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Koi carp as a fertiliser for coastal dune planting

April 2020

Introduction

Over a 3-year period the Coastal Restoration Trust in collaboration with the Waikato Regional Council and Coastcare groups have been evaluating a range of options for using the pest fish koi carp in community-based restoration programmes. The project was partially funded by the Ministry for the Environment's Community Environment Fund.

Koi carp are an invasive pest fish thought to have been imported into New Zealand accidentally in the 1960s. Numbers have exploded in the rivers and lakes of the lower Waikato basin over the last 3 decades where they cause catastrophic habit loss for native fauna and flora and have a detrimental effect on water quality.

The Waikato Regional Council have been exploring the potential for a Carp-N Neutral project aimed at trapping carp and "digesting" them into fertiliser and other products to benefit environmental programmes. Fish traps screen carp and other pest fish including catfish while allowing smaller native species to pass through unharmed.

The focus of this project has been on testing koi carp derived fertiliser as an alternative to commercially available synthetic fertiliser widely used by Coastcare groups nationwide to boost planted native seedlings as part of coastal restoration programmes. Preliminary investigation of other potential uses has included evaluating processed koi carp as animal repellents for newly planted natives to reduce browsing damage, as a lure for predator control programmes, and as an alternative fertiliser additive in nursery propagation of natives.

Establishment of dune planting trials

Coastcare planting programmes involving planting of the key native sand binders spinifex and pingao on foredunes use slow release fertiliser tablets or pellets to provide an initial boost in growth. Tablets are preferred as they reduce the complication of measuring out a certain dose of fertiliser in pellet or granule form.

Over the three years of the project, trials were established at four sites on the western and eastern coasts of the Waikato region to compare performance of koi carp fertiliser with the commercially available fertiliser tablet. All trials were established in collaboration with council staff and local community Coastcare groups. The pelletised koi carp fertiliser had a lower nitrogen content than the

tablets so to ensure comparability in trials, 72g of fish pellets (a handful) is equivalent to a 10g fertiliser tablet. Trials used a randomised complete block design, with three or four replicates at each site.

Assessments undertaken 12 months after planting involved recording survival, measuring plant spread, and a subjective assessment of plant vigour based on colour and other effects like frost damage and insect or fungal attack. The scores used were 1 = poor, 2 = unthrifty, 3 = average, 4 = good, and 5 = excellent.



The local Buffalo Beach Coastcare group and staff from the Waikato Regional Council and Thames Coromandel District Council planting native foredune seedlings at Whitianga, Coromandel Peninsula, to compare koi carp fertiliser with the standard use of commercial slow release fertiliser tablets.

Promising alternative organic fertiliser

Koi carp fertiliser gave a similar response to the standard practice of commercial fertiliser tablets in boosting early growth of both pingao and spinifex. The results of the trials at Port Waikato are shown in the graphs and are similar to results from other sites although effect of rabbits at some sites and drought at the last site where backdune species were planted have resulted in overall poor performance not related to fertiliser.

While fencing was used to exclude rabbits and hares from browsing new seedlings at the Port Waikato site, fencing around at least one replicate was breached by substantial sand movement allowing temporary access by rabbits. Consequently, the more palatable pingao survival is lower than the spinifex when assessed 12 months after planting (Figure 1).

Measures of plant spread and plant vigour indicate that koi carp fertiliser is giving a similar boost in growth compared to the fertiliser tablet and to a lesser extent for plant height (Figure 1).

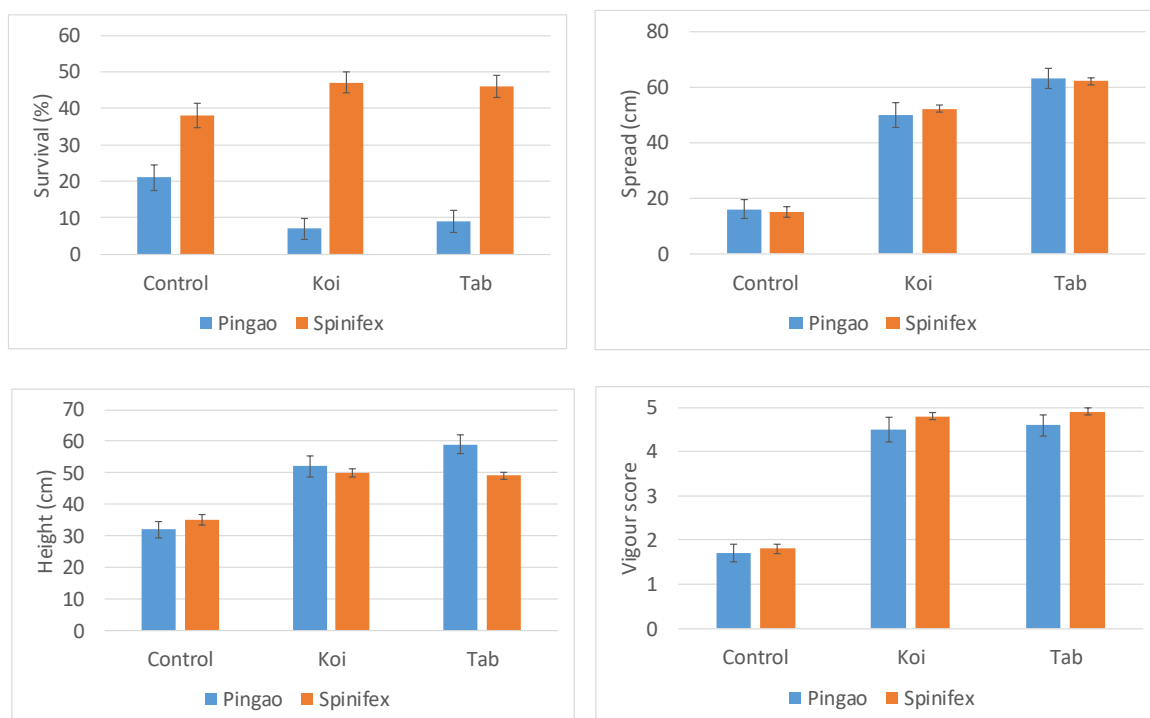


Figure 1: Mean survival, plant spread, height and plant vigour score for pingao and spinifex 12 months after planting at Port Waikato coastal dune trial. These results were similar across three other planting sites indicating koi carp fertiliser give similar boost to growth of sand binders to commercially available tablet slow release fertiliser. Growth response of both fertilisers were significantly greater than non-fertilised controls.

Interest in using pest fish

Participants at the annual Coastal Restoration Trust National Conferences during the 3 year project have consistently been enthusiastic about the potential to use koi carp fertiliser in their Coastcare planting programmes as an alternative to the standard commercial fertiliser options.

A survey undertaken during the project of potential users of koi carp as a fertiliser indicated favourably interest in using it as an alternative to commercially available slow release fertiliser. Of the numerous comments and feedback, most respondents indicated the smell was a distinctive factor but were not deterred from using koi carp pellets as a fertiliser for planting natives, especially if it could replace the use of artificial commercially prepared slow release options. In addition to smell, other major factors included continuity of supply given that it is a pest fish and perceived or real concerns with managing the resource verses any practical eradication options. Although the use of pest fish as fertiliser, predator baits and lures, nursery fertiliser and organic matter, or as a browsing deterrent was widely supported, the cost of the products was paramount for respondents, especially as many restoration programmes are community based and resource-limited.

Securing a sustainable supply

A sustainable supply of pest fish is highly likely to provide fertiliser and other products for environmental restoration. There are at least five or six other places where traps designed as mobile units could be set up in the lowland Waikato, let alone in other regions where koi carp are breeding

to help provide a sustainable supply of koi carp. The Bowhunters Club in the Waikato have an annual competition catching koi carp and end up with nearly 10 tonnes of fish that they have limited use for. There is scope to set up a central processing facility and have carp from multiple trapping sites to provide a sustainable supply of digested material that can be economically viable for supporting community-based restoration programmes.

While every opportunity should be explored to eradicate pest fish from our waterways, this is not likely to occur with the major infestations of the larger waterbodies or the Waikato river systems in the near future. Hence it is highly likely a supply of pest fish from ongoing control programmes aimed at reducing numbers and the negative impact on the environmental, social and cultural values will be self-sustaining with a secure ongoing supply of carp fish for processing to meet ongoing demand from community groups. This has ongoing economic benefits for environmental restoration programmes as fertiliser for planting of natives with the advantages of providing organic based products compared to petrochemical derived fertiliser options.

In a paper by David et al. (2018) that included results from this project and the work of Waikato Regional Council's CarP- N neutral Project, evidence from elsewhere in the Southern Hemisphere where invasive fish harvest has been commercialised suggests that while temporary reductions in catch may occur within a given waterbody subject to intensive harvest, the wider population recovers rapidly once harvest pressure is reduced. Furthermore, there is a clear indication that harvest pressure can reduce invasive fish biomass and therefore contribute to localised improvement in conservation outcomes along with other restoration initiatives such as riparian planting.

This project has demonstrated that there is an opportunity to utilise pest fish as an organic fertiliser where there is likely to be a sustainable supply using a network of mobile traps to reduce the impact on waterways throughout parts of the lower Waikato river and lake system. Further work is required to undertake an analysis of the practicality of setting up a capture and processing facility to supply koi carp fertiliser in consultation with government agencies, iwi and the wider community.

David et al (2018) also argues that the running costs for supply and use of koi carp as a fertiliser could be recovered with an increased scale of operations. However, the paper also acknowledges that commercialisation of such pest animals can result in maintaining populations or incentivising further spread resulting in potential environmental loss than gain. Clearly, a business case for developing a sustainable supply of pest fish will need to take account of these major issues to ensure there are net environmental benefits.

Other opportunities

Preliminary investigation as part of this project has also shown other potential uses for processed pest fish products in conservation projects, as both liquid and solid forms.

Predator lure/bait

Initial investigation has indicated that digested koi carp product could be used for animal predator lures and baits. As reported in David et al. (2018), a line of 50 kill traps (DOC 250's) were established around the perimeter of the National Wetlands Centre at Miranda, south of Auckland. A combination of egg and rabbit or koi carp pellet baits were placed in alternating kill traps by a local

conservation community group. Traps were checked approximately monthly by volunteers and results of any kills documented and reported.

After 9 months of trapping the traps set with koi carp pellets had trapped a greater number of rats and hedgehogs compared to the 25 traps set with rabbit/egg (Table 1). Conversely rabbit/egg baits trapped a greater number of mustelids than the koi carp baits.

Table 1: Documented kills from the predator trapping programme at the National Wetlands Centre undertaken in conjunction with the New Zealand Landcare Trust. Data are from a 9 month trapping period comprising records from 50 DOC 250 traps (adapted from David et al. 2018).

Pest	Koi carp bait	Mean	stdev	Rabbit/egg	Mean	stdev
Weasel	1	0.08	0.29	3	0.25	0.45
Rat	15	1.25	1.22	10	0.83	0.83
Hedgehog	27	2.25	2.73	11	0.92	1.56
Stoat	0	0	0	6	0.5	0.67
Mouse	0	0	0	7	0.58	1
Cat	0	0	0	2	0.17	0.39
Ferret	1	0.08	0.29	2	0.17	0.39
Totals	44			41		

These results are encouraging where koi carp appears to be a promising alternative lure for predator control programmes. Further trials on testing koi carp including other processed options of the fish including the liquid product is required.



A koi carp baited trap (left) and an egg bait trap (right) ready for setting.

Foliage repellent

Pilot trials have indicated the effectiveness of koi oil which is the liquid condensate that is a bi-product of the processing of the fish as a foliar spray to deter browsing of highly palatable planted natives by domestic stock and pest animals. The dark brown liquid which has a strong fish or sulphurous odour was applied to the foliage of planted seedlings by knapsack sprayer.

Trials compared a range different concentrations of koi carp liquid with a commercially based foliage protection product Treepel, and the use of resin. The resin mixed with the koi carp liquid condensate provide a “rain-fast” water-proof effect to extend the effectiveness of the deterrent to browsing when rain occurs. The commercially available egg and resin based product Treepel is widely available for use in restoration programmes where there are difficulties in reducing animal browsers to low numbers.

Nursery use for koi carp

Preliminary evaluation of koi carp fertiliser pellets for use as an additive to potting mixes in a commercial native plant nursery are not likely to provide any added benefits. Koi carp fertiliser pellets attract rodents, particularly mice which are a major factor in native plant propagation facilities, especially for seed storage, sowing and early germination stages, including highly palatable key native sand binders spinifex and pingao.

Commercial native plant nurseries are likely to be less interested in adopting koi carp as a fertiliser additive to potting mixes as these are commercially prepared in bulk and a substantial sustainable supply of koi carp would be required. However, there could be scope for community and iwi-based nurseries to use koi carp in organic based potting mixes in production of native plants.

Reference

David, B.; Özkundakci, D.; Pingram, M.; Bergin, D.; Bergin, M. 2018: “The CarP- N neutral Project”: Removal, processing and reuse of invasive fish in local terrestrial conservation projects. *Journal of Applied Ecology* 55:1567–1574. wileyonlinelibrary.com/journal/jpe