Potential beneficial and adverse effects to be addressed in the EPA application to introduce the moth plant fruit fly, *Anastrepha* sp. (Diptera: Tephritidae) as a biocontrol agent for moth plant

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The potential risks, costs and benefits of the introduction of biocontrol agents to New Zealand for moth plant, and the possible reduction in the abundance and vigour of moth plant, have already been formally identified and addressed in three previous applications. The first application to release the moth plant beetle, *Freudeita cupripennis* (previously *Colapsis argentinensis*) was first presented in 2011, and approved in 2018, and the second is an application to release the moth plant rust, approved for release in 2015. These applications can be found on the EPA website (https://www.epa.govt.nz/industry-areas/new-organisms/biological-control-agents/).

The potential risks, costs and benefits were identified by literature review, by public consultation and by formal brainstorming involving personnel from Manaaki Whenua – Landcare Research, Waikato Regional Council, Monarch butterfly NZ Trust, Auckland Council and the Department of Conservation. Some additional potential risks, costs and benefits that may apply specifically to the fruit fly have also been included.

Potential impacts on Māori values were addressed in a separate consultation process and will be done accordingly for the moth plant fruit fly application.

Please contact Angela Bownes, if you have any comments about the approach used in the application, or to report additional potential effects.

Potential Beneficial Effects

On the Environment

Source of potential benefit	Comments
Maintenance of habitats	
Reduced competition from moth plant leads to increased survival and diversity of native and other desirable plants in affected habitats.	This is the major expected benefit from the biological control programme. Moth plant scrambles over short stature native vegetation in many habitats, killing plants, replacing vegetation and halting regeneration. Moth plant overtops taller plants in forest margins, and can break down trees. Successful biological control will reduce those adverse effects wherever the weed occurs, acting far beyond the reach of existing management efforts. Significant reduction of seed production by the fruit fly will slow the spread and increases in density of the weed. Over time, the seed bank will be reduced which will slow replacement of old plants, eventually causing a decline in moth plant populations.
Reduced cover for pests on dunes	Back dunes support heavy moth plant infestations that harbour rabbits and predators of shore-nesting birds such as mustelids. Significant reductions of seed production by the fruit fly will reduce the rate of spread and colonisation of new sites.
Sustainability of flora and fauna	
Reduced competition with native seedlings including vines	Moth plants scrambles over the ground and short stature native vegetation in many habitats, killing plants, replacing vegetation and halting regeneration. Significant reductions of seed production by the fruit fly will, over time, reduce the density of moth plant seedlings, reducing competition with native plant species wherever the weed occurs.

Reduced damage to underlying foliage from spraying.	Moth plant commonly grows like a curtain using valued vegetation as a framework. Spraying moth plant with herbicides damages both the target and non-target plant species. Successful biological control will reduce the need for spraying moth plant with herbicides.
Improved access to underlying resources for birds.	Moth plant curtains hide flowers and fruits of underlying vegetation. Benefit limited because probably not a significant proportion of overall resource.
Reduced mortality of seedlings and improved succession of vegetation.	Moth plants scrambles over the ground and short stature native vegetation in many habitats, killing plants, replacing vegetation and halting regeneration. Successful biological control will reduce competition wherever the weed occurs.
Reduced incidence of trapping by flowers of valued insects such as bees.	As part of its pollination strategy, moth plant flowers trap some foraging insects by the proboscis. Some die, reducing the number of pollinators, although this is not been found to be common.
Ecosystem processes	
Benefits to parasitoids, predator and disease relationships in trophic webs.	Increased plant diversity as moth plant monocultures break up will increase the diversity and complexity of trophic webs. Effects will vary locally, spatially and temporally.
Reduced contamination of air, soil and water from reduced moth plant spraying.	Although likely a real local benefit of successful biological control, moth plant is not widely distributed throughout the country. Infested sites currently occupy a small percentage of the overall estate.
Intrinsic value of ecosystems	
Improved look and feel of native bush for visitors.	Successful control limits the development or reduces the occurrence of unsightly monocultures of moth plant. Not a widespread effect.
Increased carbon accumulation in affected trees.	Reduced shading following control increases tree health, but benefit limited because the number of severely affected trees is currently limited.

Further spread south following climate change avoided.	Successful control will reduce seed production and the development of new serious infestations.
Inherent genetic diversity in New Zealand	
Loss of endangered species is slowed.	Not a significant effect. No species are known to be at risk primarily because of moth plant.
New Zealand's biodiversity is increased.	Not a significant effect. Species increases by one.
Reduced cover by moth plant improves cross-pollination.	Not a significant effect. Moth plant curtains unlikely to be limiting cross-pollination at present.
Reduced cover by moth plant improves availability of nest spaces for birds.	Not a significant effect. Moth plant curtains unlikely to be limiting nesting sites for birds at present.

<u>On Human Health</u>

Source of potential benefit	
Reduced abundance of moth plant reduces incidence of skin burn by latex and allergic effects.	Likely, but NZ Poisons Centre reports few such allergic skin reactions nationally.
Reduced abundance of moth plant reduces incidence of human poisoning.	Likely. But NZ poisons Centre reports that incidents are relatively rare and are not severe.
Reduced frequency of control operations lowers the incidence of occupational health issues for gardeners and conservation workers.	Not a significant benefit. Current situation unknown, but such benefits are likely to be rare nationally.
Reduced importance of moth plant reduces use and adverse effects of herbicides.	A real but not significant benefit. Herbicide use against moth plant in New Zealand is not currently extensive or notably hazardous.

<u>On society and communities</u>

Source of potential benefit	
Successful biological control reduces costs of moth plant management to regional and territorial authorities	A significant benefit.

Successful control reduces the need for moth plant control operations, leading to better targeting of community resources and use of conservation volunteers	A significant benefit. Many community projects focus on moth plant control operations.
Reduced abundance of moth plant reduces nuisance value to householders (including safe disposal, damage to clothes, skin irritations), reducing time allocated to control, and reducing non-target damage from backyard herbicide application.	Lifestyle benefits to householders are real.
Successful control leads to fewer instances of dermal allergies in dogs.	A likely benefit but NZ Poisons Centre reports that cases are not frequent.

On the market economy

Source of potential benefit	See section 5.x.x
Reduced control costs to businesses required to control moth plant (shelterbelts, frames, other).	Successful control would mitigate costs to businesses of complying with RPMS, as well as production costs to shelterbelts and cropping frames.
Reduced control costs to infrastructure managers required to control moth plant.	Successful biological control could mitigate costs to infrastructure companies such as Ontrack and Transit (Hill 2011).
Reduced control costs/increased production in forests.	Not a significant effect. Moth plant is not seen as a limitation to forestry (Hill 2011).
Reduced contamination of export fruit by pappus hairs and seeds.	Contamination of kiwifruit by seeds is an issue for kiwifruit exporters requiring control by growers.
Reduced machinery maintenance costs for contractors.	Not likely to be a significant effect.
Damage to tweedia leads to greater sales in nurseries.	Not likely to be a significant effect; the fruit fly does not damage flowers or plant parts. Tweedia is an old fashioned garden species that is not widely available in garden centres and so is not a major revenue for nurseries.

Management of control agents creates business opportunities for Manaaki Whenua – Landcare Research.	A real effect, but a small contribution to Manaaki Whenua – Landcare Research revenue.

Potential Adverse Effects

<u>On the Environment</u>

Source of potential adverse effects	See section 5.x.x
Maintenance of habitats	See section 5.x.x
Value of moth plant as a nurse crop adversely affected	Not significant. Weed not widely acknowledged as a nurse crop.
Reduced ability of moth plant to stabilise cliffs	Not significant. Weed not widely acknowledged as a stabiliser.
Reduced protection of dunes from wind and water erosion.	Not significant. Weed not widely acknowledged as protection against erosion. Moth plant control likely to be gradual, with natural replacement of vegetation.
Sustainability of flora and fauna	See Section 5.x.x
Non-target feeding by newly established control agent significantly reduces native plant populations.	Experimentation and evidence from the native range indicates no such effect is likely. Native plants are not at risk.
Adults of the biocontrol agent compete with native species for food.	Not a significant risk. Adults *Anastrepha* sp. are likely to graze on fruit juices and pulp, bacteria, bird faeces and extrafloral glandular secretions. Their feeding requirements will be miniscule, both spatially and temporally, in comparison to other insects in the environment.
Non-target feeding by newly introduced control agent significantly reduces the usefulness of the ornamental tweedia.	Laboratory experimentation indicates that damage to tweedia seed pods in New Zealand gardens is possible. Damage will only be to the pods of tweedia, and not flowers and other plant parts such as leaves and stems. If seeds are to be harvested, this risk can be mitigated by protecting newly formed pods from insect

	damage (e.g. with the use of a protective covering).
Reduced habitat quality for some native fauna.	Not significant. Replacement vegetation will also support invertebrate fauna. No fauna of special significance found on moth plant in surveys (Winks et al. 2006).
Swift evolutionary change in insect leads to unexpected non-target damage to valued plants and/or alterations to food webs	Not a significant risk. There is little evidence of adaptive host range expansion to non-target species in weed biocontrol agents.
Ecosystem processes	
Food web interactions are adversely affected by the introduction of new prey species	Adverse effects are conceivable but not expected. Increased plant diversity as moth plant monocultures break up will increase the diversity and complexity of trophic webs, but effects will vary locally, spatially and temporally.
Intrinsic value of ecosystems	
No significant effects have been identified	
Inherent genetic diversity	
***Anastrepha* sp. hybridises with native Tephritid flies**	Not a significant risk. No fruit fly species in New Zealand are closely related to enable hybridisation.
Indirect competition causes extinction of native insects	Not a significant risk. No indication that vulnerable or endangered species are associated with moth plant infestations (Winks et al. 2006), and any measureable indirect competition would be restricted to the immediate vicinity of the host plant.

<u>On Human Health</u>

Source of potential adverse effect	
Public phobia to new fruit fly.	Possible due to concerns the fruit fly will damage tweedia plants and/or fruits of native and/or commercial crops.

Public confuses the fruit fly with invasive paper wasps, and German and common wasps.	Possible due to similarity in appearance of adult fruit flies to wasps (the moth plant fruit fly is a wasp mimic).
Public phobia that the fruit fly can sting.	Possible due to the appearance of their long ovipositor which could be confused with a sting
Fruit flies generate allergic response.	Not a significant risk. Literature search reveals no such cases.
Fruit flies need spraying with adverse effects to humans.	Not a significant risk. No predicted large-scale attack on non-target plants. Mass fruit fly populations impossible.

On the Market economy

Source of potential adverse effect	See section 5.x.x
Successful biological control reduces revenue for contractors and suppliers.	Not a significant effect. Revenues directly related to moth plant management are not a key revenue source for many or any contractors or suppliers.

On Society and Communities

Source of potential adverse effect	
Fear and distrust of exotic species and their possible non-target effects	Firmly held opinion in a proportion of the New Zealand population.
Less moth plant foliage available to feed monarch butterflies.	Not a significant risk. Most plant foliage will not be damaged by the fruit fly.
Control reduces aesthetic values of moth plant.	Not a significant risk. Moth plant is not strongly valued by the public.