the pest are widely known, the success of methods for management are uncertain. This information suggests a medium level of analysis for this criterion.

Assessment criteria 4: Level and quality of data available

This is a relatively new incursion, and there is little New Zealand specific data. Research by the Ministry for Primary Industries into costs and benefits has not been published. Where data is available it will be used in the cost benefit analysis. A high level of analysis is not possible at this time because of the lack of good data (as opposed to good information) both about the effects of Caulerpa and the effects of the surveillance.

Balancing the assessment criteria

The ranking of the assessment criteria suggest a medium level of analysis is appropriate for Caulerpa. Ideally quantitative cost benefit techniques should be used in this situation (although sensitivity analysis would not be required). The cost benefit analysis will use the qualitative information and quantitative data that is available.



Appendix 2: Estimate of costs

The cost estimate of Option 1 (surveillance and exclusion) is made up of the following annual costs:

- Communication and engagement $20,000
- Inspection $90,000
- Compliance $90,000
- Direct engagement with boaties, industry, marinas etc $5,000

Option 2, sustained control, would include an additional cost for addressing minor incursions:

- Minor incursion $250-$1m

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Part Two

Cost benefit analysis

CORBICULA (FRESHWATER GOLD CLAM)

Common name: Freshwater gold clam (also known as Asian gold clam)

Latin name: *Corbicula fluminea*

Family name: Cyrenidae

National Pest Status: Unwanted organism under the Biosecurity Act.

Introduction

Freshwater gold clam (*Corbicula fluminea),* also known as Asian gold clam, were first found near Lake Karapiro in early May 2023. Most recently (March 2024) gold clams were found in the Lake Taupo Aqua Park[5]. Currently gold clam can be found in the Waikato River from Lake Maraetai north where water temperatures range annually from 9° C to 25° C in the absence of geothermal water inputs.

Gold clam is classified as an Unwanted Organism under the Biosecurity Act. This means that it is illegal to 'knowingly move or spread the freshwater gold clam or water that may contain it.' To limit the movement of gold clam and other freshwater pests, clean-check-dry procedures[6] are required when boats are moved from the controlled stretch of the Waikato River to another part of the river or to lakes on the river. These procedures are also required in the Bay of Plenty.

Gold clam has not yet been found in the Bay of Plenty area and is not classified as a pest in the Regional Pest Management Plan (RPMP). However, on 10 November 2023 the Ministry for Primary (MPI) Industries issued a Controlled Area Notice (CAN) for the 14 Te Arawa lakes in the Bay of Plenty. This notice requires boat owners/operators who have been on the Waikato River in the previous 30 days to clean their boat at a designated wash station. Lake Ōkataina has additional protections, with controlled access and hours of access (Te Arawa Lakes Trust, 2023).

Gold clam is an aquatic freshwater bivalve mollusc native to Eastern Asia. It lives in well oxygenated freshwater and prefers sand/gravelly substrate but can survive on hard substrates (e.g. rock and concrete). It can survive water temperatures from 2^{O}C - 36 ^{O}C with the optimum for reproduction being 25 ^{O}C, suggesting that geothermally warm waters may present a particular risk. Adults are hermaphroditic. Juveniles can reproduce at 3 months and an individual adult can produce 500 microscopic (200 microns) larvae a day (70,000 a year) dispersed in water currents using pumping or mucus lines.

[5] The lagoon at the Lake Taupo Aqua Park does not discharge into Lake Taupo or the Waikato River (MPI, 2024).
[6] MPI (2023).

Gold clam is globally recognised as a highly invasive species, posing a threat to endemic freshwater ecosystems. It has the potential to out-compete native species for food and space (e.g. the native freshwater mussel or kākahi). Disturbing sediments (bioturbation) and excretion of inorganic chemicals (nitrogen and phosphorus) may negatively affect endemic freshwater communities.

Human activities are the prime vectors for spread of the gold clam. For example, transporting boats from infested areas to non-infested areas as larvae in bilge or ballast water, sand traps in jet boats, in engine heat exchangers, or on wet clothing. Small adults could also be transported on wet clothing.

Gold clam has never been successfully eradicated elsewhere in its invaded range. While numerous methods have been assessed, no effective broad acre control has been identified. Regarding the Waikato River, Biosecurity NZ noted that it is highly unlikely that gold clam could be eradicated from the river system, and containment would be 'difficult but worthwhile', and 'site-specific elimination of new populations may be possible if detected early enough. Therefore, site-specific elimination and catchment-level suppression could be a long-term goal' (2023, p.4). Further, containing gold clam in areas where it is already established is important to keep the eradication option available in the future (Biosecurity NZ, 2023).

Organism Impact Assessment

Table 1: Organism impact assessment

Category	Current	Potential	Comment	Source
Economic				
Livestock farming	-	L, DD	Potential for disease transmission to livestock if water supply from infested source.	Sousa et al. 2005.
			Potential to block irrigation systems	Biosecurity NZ, 2023
Horticulture	-	L, DD	Potential to block irrigation systems.	Biosecurity NZ, 2023
Electricity sector	-	DD	Damage to water related infrastructure, including hydro power stations.	Martin (2023), MPI (2024).
Tourism	DD	DD	Rotorua as a tourism destination – loss of amenity value of the lakes.	
Local government	DD	L, DD	Damage to water related infrastructure owned by Council.	
Environment				
Water quality	-	M, DD	May affect water quality, including increasing P and N. Feeding activity stirs up	

			sediment, plus potential food web mediated mechanisms due to concentration of heavy metals. Impacts on turbidity and possibly also nutrient status of the water column.	
Species diversity	-	M-H, DD	As a vigorous filter feeder with exceptional reproductive capabilities, the gold clam alters habitat and competes for resources with native bivalves. May impact on wetland bird reproductive success as a disease vector. Probable food-web and ecosystem process impacts of feeding and associated activity. Risk of disease transmission to native reptiles and amphibians.	
Threatened species	-	M, DD	Native freshwater species such as kōura (freshwater crayfish) and mudfish may be at risk from habitat changes.	
			It is not yet known how it will affect native NZ species, freshwater mussels, and pea clams/sphaerids	Clearwater, S, Department of Conservation (Pers. comm)
Social/Cultural				
Human health	-	L	Potential disease and parasite vector. At risk are people eating undercooked gold clams.	Sousa et al 2005. Georgieva et al 2017.
			Freshwater food source.	
Recreation	-	L, DD	Loss of water clarity.	
Māori culture	-	H, DD	Potential to impact on the mauri of wai māori. Potential impact on native freshwater species such as koura and kākahi (freshwater mussels). International evidence	Biosecurity NZ (2023)

	suggests that kākahi are likely to be outcompeted by gold clam, and in the event of a disturbance (e.g. flood), gold clam will outcompete slower growing native shellfish.	
	Effect on taonga species is not well understood, and gold clam may represent a greater risk to NZ species than where it has become a pest overseas.	Biosecurity NZ (2023)

L = Low, M = Moderate, H = High impact, DD = Data deficient

Analysis of benefits and costs[7]

The baseline

Te Arawa Lakes Trust (TALT) has worked closely with the Ministry for Primary Industries, the Rotorua Lakes Council, the Regional Council and Fish and Game New Zealand to find the best approach for the Te Arawa lakes. Methods currently used to avoid infestation and ensure early detection include surveillance, environmental DNA, CANs, existing rules, and communication/engagement (TALT, 2023a).

Surveillance for gold clam is undertaken primarily as part of the Bay of Plenty freshwater plant pest programme. Pest plant dive surveillance and benthic surveying is carried out twice a year, but only in Lakes Rotomā, Ōkāreka, Tikitapu and Ōkataina. Sediment sampling is carried out around boat ramps, specifically targeted at gold clams.

Environmental DNA (eDNA) sampling is currently carried out across all the Rotorua lakes. Sampling is done at 26 boat ramps and a few additional popular sites e.g. Hot Water Beach and the reserves adjacent to the lakes. In total 50-60 full suite samples are collected. Up to 10 samples are collected from high-risk rivers, including the Kaituna, Tarawera and Wairoa. The total cost of eDNA sampling is around $20,000 annually[8]. The eDNA sampling is across all freshwater pests, not tailored to gold clam.

In November 2023 the Ministry for Primary Industries issued a Conditional Controlled Area Notice for the Te Arawa lakes, requiring boaties who have been on the Waikato River in the previous 30 days to wash their boats at the designated wash station. Lake Ōkataina has additional protections including controlled access and lake hours (TALTb, 2023).

Boat owner engagement is part of the suite of actions to address freshwater plant and animal pests. This includes inspecting boats and trailers prior to launching, and monitoring compliance with Rule 7, which aims to avoid the spread of freshwater fish pests and plant pests.

> *To avoid the spread of freshwater fish pests and freshwater plant pests, the following provisions apply:*
>
> 1. *No person shall leave boat trailers in any water body other than for the purposes of launching and/or retrieving boats.*
> 2. *No person shall transport ballast water from any water body to any other location.*
> 3. *All occupiers of vessels or craft entering any water body within the Bay of Plenty shall ensure their vessels or craft (including trailers) are free from freshwater pest fish and freshwater pest plants including fragments.*
> 4. *All occupiers of vessels or craft using a boat ramp with a self-certification checkpoint must complete a supplied certification form. Before launching, the self-certification*

[7] Cost benefit analysis was discussed in the Biosecurity New Zealand Technical Advisory Group Report. The report noted the importance of taking a long term, whole system view, and that the high cost of acting now may in the long term be the economically favourable option. The report also noted research gaps to inform a CBA, which included identifying options for suppression or local elimination of newly discovered populations, and for control of existing populations. A better understanding of juvenille life stages of the gold clam, effecticve methods of killing juvenilles, and survivorship time outside water were also identified as research gaps. A cost benefit analysis has not been undertaken by the Ministry for Primary Industries.

[8] MPI best practice guidelines

form must either be submitted electronically or displayed in the vehicle used to launch the vessel or craft.

This is to protect production, environmental and public values that can be adversely affected by freshwater fish pests and freshwater plant pests.

The Regional Council requires public boat ramp users to self-certify that their boat is free from freshwater pest fish and plants where a self-certification checkpoint is present.

One of TALT's actions has been an increased biosecurity presence on the water, checking self-certification, doing boat inspections, and talking with boat owners/operators about the issue. One of the issues seen by TALT is the system relies on people being honest about where they have been (TALT, 2023a).

The baseline work described which addresses freshwater pests carries an annual cost of $100,000-$150,000 for the Regional Council. Resources provided by TALT are in addition to those costs.

A strength that the Regional Council has in addressing this issue is the engagement and commitment of TALT. Maintaining this relationship when choosing the policy response will enable the Council to leverage its input to achieve a better outcome.

The following cost benefit analysis is both qualitative and quantitative, drawing on quantitative information when it is available. Based on the National Policy Direction for Pest Management 2015 (NPD) guidance a medium level of analysis is appropriate (refer Appendix 1). Accordingly, the assessment uses both qualitative and quantitative information. Two scenarios are assessed:

3. Surveillance and non-regulatory actions
4. Exclusion and sustained control

OPTION 1: Surveillance and non-regulatory actions

Under the surveillance and non-regulatory option, the baseline actions of the Regional Council and TALT would continue but surveillance would increase. Any CANs put in place by the Ministry for Primary Industries would continue to apply, and Rule 7 (p.4) would remain in place.

Costs

Although much of the cost of surveying is covered in the existing budget (baselineabove), the inclusion of gold clam specific objectives would increase monitoring costs. Sampling intensity would increase.

The diving and benthic surveying (in-house dive team) would increase by an additional 5-7 days per year. Shore sieving would be undertaken by contractors at a cost of $10,000-$20,000/year.

Environmental DNA would increase to include the Rotorua lakes that are not currently monitored. The Rangitāiki River would be added to the rivers currently monitored. One sample is currently taken at each of the monitored sites; this would increase to six samples. This additional eDNA activity is expected to cost about $60,000/year.

It is worth noting that eDNA technology has been described as a tool that needs development and validation work before it is an effective surveillance tool [for gold clam] (Biosecurity NZ, 2023). eDNA cannot be relied on to take the place of in-person monitoring, at least in the short term.

The annual cost of the additional activity described above is expected to be $70,000-$80,000, plus the additional time described above for the in-house dive team.

Benefits

Intensive monitoring will assist in avoiding large scale incursions that become impossible to eradicate. Delaying incursions allows more technologies to be developed and provides opportunities to learn from the experience of other regions.

Avoidance of infestation and clogging of equipment in hydro power areas of the Bay of Plenty such as on the Rangitāiki River (e.g. Aniwhenua scheme, Wheao and Flaxy power scheme).

Avoidance of clogging infrastructure pipes, such as water intakes and water discharges with potential impact on pastoral farming and horticulture where water is drawn from surface water sources.

Local government owned assets such as flood defences may be affected, for example floodgates won’t open or won’t close. Related pipes may become clogged. Drinking water infrastructure may be affected if drawn from surface water sources.

Maintenance of a healthy freshwater environment protecting freshwater species biodiversity.

Protection of native freshwater species such as koura and kākahi, which are at risk from habitat changes associated with gold clam.

Help protect other regions from the risk of spread of gold clam.

Risks to success

Clause 6(2)(g) of the National Policy Direction (NPD) requires that the analysis consider the risks to success. The following section identifies and assesses the risks as required under clause 6(3)(a) of the NPD.

A summary of the risks, the likelihood that the risk will eventuate (low, moderate, high), the potential impact on the success of the objective (low, moderate, high), and the risk detail is provided in Table 2. There is insufficient data to gain a full understanding of the impact and risks in many of the areas considered.

Table 2: Risks of not achieving the exclusion objective

Risk	Likeli-hood	Impact	Risk detail	Potential for mitigation
Technical and operational risks of the option (i.e. outcome risk)	M	H	There are many avenues for gold clam to come into the region, including boat movements, movement of fish from one area to another[9], intentional release as a food source, on clothing (e.g. wet togs). Boat ramps are a likely point of ingress, but gold clam may appear elsewhere depending on the means of transport.	Availability of the means for people to treat gear and clothing when arriving or leaving a waterway. High level of communication to engage public to increase informal monitoring. Status as an Unwanted Organism may deter intentional releases.
Extent to which the option will be implemented and complied with (i.e. regulatory risk).	M	H	High trust model, relying on people's honesty. One wash-down station in Rotorua (The Wash Place, Te Ngae Road). Commercial facility charging $2/2-3 minutes.	Education and communication to increase awareness and engender support. Ensure provision of sufficient wash-down facilities to meet demand.
Compliance with other legislation will adversely affect the implementation of the plan (i.e. legal risk)	-	-	Nil identified	
Public or political concerns will adversely affect	M	H	Long term funding requirement.	

[9] Translocating elvers in the Waikato River may have inadvertantly spread the gold clam to new locations on the river (Biosecurity NZ, 2023).

implementation of the option (i.e. socio-political risk)				
Other material risk			Nil identified.	

Option 2: Exclusion and sustained control

Under this option the Regional Council would classify gold clam a pest in the RPMP, excluding the pest where possible, and sustainably controlling infestations if/when they occur. Rule 7 would be altered to target gold clam alongside other fish and plant pests. This would be done by adding the 'dry' component, as currently applies in the Waikato Region:

- *Allow gear to dry to touch, inside and out, then leave it to dry for at least 48 hours (2 days) before using again.*
- *Dry areas in the watercraft where water has pooled, for example with an old towel, and then leave the craft to dry for at least 48 hours (2 days). The hull of a watercraft will dry when towed.*

These requirements include emptying bilge water and sand traps to ensure that clam larvae and eggs are not present.

Under this option the Regional Council could put in place CANs, rather than rely on the Ministry for Primary Industries to do so.

Exclusion

The exclusion programme covers species that Bay of Plenty Regional Council has opted to be the lead agency or partner for managing new incursions into the region. The pest must not be present in the region or in the parts of the region where exclusion is the target.
The objective of the exclusion programme is:

> '*…to prevent the establishment of the subject, or an organism being spread by the subject, that is present in New Zealand but not yet established in an area*' (NPD, 2015).

Under the exclusion programme the Council can put in place actions that directly target gold clams and may impose CANs to stop the spread of incursions.

Sustained control

Sustained control is 'to provide for the ongoing control of the subject to reduce its impacts and its spread to other properties' (NPD, 2015), and is appropriate:

> *Where a pest is well established and preventing its spread is no longer a realistic objective, management of the pest focuses on reducing the general impacts of the pest* (BOPRC, 2021).

Should an incursion occur, gold clam will be managed by sustained control within the area where the incursion occurs. For example, if gold clam is found in one lake, it may be sustainably controlled in that lake, but surveillance is likely to increase in the other lakes and an exclusion policy would be maintained.

Density of population is likely to be positively correlated with impact on native species. Should an incursion occur and not be eliminated, then monitoring and management of density is likely to be critical to reducing impacts on native species (Biosecurity NZ, 2023). If small populations can be eliminated or contained, eradication may be possible in the future (Biosecurity NZ, 2023).

Costs

Sustained control would include a high level of surveillance to detect any newly established populations of gold clam in places it is not currently known to be. The costs described in option 1 would continue under sustained control.

Additional costs would be incurred when an incursion was discovered. The costs would vary depending on the situation. Surveying would be necessary to determine the extent of an incursion, whether it could be managed, and what management tools would be suitable (e.g. community handpicking[10], dredging (suction or mechanical), benthic mats). For example, in a small and contained incursion the objective might be eradication.

The costs of any future incursion are unknown for the reasons mentioned above, and because with experience in other regions, additional management methods may become available, and costs may change. Decisions would be made on a case-by-case basis.

Benefits

A high level of monitoring will potentially avoid large scale incursions that are impossible to eradicate.

One of the biggest benefits of sustained control within the region is that it will limit the widespread infestation within the Bay of Plenty and into other regions. Elimination of small local populations may be possible (Biosecurity NZ, 2023, p.7), and eradication may become possible in the future if populations are contained. Sustained control will build experience and enable ongoing development of new methods to manage gold clam.

The effects of gold clam in the New Zealand environment are not well understood (Biosecurity NZ, 2023). Ongoing monitoring and control will grow that knowledge.

The environmental, infrastructure, and socio-cultural benefits associated with option 1 (monitoring and surveillance) also apply to the sustained control option.

Risks to success

Clause 6(2)(g) of the National Policy Direction (NPD) requires that the analysis consider the risks to success. The following section identifies and assesses the risks as required under clause 6(3)(a) of the NPD.

A summary of the risks, the likelihood that the risk will eventuate (low, moderate, high), the potential impact on the success of the objective (low, moderate, high), and the risk detail is provided in Table 3. There is insufficient data to gain a full understanding of the impact and risks in many of the areas considered.

[10] In the Waikato region, river iwi collected 125kg of gold clams as an experimental control harvest in August 2023 (Waikato Tainui, 2023).

Table 3: Risks of not achieving the sustained control objective

Risk	Likelihood	Impact	Risk detail	Potential for mitigation
Technical and operational risks of the option (i.e. outcome risk)	M	H	There are many avenues for gold clam to come into the region, including boat movements, movement of fish from one area to another within a catchment[11], intentional release as a food source, on clothing (e.g. wet togs). Boat ramps are a likely point of ingress, but gold clam may appear elsewhere depending on the means of transport.	Availability of the means for people to treat gear and clothing when arriving or leaving a waterway. High level of communication to engage public to increase informal monitoring. Status as an Unwanted Organism may deter intentional releases.
Extent to which the option will be implemented and complied with (i.e. regulatory risk).	M	H	High trust model, replying on people's honesty. One wash-down station in Rotorua (The Wash Place, Te Ngae Road). Commercial facility charging $2/2-3 minutes. 'Dry' requirement of 48 hours may not be practical for lake users travelling between lakes.	Education and communication to increase awareness and engender support. Ensure provision of sufficient wash-down facilities to meet demand. Development of alternative means of destroying larvae and eggs that may be present on boating gear and equipment.
Compliance with other legislation will adversely affect the implementation of the plan (i.e. legal risk)			Nil identified.	
Public or political concerns will adversely affect	M	H	Long term funding requirement.	

[11] Translocating elvers in the Waikato River may have inadvertantly spread the gold clam to new locations on the river (Biosecurity NZ, 2023).

implementation of the option (i.e. socio-political risk)				
Other material risk	Unknown	Unknown	Other species may be negatively impacted through methods to control the gold clam (Biosecurity NZ, 2023).	Consider on case-by-case basis.

Conclusion

The breeding capability combined with the very small early stages of the gold clam make them easily transportable and lend themselves to a rapid and undiscovered spread.

Where gold clam becomes established it will cause high economic costs in terms of maintaining infrastructure, affecting the economics of hydroelectric generation, pastoral farming (where water is sourced from surface water), and for councils (e.g. some drinking water sources, flood schemes).

The longer-term effects of incursions in the Bay of Plenty freshwater ecological environment are largely unknown, but it is known that taonga species such as kākahi and koura are likely to be at risk. The socio-cultural effects have not been investigated. However, increased turbidity in an environment where gold clam is present will impact on the aesthetic, cultural and recreational amenity.

Decisions about sustained control of incursions can be managed on a case-by-case basis, depending on the characteristics of incursions, the location, and available tools and technologies. Learnings from incursions in other regions (e.g. Waikato) will assist in decision making.

The relatively low costs of surveillance, with a view to exclusion and sustained control, alongside the likely high economic costs for managing the effects on infrastructure alone suggest that option 2 is an economically sound choice. Further, sustained control will leave open the possibility of eradication, should that option become available in the future.

Appendix 1: Level of analysis assessment

The National Policy Direction (NPD) requires that the following four criteria be assessed to determine the level of cost-benefit analysis appropriate to each pest management situation. The criteria and assessment matters are set out below.

Assessment criteria 1: The likely significance of the pest or the proposed measures

There is a high level of interest in the community, particularly by iwi in the Rotorua Lakes area where a high risk of infestation exists. For iwi, the significance is socio-cultural – affecting the mauri of the lake or water body, and unknown impacts on taonga species. The economic costs of an incursion is likely to be felt in many areas of the community due to effects on infrastructure owned by hydro electricity generators, water supplies and water infrastructure owned by local councils, and farmers and horticulturalists who draw water from surface water supplies. Affected infrastructure will require more frequent servicing to ensure it does not fail.
The exclusion response increases the current spend to manage freshwater pest species in the region, but overall, the additional cost is minor. For context, about the level of 1 full-time minimum wage worker in New Zealand.

This criterion is rated as having moderate to high significance.

Assessment criteria 2: The likely costs relative to likely benefits

Given the high, relatively well-established, and ongoing costs of an infestation and its likelihood of spreading from waterbody to waterbody (the more it spreads, the more it spreads), relative to the costs of surveillance and exclusion - equivalent to 1 minimum wage full-time employee, this criterion is rated as of low significance. Under sustained control, incursions could be considered individually. The costs depend on the characteristics of the incursion.

Assessment criteria 3: Uncertainty of the impacts of the pest and effectiveness of the measures

The economic impacts on infrastructure are largely known in an international context and may be able to be reasonably well assessed in the Bay of Plenty context. What is not known is the environmental, social and cultural impacts of gold clam in New Zealand and in the Bay of Plenty lakes and rivers. Biosecurity NZ (2023) noted the impact on taonga species as an unknown.
Regarding the measures to be taken to exclude the pest, or sustainably manage it should it arrive in any waterbody, these are the only practical measures available. Eradication has not been achieved elsewhere, however limiting the incursion keeps available future opportunities for eradication (Biosecurity NZ, 2023).
This criterion is assessed as having moderate to high significance.

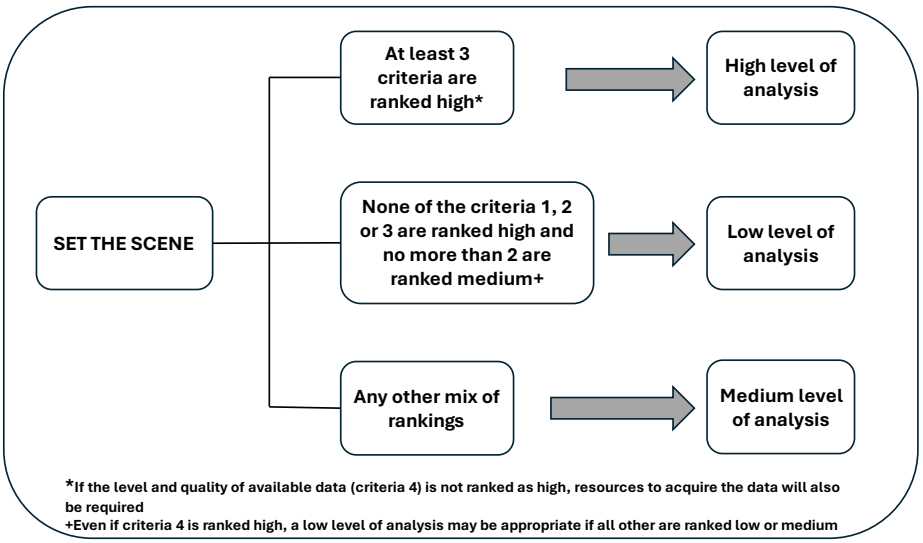
Assessment criteria 4: Level and quality of data available

There is no data available about the ecological impacts of the gold clam in the New Zealand context, such as its impact on taonga species. There is sufficient overseas experience to know that gold clam could have profound effects, changing the ecology of its new habitat to suit its own requirements. There has been little or no success in eradication overseas. There is little NZ-specific

economic information available to compare costs of control and eradication. Although Biosecurity NZ (2023) suggested a comprehensive cost benefit analysis at a national level would be useful, none has been undertaken.

Balancing the assessment criteria

Based on the first three criteria, a moderate level of analysis is appropriate. The absence of data to help inform the decision suggests that without significant research, a low level of analysis is possible. In this case much of the information is qualitative rather than quantitative, and there is little data for the New Zealand context. In time, as experience grows in New Zealand, more information will become available enabling a more robust cost benefit analysis.



Appendix 2: Estimate of costs

The cost estimate of Option 1 (surveillance and non-regulatory actions) is made up of the following annual costs:

- Shore sieving by contractors $10,000 - $20,000.
- Additional eDNA costs $60,000.
- Opportunity costs of in-house dive team for 5-7 days per year. While this is no additional cost to the Council, it shifts the divers away from other activities for those days.

The cost estimate for Option 2 (exclusion and sustained control) is similar to Option 1, except in the event of an incursion. The decision to address and the cost of addressing any incursion would depend on the location, area and density, and the suitability and costs of the methods available.

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Part Three

Cost benefit analysis

INTRODUCED TURTLES

Definition: Introduced turtles are turtle species introduced to New Zealand, including (but not limited to) the species identified in the draft National Pest Pet Accord (listed below), all turtles kept in captivity, and red-eared slider turtles living in the wild.

Common name: Red-eared slider and all sub-species (includes Yellow-bellied turtle, Cumberland turtle)

Latin name: *Trachemys scripta elegans, T. scripta scripta, T. scripta troostii*

Family: Emydidae

National Pest status: None

Common name: Common box turtle and all subspecies (includes Eastern box turtle, three-toed American box turtle)

Latin name: *Terrapene carolina*

Family: Emydidae

National Pest status: None

Common name: Murray River turtle and all sub-species

Latin name: *Emydura macquarii macquarii*

Family: Chelidae

National pest status: None

Common name: Snake-neck turtle

Latin name: *(Chelodina longicollis)*

Family: Chelidae

National pest status: None

Introduction

Pet escapes and deliberate releases are a proven source of invasive species into the wild. Once pet species establish feral populations they can become pests, leading to adverse impacts on the environment, native wildlife (through competition, predation, and disease transmission), industry sectors such as agriculture and horticulture, and our way of life (MPI, 2012). Turtles are no exception.

There are no native turtles in New Zealand, so turtles, unless bred in the wild, started life as a pet. Some turtle owners deliberately release unwanted turtles into the wild. Currently this is a particular problem with red-eared slider turtles (red-eared sliders), although is not limited to this species. In addition to deliberate releases, adult turtles may wander if inadequately contained. Females can roam several hundred meters from water bodies to locate suitable nesting sites.

Red-eared sliders are the most popular pet turtle in New Zealand. They have a distinctive red stripe behind each eye. They and their sub-species (yellow-bellied turtle, Cumberland turtle) are commonly sold as hatchlings, with a carapace c.4 cm in length. The adult carapace is up to 30 cm, but more commonly 15-20 cm, and is olive to brown with yellow spots/stripes. The adult weight is about 1 kg, with females slightly heavier than males. Red-eared sliders live for 30+ years. The diet of red-eared sliders includes vegetation (all plant parts), zooplankton, molluscs, frogs, crustaceans, insects, gastropods, birds, small reptiles and possibly also fish. Diet composition varies with age, location, and food availability, but plant material tends to be a dominant component.

Red-eared sliders are active during the day and inhabit a wide variety of soft-bottomed still/slow-moving water bodies including ponds, lakes, wetlands, rivers (including brackish reaches and salt marshes), and drainage ditches. They are capable of rapid range expansion via overland dispersal and may seasonally use varied terrestrial habitats including golf courses, farmland, and forest. Adults can survive extended periods at -10°C while juveniles are more cold-sensitive and may die at -0.6°C, although overwintering in nests can provide some protection from freezing temperatures. Pollution tolerant.

In countries where the red-eared slider is considered a pest, species under pressure include amphibians, reptiles, fish, and arthropods (Rabitsch, Aronsson, Strand and Rosher, 2020). In New Zealand '*… given their omnivorous diet, they could adversely impact aquatic plants, insects, eels, small fish species and ground-nesting birds. They can survive in the wild in a wide range of aquatic habitats, including manmade drains and canals, natural wetlands, rivers, lakes, ponds and brackish estuarine waters' (Waikato Regional Council).*

For red-eared sliders, sexual maturity appears to be size-related, with males mature when carapace is c.10 cm long, females at c.17 cm. Females can retain sperm and produce offspring up to five years after insemination. Red-eared sliders can produce 2-3 clutches per season, occasionally more. The egg number per clutch is variable, generally in the range of 4-15, but as many as 23 per nest have been recorded. Eggs may be buried up to 140 cm deep. Successful incubation requires soil temperatures of 22-33°C for 55-80 days. Sex determination is temperature-dependant; males are favoured under cool temperatures (c.27°C or below typically produces all males), females are favoured under warmer temperatures (c.30°C or above typically produces all females). In between these temperatures, both male and female offspring may be produced in the same clutch. Juvenile mortality is frequently high due to predation pressure (e.g. from birds). Surviving individuals have a rapid growth rate.

In recent years red-eared sliders have been documented breeding in the wild at Cooks Beach (Whitianga). A local community group has caught more than 70 juveniles over two years.

While current temperatures in this part of New Zealand are sufficient for red-eared sliders to breed, in some areas of the Bay of Plenty the warm geothermal soils would enable the red-eared slider (and other temperature-dependent breeders) to produce both male and female young. It is also worth noting that not all turtles have temperature-dependent sex determination. For example, the snake-neck turtle could produce male and female young living in the wild in New Zealand. One reason it is not plentiful may be the price - at about $400 resale is likely to be preferable to deliberate release.

In the Bay of Plenty region individual and pairs of red-eared sliders have been reported in the wild in Tauranga (Carmichael Reserve), Katikati, Lake Rotorua, and Papamoa (Wairakei Stream/Papamoa Drain).

While the red-eared slider is the most frequently seen turtle in the wild, there are many species of turtle kept as pets in New Zealand (see Appendix 1). This cost benefit analysis is based on the species listed in the *draft* National Pet Pest Plan. Table 1 summarises the characteristics of these turtles.

Table 1: Turtle species for inclusion in the Regional Pest Management Plan

	Red-eared slider	Common box turtle	Murray River turtle	Snake-neck Turtle
Latin name	*Trachemys scripta elegans*	*Terrapene carolina*	*Emydura macquarii macquarii*	*Chelodina longicollis*
Family	Emydidae	Emydidae	Chelidae	Chelidae
Availability as pet in New Zealand	Particularly popular due to price (~$70) and availability	Not common	Not common	Not common. Price $300-$400.
Native to	Asia.	USA and Mexico where they are endangered.	Eastern Australia (threatened).	Southeastern Australia (abundant).
Habitat (ability to survive in wild)	Lakes, ponds, ditches…	Predominantly terrestrial, Vulnerable to flooding and shade (canopy cover of habitat). Need exposure to direct sunlight to remain healthy.	Fresh water bodies (lakes and rivers), no tolerance for salinity	Preference for slow moving waters of wetlands living as bottom dwellers
Diet (risk to NZ flora and fauna)	Omnivorous. Plant material dominant component.	Omnivorous. Insects most common prey, Will eat worms, fungi and some grasses. Mature individuals may eat mice and small birds.	Filamentous green algae primary food source in Australia. Limited home range (500m).	Ambush predator. Aquatic invertebrates, fish, tadpoles, and plankton by suction feeding. Very resource competitive. Large home range (>5kms)

Activity	Daytime active. Degree dictated by temperature and season with respect to breeding.	Daytime active. Degree dictated by temperature and season with respect to breeding. Home range 1 to 4 ha with seasonal and diurnal favoured areas.	Daytime active temperature above 24°C (October to April Australia)	Day and nighttime active temperature above 24°C (October to April Australia)
Survival temp range	Down to -10 degrees C			
Reproduction	22-33°C for 55-80 days. Temperature dependent sex determination.	One clutch per year (2-8 eggs). Temperature dependent sex determination.	One large clutch per year (average 21 eggs). 95% mortality at vulnerable egg stage primarily from birds and foxes (Australia).	Three clutches per year of 8 to 24 eggs per clutch.
Breeding in the wild in NZ	Yes, documented.	No record.	No record.	No record.
Other notes		Can live to 100+ years.		Individuals recorded in the wild including one in Hamilton Lake in 1995. Now residing at the Hamilton Zoo. No record of breeding in the wild, but no impediment to breeding in wild.

Organism Impact Assessment

The following organism impact assessment for red-eared slider and subspecies was undertaken by Auckland Council for the Auckland Regional Pest Management Plan (2020-2030). These impacts are generally applicable across the turtle breeds identified (see also Table 1). Data on many of the impacts is deficient, particularly in the New Zealand context. *Non-Auckland Council additions in italics*.

Table 2: Organism Impact Assessment

Category	Current	Potential	Comment	Source
Production				
Dairy	-	L, DD	Potential for disease transmission to livestock.	Kikillus et al. 2011
Sheep and beef	-	L, DD	As above.	
Environment				
Soil resources	DD	L	Potential for soil disturbance during nesting.	
Water quality	DD	M, DD	May affect water quality, including increasing pH and conductivity. Turtle activity stirs up sediment, plus potential food web mediated mechanisms due to consumption of macrophytes and plankton, as has been documented for exotic fish. Therefore, probable impacts on turbidity and possibly also nutrient status of the water column. May accelerate leaf litter breakdown.	Lindsay et al. 2013 Also, see references relating to freshwater fish.
Species diversity	L, DD	M, DD	Opportunistic omnivores, therefore potential impacts via herbivory (all plant parts), and predation of zooplankton, molluscs, fish, frogs, crustaceans, insects, gastropods, birds, small reptiles. May impact on wetland bird reproductive success by displacing parent birds from nests to use nests as basking sites. Probable food-web and ecosystem process impacts of feeding and associated activity. Risk of disease transmission to native	Kikillus et al. 2010; 2011 Kimmons and Moll 2010 Lindsay et al. 2013 Outerbridge 2008 Perez-Santiagosa et al. 2011 Prevot-Julliard et al. 2007

			reptiles and amphibians. Capable of seed dispersal – could be positive or negative impacts depending on identity of native and/or invasive plants present at site.	
Threatened species	DD	M, DD	Native freshwater species such as kōura (freshwater crayfish) and mudfish may be at risk from predation pressure.	
Social/Cultural				
Human health	Nil-L	L	Potential disease vector, including Salmonella. Children especially at risk due to increased probability of contact. *Frequent outbreaks of Salmonella in the United States due to small turtles.*	Harris et al. 2010 *Centers for Disease Control and Prevention*
Recreation	-	L-M	Dig nesting holes in gardens and golf courses.	Outerbridge 2008 Waikato Regional Council 2015
Māori culture	DD	M, DD	Potential to impact on the mauri of wai māori. Potential predators of native freshwater species such as kōura. See 'Water quality', 'Species diversity' and 'Threatened species'.	Perez-Santigosa et al. 2011

L = Low, M = Moderate, H = High impact, DD = Data deficient

Analysis of costs and benefits

The following cost benefit analysis is largely qualitative. Based on the National Policy Direction (NPD) criteria a low level of analysis is appropriate (refer Appendix 2). Currently it is illegal to release turtles into the wild under the Biosecurity Act and the Animal Welfare Act. The Regional Council responds to reports of turtles in the wild in the region. The alternative approach is to classify the turtles identified in this cost benefit analysis as pests in the Regional Pest Management Plan. As a pest in the RPMP, Rule 6 would restrict ownership, breeding, and distribution.

The options considered are:

- Option 1: No regionally coordinated intervention (the status quo)
- Option 2: Classify the identified turtles as a pest and undertake sustained control across the region.

Option 1: No regionally coordinated intervention (status quo)

Currently in the Bay of Plenty region, turtles may be kept as pets, bred, bought, and sold. The Regional Council may respond to reported sightings of turtles in the wild, but there is no regionally coordinated intervention.

An estimated 1,000-1,500 red-eared sliders are bred in New Zealand annually at a retail price of around $80 (Feldman). Based on that number, around 70-100 red-eared sliders would make their way to owners in the Bay of Plenty region each year. In addition to these, lesser numbers of other species are sold in the region.

In the absence of regionally coordinated intervention, the wild turtle population will continue to grow through deliberate releases and breeding. Even in the absence of female young, released females will continue to contribute to the breeding stock. Warming temperatures will encourage population growth. Geothermal areas in the Bay of Plenty carry additional risk associated with population growth and the negative ecosystem effects.

Costs

Many of the costs listed are currently being experienced, but all are expected to increase over time due to an increasing population of turtles under this policy response.

- Impacts on the survival and distribution of indigenous plants and animals in wetland and other freshwater ecosystems. At risk taxa include zooplankton, molluscs, fish, frogs, crustaceans, insects, gastropods, birds and small reptiles.
- Impacts on the sustainability of wetlands, including regionally significant wetlands, and other freshwater ecosystems, and the ecological processes and biological diversity therein. Water quality and nutrient cycling may be the ecosystem values/processes most at risk.
- Reductions in the existence, amenity and social values of wetland and other freshwater ecosystems.
- Degraded relationship between Maori, their culture, and their traditions and ancestral lands, water, sites, wahi tapu, kai (e.g. whitebait, eels) and taonga.
- Health impacts arising from disease transmission to humans, especially children.
- Potential for reduction in economic well-being from disease transmission to livestock. This cost is likely to be isolated and low.

- Costs to animal welfare agencies such as Turtle Rescue (Christchurch). These costs include aquariums, turtle food, electricity, lighting, healthcare (vets), and costs associated with rehoming turtles. Lack of funding and growth in the turtle population may overwhelm the existing facilities.
- Animal welfare issues associated with poor health of deliberately released turtles.

Costs to Council include:

- Costs associated with public inquiries, education, and advice. This includes costs of capturing turtles and may include the cost of euthanising turtles (red-eared slider only).
- Costs associated with managing impacts on Council-managed land.
- Research costs addressing pest impacts and control tools.

Benefits

- Economic benefits from the sale of turtles. For example, the estimated total value of red-eared sliders sold in the Bay of Plenty per year is $5,600-$8,000. Setting up an aquarium for red-eared sliders could cost $600-$800, totalling $42,000-$80,000 annually (assuming every new owner provided an adequate level of housing). In addition are running costs such as electricity and turtle food. It is not clear how much benefit accrues to the Bay of Plenty region in the absence of location data on breeders and breeder suppliers. Given that the regional economy is worth $20,523 m annually, the wider economic benefit of turtle breeding and selling is tiny, particularly considering the ability to substitute (e.g. breed or buy other pets in the absence of red-eared sliders).
- Continued availability of all turtle breeds as domestic pets.

Risks to success

Clause 6(2)(g) of the National Policy Direction (NPD) requires that the analysis consider the risks to success. The following section identifies and assesses the risks as required under clause 6(3)(a) of the NPD.

The following table summarises the risks, assesses the likelihood that the risk will eventuate (low, moderate, high) and the potential impact on the success of the objective (low, moderate, high).

Table 3: Risks to success of Option 1

Risk	Likelihood	Impact	Risk detail	Potential for mitigation
Technical and operational risks of the option (i.e. outcome risk)	High	Medium	Control of individuals in the wild is difficult, due to biological characteristics of the animal and a lack of effective control tools. Control is unlikely to be successfully implemented by the public in the absence of regionally coordinated intervention. The extent to which the option will be implemented and	Council provision of education, advice and support of services to owners seeking to get rid of red-eared sliders.

			complied with (i.e. regulatory risk).	
Extent to which the option will be implemented and complied with (i.e. regulatory risk).	High	Medium	Currently turtles are released into the wild, particularly red-eared sliders. This practice is unlikely to cease under the current policy response.	Council provision of education, advice and support of services to owners seeking to get rid of red-eared sliders.
Compliance with other legislation will adversely affect the implementation of the plan (i.e. legal risk)	-	-	The Wildlife Act 1953 gives protection to reptiles. The red-eared slider is an exception under Schedule 5.	Ensure actions are consistent with the Wildlife Act 1953.
Public or political concerns will adversely affect implementation of the option (i.e. socio-political risk)	High	Medium	Animal welfare organisations have limited financial capacity to take on default management of abandoned turtles.	Support of services to owners seeking to rehome or otherwise dispose of turtles.
Other material risk	-	-	None identified.	

Option 2: Sustained control across the region

The objective of declaring the turtles identified as pests in the Regional Pest Management Plan (RPMP) is sustainable control, defined as:

> *Where a pest is well established and preventing its spread is no longer a realistic objective, management of the pest focuses on reducing the general impacts of the pest.*

As a listed pest in the RPMP, Rule 6 states:

No person shall:

1. *Move or interfere with any article or substance left in place by an authorised person for the purpose of monitoring, controlling, or eradicating a pest listed in [the] RPMP, or*
2. *Move, or allow to be moved, any live pest listed in [the] RPMP, or any machinery, vessel, organism or goods that are contained with any pest listed in [the] RPMP, or*
3. *Keep, plant, propagate, distribute or release any pest listed in [the] RPMP or assist in their maintenance including tending, feeding or sheltering them.*

This is to protect the production, environment and public values that can be adversely affected by pests.

Turtles currently owned as pets can be exempted under s78(3) of the Biosecurity Act 1993:

> *The council may exempt all persons, a specified class of persons, persons in a specified place, or persons responsible for specified goods or things from a requirement in a rule, without conditions or on conditions that the council considers appropriate.*

Conditions could be attached to exemptions such as no releasing into the wild, must have secure habitat, no breeding, and if rehoming (e.g. selling) the turtle's new home must be outside the Bay of Plenty region.

Principal measures to manage pests (RPMP, pp. 31, 101)

Requirement to act	Require pet owners to act where pests are to be controlled, the presence of pests to be reported, actions are to be reported, and pests are not to be spread (propagated, sold distributed).
Council inspection	Undertake inspections, monitoring and surveillance of pet shops, markets and online pet trade.
Service delivery	Enforce restrictions on the sale, breeding, distribution and exhibition of the pest.
Advocacy and education	Increase public awareness, following up complaints. Provide information and advice on responsible pet ownership as well as identification, impacts and control of the pest animal. Support ongoing science to advance effective pest management.

Costs

Costs to the public include:

- Reduction in the turtle species able to be kept as domestic pets. Currently owners could be exempted for the lifetime of the pet, but those who don't currently own the identified turtle species would not be permitted to obtain one. The latter is an opportunity cost, and pet substitutes are available.
- There is a small economic cost to the local economy. For example, the total estimated spend on red-eared sliders and set-up is $42,000-$88,000 per annum (assuming all new owners set up an environment that is optimal for the pet). Other spending includes electricity and food. It is not clear how much benefit accrues to the Bay of Plenty region in the absence of location data on breeders and breeder suppliers. The regional economy is worth $20,523 m annually, within which the economic benefits of turtle breeding and selling is insignificant, particularly given that there are substitutes for this pet. The availability of substitute pets lessens this cost.
- Turtle breeders and suppliers of turtle requirements will experience losses in relation to current income. However, the Bay of Plenty regional population makes up less than 7 percent of the New Zealand population, and the ability to sell online will help to mitigate the costs for breeders and suppliers.

Cost to Council

- Implementing the sustained control programme is estimated to cost $20,000-$30,000 per annum over the life of the current RPMP plan, although the programme is expected to continue into the next RPMP. The main actions by Council will be through advocacy and education. Increased public enquiries for education and advice are expected in the short to medium term. A breakdown of costs is set out in Appendix 3.

Benefits

In summary a Sustained Control programme is expected to:

- Reduce turtle-associated impacts:
    - on the survival and distribution of indigenous plants or animals in the region's wetland and other freshwater ecosystems. At risk animal taxa include zooplankton, molluscs, fish, frogs, crustaceans, insects, gastropods, birdsand small reptiles.
    - on the sustainability of wetland ecosystems and the ecological processes and biological diversity therein. Ecological processes identified as being particularly at risk include nutrient cycling.
- Contribute to safeguarding the relationship between Māori, their culture, and their traditions and their ancestral lands, waters, sites, wāhi tapu, kai (whitebait, eels), and taonga.
- Avoid reductions due to turtle-associated impacts in the tourism, existence, amenity, social and recreational values of the region's wetland ecosystems.
- Reduce costs to animal welfare agencies in caring for unwanted turtles.
- Reduce animal welfare costs associated with poor health of deliberately released turtles.
- Potential for reductions in economic wellbeing derived from disease transmission to livestock. This cost type is likely to be low and isolated, and therefore the accompanying benefit in mitigating it is also low.
- Reduce costs to Council associated with managing impacts on Council-managed land.

- In the longer term reduce costs to Council associated with responding to sightings of turtles in the wild.
- Preserve future options by mitigating spread into natural areas and allowing time for current and future wild populations to die out prior to gender-balanced reproduction which may occur in the future because of climate change.

Risks to success

Clause 6(2)(g) of the National Policy Direction (NPD) requires that the analysis consider the risks to success. The following section identifies and assesses the risks as required under clause 6(3)(a) of the NPD.

The following table summarises the risks, assesses the likelihood that the risk will eventuate (low, moderate, high), the potential impact on the success of the objective (low, moderate, high).

Table 4: Risks to success of Option 2

Risk	Likelihood	Impact	Risk detail	Potential for mitigation
Technical and operational risks of the option (i.e. outcome risk)	High	Medium	Some spread of turtles will continue due to dumping of unwanted pets. This may be exacerbated by overflows at turtle rescue centres through the changing of rules. The long lifespan of turtles and their ability to breed in the wild will contribute to the ongoing problem. Targeting some breeds may make breeding of alternative breeds more common, reducing the price of those, for example the Reeves turtle.	Council provision of education, advice. Exemption of current turtle pets from the rules, albeit with conditions. Considering adding turtle breeds not currently common in New Zealand, but potentially an issue if they were to become common.

Extent to which the option will be implemented and complied with (i.e. regulatory risk).	Medium	Low	Private individuals may still choose to move pest pets into or within the region. This risk pathway is small relative to the volumes potentially associated with commercial trade. Pests may be sold erroneously under an incorrect name or substituted with closely related taxa. Sale and distribution may occur largely through online, and interest-group based forums, making monitoring and enforcement difficult.	Council provision of education, advice. Include all sub-species in pest pet classification. Council provision of education, advice.
Compliance with other legislation will adversely affect the implementation of the plan (i.e. legal risk)	-	-	The Wildlife Act 1953 gives protection to reptiles. The red-eared slider is an exception under Schedule 5. The lack of a national plan to provide consistency across the country could lead to turtles being sold to Bay of Plenty residents from breeders outside the region.	Ensure actions are consistent with the Wildlife Act 1953. Support the development of a national plan.
Public or political concerns will adversely affect implementation of the option (i.e. socio-political risk)	High Low	Medium Low	In the short-term animal welfare agencies may be under pressure to take and rehome more turtles than they have capacity for. Sectors of the public may be concerned at restrictions on new ownership, or prospect of control of released individuals.	Support for agencies undertaking this role. Council provision of education, advice.
Other material risk	-	-	None identified.	

Conclusion

The current approach to managing turtles in the Bay of Plenty region will not achieve the outcome sought - *to protect the production, environment and public values that can be adversely affected by pests.* The proven ability of red-eared sliders to breed in the wild in the Waikato region suggests that populations will increase even under the current climate; with climate change population growth will be higher. Some turtles, such as the snake-neck turtle, could produce both female and male offspring under current temperature ranges.

A policy response targeting only the current problem species (i.e. red-eared sliders) is likely to be a short-term solution because it will encourage breeding of non-target species. Growth in the number of any particular species relative to demand will start to push the price downwards, increasing the number of pets of that species, and ultimately leading to deliberate releases if there is little or no resale value.

While data on the impacts of turtles in New Zealand is sparse, however there is ample evidence from overseas research to suggest that the benefits of the regionally coordinated approach to manage turtles will outweigh the costs.

Appendix 1: Turtles potentially living in New Zealand

Red-eared slider turtle *Trachemys scripta elegans*

Cumberland's turtle *Trachemys scripta troostii*

Eastern snake-neck turtle *Chelodina longicollis*

Oblong turtle *Macrodiremys oblonga*

Broad shelled turtle *Macrochelodina expansa*

Murray River turtle *Emydura macquarii macquarii*

Australian painted turtle *Emydura subglobosa*

Western black bridged leaf turtle *Cyclemys atripons*

Asian leaf turtle *Cyclemys dentata*

Asian spiny turtle *Heosemys spinosa*

Eastern River cooter *Pseudemys concinna concinna*

Eastern painted turtle *Chrysemys picta picta*

Reeve's turtle *Mauremys reevesii*

Diamond back terrapin *Malaclemys terrapin*

Soft-shelled turtles *Trionyx sp.*

Source: HotHouse Turtles Ltd 2022, Taradale, Napier 4141

Appendix 2: Level of analysis assessment

The National Policy Direction for Pest Management 2015 (NPD) requires that the following four criteria be assessed to determine the level of cost benefit analysis appropriate to each pest management situation. The criteria and assessment matters are set out below.

Assessment criteria 1: The likely significance of the pest or the proposed measures

Turtles are an introduced species and can have negative impacts on the natural environment, as set out in the cost benefit analysis.

For example, a reported 2,000 red-eared sliders are sold in New Zealand each year (Feldman). By population this could be around 133 in the Bay of Plenty. The overall benefit to the regional economy is very small, but individual breeders and sellers of turtles are likely to experience some losses. Sellers outside the Bay of Plenty will no longer be able to make sales of turtles to people living in the region, while sellers in the region will have to make changes to their businesses to accommodate the new rules. This is likely to be a small number of people and the prices of turtles suggest that the income loss for individual breeders is small. Accessories such as aquariums could still be sold, although buyers would tend to be outside the region.

The cost of the programme is relatively minor at $20,000-$30,000 per year.

Overall, this assessment criteria is rated as of low significance.

Assessment criteria 2: The likely costs relative to likely benefits

The likely costs of an approach to achieve sustained control across the region are relatively small compared with the range of qualitative benefits discussed in the cost benefit analysis. The costs are expected to reduce over time as the population of turtles in the wild decreases.

This criterion is rated as having low significance.

Assessment criteria 3: Uncertainty of the impacts of the pest and effectiveness of the measures

Red-eared sliders have been named one of the 100 worst invasive pests in the world, competing directly with native species for food. Red-eared sliders have been observed breeding successfully in the wild in the Waikato region, and in the absence of the proposed programme the population will increase both through dumping and through breeding. Other turtle species can also breed successfully in New Zealand, such as the snake-neck turtle. Population growth through breeding in the wild will increase as temperatures become more conducive to breeding. This will increase the pressure on native fauna species.

The measures to be taken can be expected to sustainable manage the population of turtles. A more active approach through monitoring and additional public education will enable Council to respond more effectively to the issue.

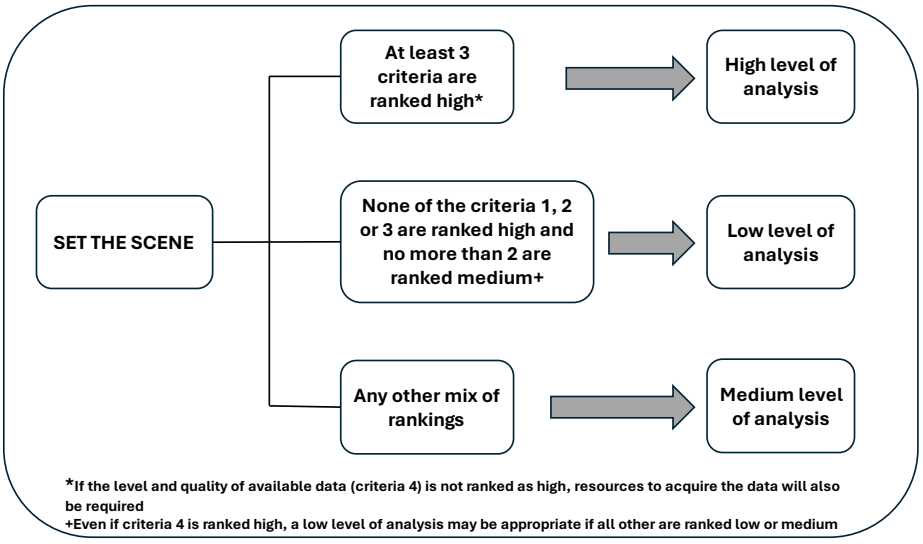
The level of uncertainty is relatively low regarding the pest and the proposed measures.

Assessment criteria 4: Level and quality of data available

Data is relatively sparse for the effects of turtles in the wild in New Zealand. Overseas research is available and suggests that this widespread pest can outcompete native and endemic species and reduce biodiversity.

Balancing the assessment criteria

Based on the relatively low cost of the measures, the relatively small number adversely affected (notwithstanding that future opportunities will be limited for some would-be owners of turtles), and the insignificant effect on the local economy, a low-level cost benefit analysis is appropriate.



Appendix 3 Expected costs of Option 2

The cost estimate for Option 2 is $20,000-$30000/year, made up of the following individual annual costs (BOPRC):

- Communication and engagement with community $5,000
- Inspections, monitoring and surveillance $5,000
- Responding to reports of sightings $5,000
- Compliance $15,000
- Direct engagement with pet stores and pet owners (year 1 only) $1,000

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Part Four

Cost benefit analysis

PEST CONIFERS

Common Name: Lodgepole pine, Scots pine, Dwarf mountain pine, Mountain pine, European larch
Latin Name: Pinus contorta, Pinus sylvestris, Pinus mugo, Pinus uncinata, Larix decidua

Introduction

Wilding conifers are already included in the RPMP. Comprehensive cost benefit analyses to support management of wilding conifers has been undertaken at the national scale and data contained within can be extrapolated to understand the regional costs and benefits of managing wilding conifers. (New Zealand Wilding Conifer Management Strategy 2015–2030, Ministry for Primary Industries, 2014).

The additional CBA required for this review proposal focuses on including progressive containment conifer species in planted form. This necessitates an understanding of the extent of planted progressive containment species in the region and the costs and benefits of preventing future planting. Note *Pinus contorta* (Lodgepole pine) is an Unwanted Organism and cannot be planted.

The only progressive containment species known to be deliberately planted in the Bay of Plenty are *Pinus contorta* (Lodgepole pine) and to a lesser degree, *Larix decidua* (European larch)

P.contorta was planted in the Kaingaroa Forest in the Bay of Plenty as part of forestry plantation trials in the 1920's and 1930's when Kaingaroa Forest was owned by the Government. There are also records of *P.contorta* trials being established in the frost flat areas of Kaingaroa in the 1970's. These have all since been removed, however a legacy of wildings that resulted from these plantings still remains in the area, in particular across the adjacent Public Conservation Land.

In addition to the Government planting trials*, P.Contorta* was also planted for shelter rows on farms in the upper Rangitāiki area where other shelter row species were difficult to establish due to the dry, cold environment. All known *P.Contorta* shelter belts have since been removed by either the landowner, or as part of the National Wilding Conifer Control Programme (NWCCP), but there is the possibility that other *P.Contorta* shelter rows exist that Council is not currently aware of.

There are also records of historic mixed conifer species plantation trials existing in the Kaingaroa Forest that included *L.decidua*, however it is believed that these have all been since replaced with *Pinus radiata*.

Organism Impact Assessment

Category	Current	Potential	Comment	Source

Economic				
Livestock farming and horticulture	L	L-M	Contributes to wilding seed source – loss of productive land, especially infrequently grazed pasture	Benefits and Costs of Additional Investment in Wilding Conifer Control, Sapere (Prepared for Ministry for Primary Industries), 2022
Electricity sector	L	DD	Contributes to wilding seed source – impacts to yields for hydro generation	
Tourism	L	DD	Contributes to wilding seed source - impacts enjoyment of natural pristine environments/landscapes for recreation and aesthetic value	
Environment				
Soil Resources	DD	DD	Alters below-ground nutrient cycling and soil biota Can raise soil levels through sedimentation	Benefits and Costs of Additional Investment in Wilding Conifer Control, Sapere (Prepared for Ministry for Primary Industries), 2022
Water quality	DD	DD	Contributes to wilding seed source - can cause lowering of the water table.	
Species diversity	L	M	Contributes to wilding seed source - dense stands compete with indigenous species and prevent native recruitment.	
Threatened species	L	DD	Contributes to wilding seed source - dense stands compete with threatened plant species and prevent recruitment.	
Social/Cultural				
Human health	L	L	Pine pollen contributes to allergies, affecting people's health.	allergy.co.nz
Recreation	DD	DD	Contributes to wilding seed source - forms dense and impenetrable stands that obstruct access and changes general landscape feel of the area.	Benefits and Costs of Additional Investment in Wilding Conifer Control, Sapere (Prepared for Ministry for Primary Industries), 2022
Māori culture	L	L	Can impede or restrict access to cultural sites and contribute to loss of taonga species	

Fire Risk	L	L	Contributes to wildfire risk

L = Low, M = Moderate, H = High impact, DD = Data deficient

Analysis of costs and benefits

The following cost benefit analysis is largely qualitative but quantitative information is provided if available. Based on the National Policy Direction (NPD) criteria a low level of analysis is appropriate (refer Appendix 1).

Options considered

1. Status quo – Current RPMP provisions that only require removal of wilding conifers
2. All progressive containment conifer species are listed as a pest in any form (wilding, planted, plantation) and therefore need to be removed.

Option 1 – status quo

Under the RPMP, conifers included in the progressive containment programme only need to be removed in their wilding form.

Costs

- Cost of ongoing control of wilding conifers that result from the spread from planted conifers (i.e. shelter rows, planted stands for truffles). Contorta is known to be the most invasive conifer species.

Benefits

- No restrictions on occupiers wanting to plant subject conifer species (apart from P.contorta which is an UWO)
- Existing planted conifers can continue to serve the purpose they were planted for (eg shade/shelter)

Risks to success

Clause 6(2)(g) of the National Policy Direction (NPD) requires that the analysis consider the risks to success. The following section identifies and assesses the risks as required under clause 6(3)(a) of the NPD.

The following table summarises the risks, assesses the likelihood that the risk will eventuate (low, moderate, high), the potential impact on the success of the objective (low, moderate, high).

Risk	Likelihood	Impact	Risk detail	Potential for mitigation
Technical and operational risks of the option (i.e. outcome risk)	-	-	No operational risks identified as no operational work required on planted stands under this option.	-
Extent to which the option will be implemented and complied with (i.e. regulatory risk).	Med	Med	Planted stands are not controlled by the occupier voluntarily, becoming additional sources of seed. New stands are planted, becoming new seed sources for wildings, increasing the distribution of wildings across the region.	Council provision of information and advice regarding impact of wilding conifers to occupiers of land with planted stands of subject species. Funding and management of the control of planted stands by Local/Central Government.
Compliance with other legislation will adversely affect the implementation of the plan (i.e. legal risk)	Low	Med	The wilding risk assessment required under the National Environmental Standards for Permanent Forests is only needed for new plantings over 1ha. This could result in new plantings of subject species under 1ha, with a high wilding risk, being able to be planted adjacent to environments vulnerable to wilding invasion.	Council provision of information and advice regarding impact of wilding conifers to occupiers of land with planted stands of subject species.
Public or political concerns will adversely affect implementation of the option (i.e. socio-political risk)			Planted conifers will continue to contribute to seed source allowing conifers to expand their range which could become a nuisance and be noticed by the general public in future.	
Other material risk			None identified.	

Option 2

All progressive containment conifer species are lists as a pest in any form (wilding, planted, plantation) and need to be removed.

Costs

- Cost of tree removal
- Loss of intended purpose of planted trees (shade/shelter)
- Restrictions on future plantings
- Breakdown of expected costs is provided in Appendix 2.

Benefits

- Environmental gains through reduced wilding conifer risk
- Manages seed source
- Occupiers might consider native alternatives
- In the longer term reduced costs to Council associated with managing wild conifers

Risk	Likelihood	Impact	Risk detail	Potential for mitigation
Technical and operational risks of the option (i.e. outcome risk)	L	L	Some risk if using chemical control due to the potential for non-target damage. Some risk where subject conifers are hard to access or near infrastructure (eg roads)	Removal of planted stands is funded and managed by Council using best practice methodology. Council provision of best practice guidance to occupiers.
Extent to which the option will be implemented and complied with (i.e. regulatory risk).	L	M	Planted stands are not removed by occupier voluntarily due to their value and cost to remove.	Biosecurity Act powers can be used to allow Council to undertake control work without occupiers' permission where they will not comply. Funding management of control operations by Local/Central Government.

Compliance with other legislation will adversely affect the implementation of the plan (i.e. legal risk)			The wilding risk assessment required under the National Environmental Standards for Permanent Forests is only needed for new plantings over 1ha. This could result in new plantings of subject species under 1ha, with a high wilding risk, being able to be planted adjacent to environments vulnerable to wilding invasion.	Council provision of information and advice regarding impact of wilding conifers to occupiers of land with planted stands of subject species.
Public or political concerns will adversely affect implementation of the option (i.e. socio-political risk)			Occupiers might have to remove conifers planted to serve a purpose (eg shade/shelter). Little appetite to plant these species.	The risk is low due to extent of conifers captured by this approach. Alternative species could be planted to serve same purpose.
Other material risk			None identified.	

Conclusion

Including pest conifers (in planted or wilding form) has little cost for occupiers as their current extent is very limited and support for removal of these conifers is available. The real gains from Option 2 will be made through preventing future plantings of these species and therefore directly impacting future seed source for wildings. These benefits outweigh the minimal costs expected for Council.

Appendix One: Level of analysis assessment

The National Policy Direction for Pest Management 2015 (NPD) requires that the following four criteria be assessed to determine the level of cost benefit analysis appropriate to each pest management situation. The criteria and assessment matters are set out below.

Assessment criteria 1: The likely significance of the pest or the proposed measures

Subject conifers are an introduced species and can have negative impacts on the natural environment, as set out in the cost benefit analysis.

Occupiers will be required to remove existing subject conifers and will not be able to plant them in the future. The intended purpose of these planted trees will be lost once trees are removed (for example shade, shelter, host trees for truffles etc) .

Councils supports removal of existing conifers.

The extent of conifers that would need to be removed through this proposal in the Bay of Plenty region is very limited.

The cost of the programme is relatively minor at $20,000-$30,000 per year.

Overall, this assessment criteria is rated as of low significance.

Assessment criteria 2: The likely costs relative to likely benefits

The likely costs of removing subject conifers is small due to minimal (if any) number of incursions. These costs are relatively small compared with the range of qualitative benefits discussed in the cost benefit analysis. The costs are expected to reduce over time as future plantings are limited.

This criterion is rated as having low significance.

Assessment criteria 3: Uncertainty of the impacts of the pest and effectiveness of the measures

Contorta is known to be the most invasive conifer species in NZ and undoubtedly contributes to the wilding conifer issue. Addressing the potential seed source is an effective way of reducing future impacts from wilding conifers

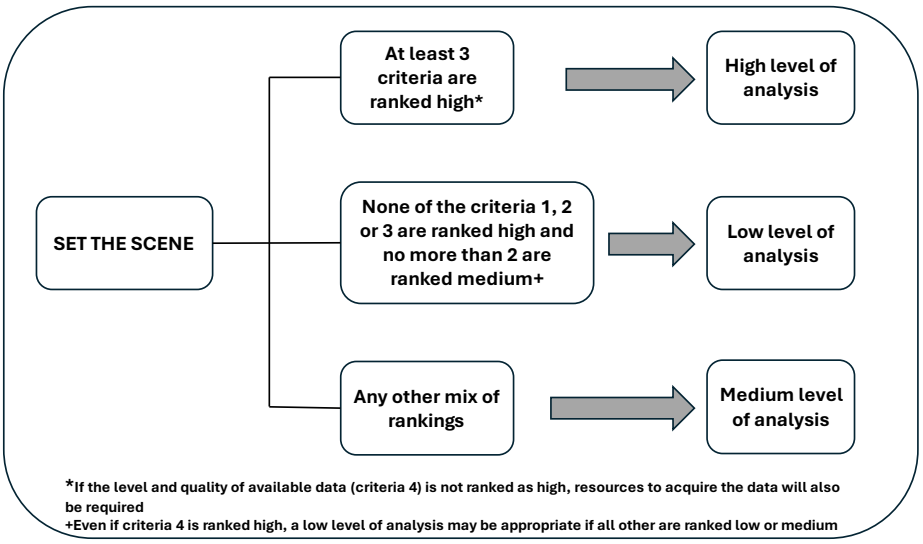
The level of uncertainty is relatively low regarding the pest and the proposed measures.

Assessment criteria 4: Level and quality of data available

There is a moderate level of information regarding planted conifers.

Balancing the assessment criteria

Based on the relatively low cost of the measures, the relatively small number adversely affected and the insignificant effect on the local economy, a low-level cost benefit analysis is appropriate.


SET THE SCENE
At least 3 criteria are ranked high*
High level of analysis
None of the criteria 1, 2 or 3 are ranked high and no more than 2 are ranked medium+
Low level of analysis
Any other mix of rankings
Medium level of analysis
*If the level and quality of available data (criteria 4) is not ranked as high, resources to acquire the data will also be required
+Even if criteria 4 is ranked high, a low level of analysis may be appropriate if all other are ranked low or medium

Appendix Two: Expected Costs

The cost estimate for Option 2 is $25,000 in year one, followed by $20,000 annually, made up of the following individual costs for (BOPRC):

Activity	**Cost**	**Comments**
Assistance to remove trees	$20,000	Annual cost estimate. Only required if unknown stands are found.
Updating existing wilding conifer advice materials to reflect new rules.	$2,500	Year 1 only
Creating additional wilding conifer advice materials specifically regarding shelter belt replacement options	$2,500	Year 1 only
TOTAL	**$25,000**	

References

https://www.wildingpines.nz/assets/Documents/CBA_Proactive-Release-v2-2022.pdf

https://www.ecan.govt.nz/your-region/plans-strategies-and-bylaws/canterbury-regional-pest-management-plan/pest-management-plan/

New Zealand Wilding Conifer Management Strategy (mpi.govt.nz)