

Students join the ‘War against Weeds’

Murray Dawson¹ and Hugh Gourlay

In the latter half of 2016, a project conceived by Murray Dawson and Hugh Gourlay of Landcare Research was awarded an Unlocking Curious Minds grant by the Ministry of Business, Innovation and Employment (MBIE). These grants are aimed at better engaging New Zealanders with science and technology, especially those who have fewer opportunities to do so. Young people, especially those in remote rural areas and lower decile schools, have been identified as one of the more ‘hard to reach’ groups that this fund seeks to involve. An added bonus of targeting this group is the potential to stimulate more young people to consider careers in science and technology – something the country definitely needs for the future.

New Zealand has serious problems with invasive weeds, and as many citizens as possible are needed to join the call to arms. Weeds species now outnumber our native flora. Weed species out-compete and displace our native flora and fauna, reducing biodiversity of New Zealand’s unique ecosystems. Weeds cost New Zealand’s economy billions of dollars annually through lost productivity and control measures.

To win the war against weeds perceptions need to change, driven by the next generation of informed enviro-kids who are better connected with nature. Wildflower weeds marching along roadsides and self-seeding conifers overtaking open landscapes may look attractive to the uninformed, but from environmental and economic viewpoints they are disastrous. Plantings in school grounds, parks, marae, and people’s gardens contain numerous National Pest Plant Accord (NPPA) species prohibited from sale, propagation, distribution and display because of their weedy qualities. But how many of us know about these banned

species? Every year, plants in cultivation ‘jump the garden fence’ and escape into the surrounding environment.

However, many New Zealanders are not even sure about whether plants they see in the environment are native or introduced, or where they can find out, let alone what they should do about them. This Unlocking Curious Minds project aims to start turning this around by increasing awareness amongst young people about the threats posed by weeds, how to recognise them, and how to get further information and do things that will help. “We need to educate students about the importance of early detection being fundamental to controlling the spread of weeds, and hope they will pass the message on to others,” Murray said. “The more people in a community involved, the better the chance we have of spotting new and emerging problems and nipping them in the bud.”

So Murray and his team of collaborators travelled far and wide visiting schools to spread the word about the importance of recognising and controlling weeds. “The Unlocking Curious Minds fund was a good fit with the national objective of trying to improve weed surveillance, especially in more remote areas of New Zealand where weed experts are thinner on the ground and have fewer resources for this work,” said Murray. “Information about weeds in these areas is often out-of-date or incomplete since little, if any, formal surveillance work has been undertaken,” he explained. “We need more ‘boots on the ground’, and eyes out there looking and reporting what they find.”

Nine schools from Auckland (said to be the ‘Weed capital of the world’), Gisborne and the West Coast of the South Island, involving Year 5–13 students, participated in this

pilot programme. The Brian Mason Trust provided additional financial assistance to allow more schools to be involved in Westland. The project has also been fortunate to have support from Weedbusters (who support community groups to manage their weeds) and the Department of Conservation (DOC). “DOC staff from all three regions came along to help,” said Murray. “It was also great to see members of the community joining us.”

Lincoln University ecologist Jon Sullivan was one of the collaborators, joining the visit to Haast School. Jon is a NatureWatch NZ founder, the Citizen Science platform chosen to share online the weed observations generated by the project. Landcare Research botanist David Glenny and weed biocontrol expert Hugh Gourlay also added their skills and expertise to some school visits. Monique Russell from the Tread Lightly Caravan (The Urban EcoLiving Charitable Trust) and Robinne Weiss, a heritage interpreter, also assisted as the North and South Island educators, respectively, for this project.

The school visits involved time in the classroom and field trips to local weedy areas. Classroom lessons included learning about what makes a plant a weed, how to identify weeds, values and perceptions of plants, seed dispersal, ecosystems and the web-of-life, and biocontrol. Taking the students out of the classroom to look for weeds growing nearby gave them a chance to use smartphone apps to identify, record and share their weed observations online. The students also collected specimens of weeds and added them to plant presses so that they could be taken back to add to the Allan Herbarium at Lincoln.

Here is a journal of our experiences in each school over the last four months of 2016.

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What is a weed?

A weed is a plant growing where it is not wanted. It can be harmful to human activities, such as farming or recreation, or it can be harmful to New Zealand's unique environment. Weeds are usually plants that have been introduced to New Zealand by people.

Economic weeds are plants that are harmful to money-making activities such as agriculture or forestry.

Environmental weeds are plants that invade native vegetation and are harmful to native ecosystems and/or biodiversity. Many economic weeds are also environmental weeds.

Whataroa School

On 12–13th September, Murray and David Glenny visited Whataroa School (Fig. 1).



Fig. 1 Whataroa School, Westland. Photo: Murray Dawson.

This was the first of our school visits and was timed to coincide with Conservation Week (10–18th September) and the US Embassy's desire to demonstrate support for conservation-related rural citizen science.

At Whataroa School, we were warmly welcomed by Principal Jenny Bainbridge and a waiata from the school (comprising 34 junior and senior students) before everyone went on a field trip out to the school grounds and to a large block of land behind the school. The 22 senior students photographed, recorded and identified weeds using the smartphones and preinstalled apps that we provided (Fig. 2–3).



Fig. 2 Whataroa students using the iNat (NatureWatch NZ) plant recording app. Photo: Murray Dawson.

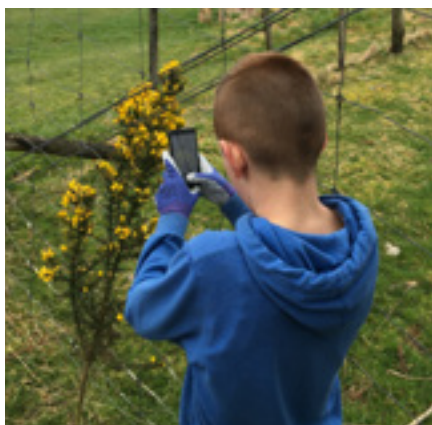


Fig. 3 Whataroa student recording gorse (*Ulex europaeus*). Photo: Murray Dawson.

Robert Tate, Country Public Affairs Officer from the US Embassy in Wellington, joined in on the field trip – rolling up his sleeves and pitching in. Afterwards, Rob addressed the school on US conservation initiatives and marked the 100th anniversary of the National Park Service (Fig. 4).



Fig. 4 After addressing the school, Rob Tate presents gifts to students at Whataroa School. Photo: Murray Dawson.

Nina Robb, a DOC Biodiversity Ranger and Weedbuster from Westland, provided great advice and local expertise. She had helpfully scouted out the field trip area beforehand and joined in on the field day, encouraging and motivating the students (Fig. 5). Nina rejoined us on a later trip to Franz Josef Glacier School.



Fig. 5 Nina Robb (DOC) helps Whataroa students identify weeds from our laminated species profiles. Photo: Murray Dawson.

The following day, Robinne Weiss (our contracted South Island educator) joined us to lead the classroom-based activities (Fig. 6). In one activity, students designed and drew their own gardens, and this was used to discuss plants used for food, ornamental purposes and those that can escape into the wild. In another activity, students used a ball of string to create a 'web-of-life' (Fig. 7) between different plants and animals (aka students with various name badges). Robinne's expertise and experience proved invaluable for this project.



Fig. 6 Whataroa students study seeds through a microscope to examine different dispersal structures. Photo: Murray Dawson.



Fig. 7 Whataroa students learn about the 'web-of-life'. Photo: Murray Dawson.

What were some of the plants that we found at Whataroa? We found a bevy of environmental weeds typical of Westland, and indeed common in most other areas of New Zealand (see Summary). These included: blackberry (*Rubus fruticosus*),

cotoneaster species, creeping buttercup (*Ranunculus repens*), English ivy (*Hedera helix*; Fig. 8), European holly (*Ilex aquifolium*), gorse (*Ulex europaeus*), Himalayan honeysuckle (*Leycesteria formosa*), Scotch broom (*Cytisus scoparius*), tradescantia (*Tradescantia fluminensis*), and tree privet (*Ligustrum lucidum*).



Fig. 8 Whataroa student collecting ivy. Photo: Robert Tate.

Summer snowflake (*Leucojum aestivum*; Fig. 9) was found growing in the school grounds. It was probably originally planted there but can be a weedy species.



Fig. 9 Summer snowflake (*Leucojum aestivum*) observed and pressed by students of Whataroa School. Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4089230>).

We also discovered on the school grounds a young cherry laurel (*Prunus laurocerasus*) plant. We later found the likely seed source of this plant growing as a mature tree in the adjacent Whataroa Golf

Course (Fig. 10A–B). Cherry laurel can become quite invasive and is becoming an increasing problem in Westland and other areas of New Zealand.



Fig. 10 Cherry laurel (*Prunus laurocerasus*). **A**, mature tree. **B**, flower spike. Photos: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4222029>).

Hokitika Primary School

After our successful trip to Whataroa School, Murray, David and Robinne travelled north to visit Hokitika Primary School (Fig. 11) on the 14th September.



Fig. 11 Hokitika Primary School, Westland. Photo: Murray Dawson.

Although we had the daunting task of handling three combined classes in a tighter half day time-frame, all went well. We divided the group of 45 students (Fig. 12) into two, with Robinne teaching half of the class inside and Murray, David and teachers supervising the field exercise in and behind the school grounds. We then swapped the inside and outside groups around.



Fig. 12 Students at Hokitika Primary School. Photo: Murray Dawson.

Our Hokitika School students were very enthusiastic and enjoyed learning about, recording (Fig. 13), collecting and pressing (Fig. 14) the weeds that we discovered together.



Fig. 13 Hokitika Primary School students collecting and recording gorse (*Ulex europaeus*). Photo: Murray Dawson.



Fig. 14 Hokitika Primary School students pressing plants for the Allan Herbarium. Photo: Murray Dawson.

What were some of the plants that we found around the school area?

The first plant we came across was the innocuous English daisy (*Bellis perennis*; Fig. 15), a very common weed found in lawns, and providing a good example for the classes to learn how to use the iNat (NatureWatch NZ) smartphone app to record the other weeds that they went on to find.

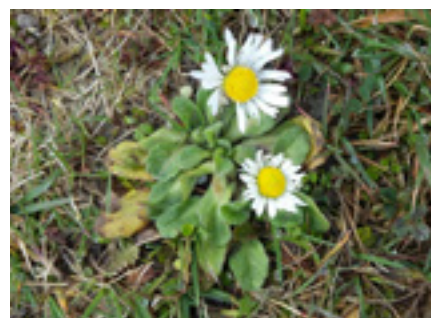


Fig. 15 English daisy (*Bellis perennis*). Photo by Hokitika Primary School students, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4147190>).

Not surprisingly, there was a similar range of environmental weeds around Hokitika School as we found further south at Whataroa, including: cotoneaster, creeping buttercup (*Ranunculus repens*), English ivy (*Hedera helix*), gorse (*Ulex europaeus*), Himalayan honeysuckle (*Leycesteria formosa*), privet (*Ligustrum*), and Scotch broom (*Cytisus scoparius*).

We also found onion weed (*Allium triquetrum*; Fig. 16A–B), and handed out pieces for the students to taste, explaining that this is an example of a culinary herb that has escaped gardens to become a weed. We also pointed out its characteristic triangular flowering stems which give rise to its other common name ‘three-cornered leek’. The students enjoyed finding something they could eat, but we were careful to explain that there are many poisonous plants and that very few wild plants are edible. Onion weed is common in Westland and Auckland and, whenever we came across it, we taught about this plant in visits to the other schools.



Fig. 16 Onion weed (*Allium triquetrum*). **A**, field photo by Hokitika Primary School students. **B**, pressed photo by Murray Dawson. Via NatureWatch NZ (<http://naturewatch.org.nz/observations/4147207>).

We puzzled over one shrub found in the weedy area behind the school. It was obviously a conifer, but with soft foliage. Once we posted it online, our finding was discussed by the online community and it was concluded

to be a juvenile Japanese cedar (*Cryptomeria japonica*; Fig. 17).



Fig. 17 Japanese cedar (*Cryptomeria japonica*). Photo by Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4147041>).

Haast School

We visited Haast School (Fig. 18) on 11–12th October.



Fig. 18 Aerial view of Haast School, Westland. Photo courtesy of the school.

This was the third school visited by Murray and Robinne. Jon Sullivan, NatureWatch NZ guru and weed ecologist from Lincoln University was also able to join us on our long journey south to Haast.

Upon arrival at the school, we were warmly greeted by their Principal, Michelle Green, who made us very welcome. They have a lovely school that is well resourced. The teachers are professional and the students attentive making it a pleasure to work with them all. There were relatively few pupils (11 of them, from Y3–6), as can be expected from such a remote location. However, they pointed out that they don't really feel remote with the internet connecting them to the rest of the world.

We were amazed at how environmentally aware these students are, no doubt helped by

the positive role that the Department of Conservation have in the local community. We were told that DOC staff regularly visit the school. For Conservation Week the previous month, DOC showed the students how to set up track-lines behind their school (rat and maybe stoat tracks were observed). The first day we visited, the local DOC staff showed off a Fiordland crested penguin that they were nursing back to health before release (Fig. 19A–B). DOC held a school discussion on the biology of these penguins.



Fig. 19 Fiordland crested penguin. **A**, Rachel Norton from DOC showing the penguin to Haast School. **B**, close-up of penguin. Photos: Murray Dawson.

The first day was classroom based, and Robinne led the kids through our programme of weed activities (Fig. 20–21). Jon and I collected some plants from the rainy outdoors to bring into the classroom for study.



Fig. 20 Robinne Weiss teaching about weeds to Haast School students. Photo: Murray Dawson.



Fig. 21 Haast School students learning about the web-of-life with Jon Sullivan and Robinne Weiss. Photo: Murray Dawson.

During the second day, the students used our smartphones and apps to record and identify plants (Fig. 22A–B) found in the school grounds (Fig. 23) and adjacent areas.



Fig. 22 Haast School students using a weed identification app to identify plants. **A**, classroom activity. **B**, student identifying periwinkle (*Vinca major*). Photos: Murray Dawson.



Fig. 23 Haast School students collecting and recording a foxglove (*Digitalis purpurea*) seedling. Photo: Murray Dawson.

Haast School later nominated their Y6 student Charlotte to visit our research centre at Lincoln to learn more about weeds and biological control.

What were some of the plants that we found around Haast?

The school backs onto the coast with a narrow strip of windswept native forest between the school grounds and the sea. It was great to see few weeds along this area, and relatively few weeds in the school grounds. We didn't find many of the environmental weeds seen further north in Westland.

The school has actively removed most agapanthus that were growing in their front gardens, but we found some remnants that were re-sprouting there.

Unsurprisingly, montbretia (*Crocasmia* × *crocosmiiflora*) was found in the school grounds. Montbretia is abundant in Westland (Fig. 24A–B), along with the ubiquitous gorse.

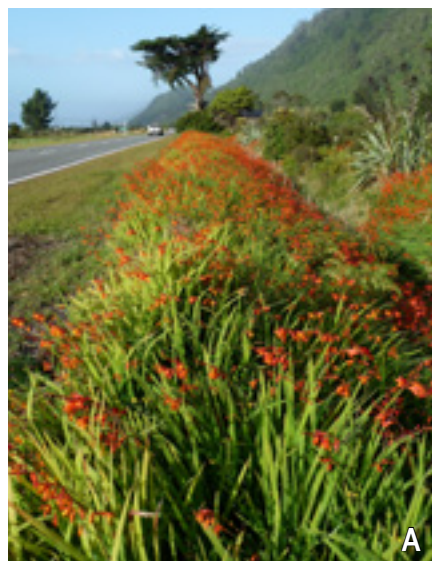


Fig. 24 Montbretia (*Crocasmia* × *crocosmiiflora*) observed in Westland. **A**, growing along a drainage channel. **B**, close-up of flowers.

Photos: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/958674>).

We talked to the class about hydrangea, explaining that it is often seen in Westland persisting in former gardens long after the original houses are gone. Hydrangea can also spread by seed from these old remnant plantings.

Some of the native plants observed by the students (as 'by-catch') included: kōtukutuku (*Fuchsia excorticata*), leather-leaf fern (*Pyrrosia eleagnifolia*), *Leptinella squalida* subsp. *mediana*, and pōhuehue (*Muehlenbeckia australis*).

After we finished teaching at the school, we made some observations of the wider Haast area along what is generally considered to be a relatively pristine coastline.

We saw coastal developments north of Haast School – large blocks of land cleared of what had been a continuous coastal strip of indigenous forest. We wondered about the wisdom of removing this living barrier protecting the land from the sea and coastal gales.

Along this coastline, where there are several small communities, we also saw the too-familiar pattern of exotic plantings escaping from nearby gardens into the surrounding environment.

At Okuru River we found giant gunnera persisting from a roadside dumping at the edge of the settlement, where there was also lots of agapanthus planted.

At Jackson Bay, as far south as the road takes you on that coast, we saw one property with extensive plantings of arum lily (*Zantedeschia aethiopica*) growing along one boundary and escaping into nearby roadside areas. The same property has Mexican daisy (*Erigeron karvinskianus*) planted along its front retaining wall. Both are major environmental weeds that are being cultivated alongside a vulnerable natural area.

Nearby, Jon found some ivy growing on a stream-bank and collected a specimen for the Allan Herbarium. He later identified it as Canary Islands ivy (*Hedera canariensis*) and told us that it is often confused with English ivy (*Hedera helix*). The main separable character is the stellate (star-shaped) hairs on the leaf stalks (petioles) which require a hand lens or microscope to see. Also at Jackson Bay, we saw a pōhutukawa (*Metrosideros excelsa*) tree planted on the foreshore, surely the most southerly planting of this species in Westland.

Franz Josef Glacier & Fox Glacier Schools

On 18th October, Murray and Robinne returned to Westland to teach at Franz Josef Glacier School (Fig. 25) for the day.



Fig. 25 Franz Josef Glacier School, Westland. Photo: Nina Robb.

In addition to the 24 students from Franz Josef Glacier, Fox Glacier School teacher Lisa Bron brought three of her older students north to join in on the weed related activities (Fig. 26).



Fig. 26 Nina Robb, Murray Dawson, Robinne Weiss and Myles Riki with Franz Josef Glacier and Fox Glacier School students in a group photo. Photo: Lisa Bron.

Our educator Robinne led the indoor classroom activities as usual. We split the class into two groups and for the outside field work (Fig. 27), we collected weeds in the school grounds and next door in the extensive block of land owned by the Franz Josef Top 10 Holiday Park. Behind the school there is a corridor of tall native forest but, as we were looking for weeds, we spent little time in the forest.



Fig. 27 Teachers and students on a field trip next to Franz Josef Glacier School. Photo: Murray Dawson.

Nina Robb (who is based at the Franz Josef DOC office) again scoped out the local area and joined us at the school (Fig. 28).



Fig. 28 Nina Rob (DOC) holding a hypericum collected from the Holiday Park next to the school. We are currently unsure if it is a cultivated variety or the invasive tutsan (*Hypericum androsaemum*). Photo: Murray Dawson.

For the last session of the day, Myles Riki from DOC visited the school. Myles is a hands-on expert at controlling and removing weeds by spraying and physical removal. He worked alongside Murray to help the students put plants in our presses (Fig. 29) and spoke to them about how to control the weeds that they collected.



Fig. 29 Murray Dawson with students and a full plant press. Photo: Lisa Bron.

What were some of the plants that we found in and around Franz Josef Glacier School?

Again, we found the usual widespread environmental weeds of Westland (and elsewhere) including, among others: creeping buttercup (*Ranunculus repens*), English ivy (*Hedera helix*), hydrangea, and montbretia (*Crocsmia* × *crocsmiiflora*).

Cotoneasters were rampant in the Holiday Park next to the school, from mature trees that were planted (Fig. 30) to numerous seedlings and all sizes in-between. We observed at least three different species from this site – *Cotoneaster simonsii*, *C. glaucophyllus* and *C. franchetii* (Fig. 31A–C). Cotoneasters are a major problem in many areas of Westland, including our later field site behind Kaniere School.



Fig. 30 Large-leaved cotoneaster (*Cotoneaster glaucophyllus*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4957748>).



Fig. 31 *Cotoneaster* species. **A**, *C. simonsii*. **B**, *C. glaucophyllus*. **C**, *C. franchetii*. Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4957748>).

We also discovered more than a dozen saplings of European alder (*Alnus glutinosa*), happily establishing themselves in the street-front garden beds of the Holiday Park (Fig. 32). These have presumably come from seed dispersed from specimen trees planted somewhere nearby (but not seen by us). Elsewhere in New Zealand, alder has been noted to be widespread and weedy, especially in the Waikato and Wairarapa.

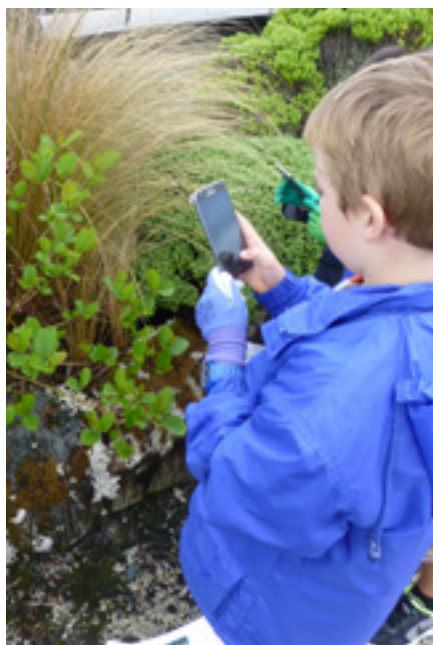


Fig. 32 Franz Josef Glacier School student recording a European alder (*Alnus glutinosa*) sapling using the iNat app. Photo: Murray Dawson.

In the Holiday Park grounds, Murray also found a small patch of Mexican daisy and a plant of Paris daisy (*Euryops*; Fig. 33), that were probably originally planted.



Fig. 33 Paris daisy (*Euryops*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4422867>).

We puzzled over a bronze-leaved groundcover growing in the lawn of the school grounds. Murray suspected this to be a native gunnera. He confirmed this when he found more of this mystery plant growing in the Holiday Park grounds next door. There, both sexes were observed in flower. This low-growing native gem, *Gunnera prorepens*, was seen thriving in the damper areas of the turf (Fig. 34A–C). There does not appear to be any other collections in the Allan Herbarium of this species from Franz Josef, but Westland seems to be a stronghold for this species.

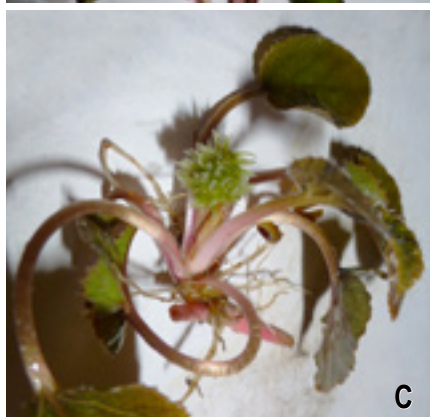
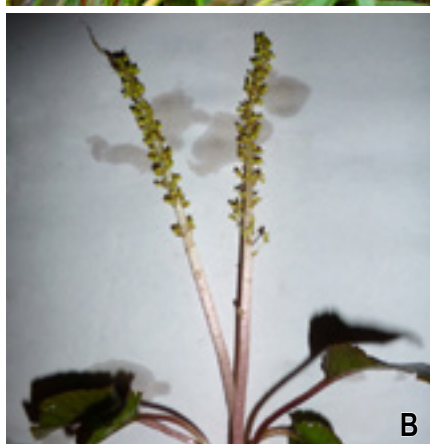


Fig. 34 *Gunnera prorepens*. **A**, habit of male plants in flower. **B**, close-up of male plant. **C**, close-up of female plant. Photos: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4423353>).

Other native plants observed include: bush lawyer (*Rubus cissoides*; Fig. 35A–B), kōtukutuku (*Fuchsia excorticata*), and shining karamū (*Coprosma lucida*).



Fig. 35 Bush lawyer (*Rubus cissoides*). **A**, habit of plant. **B**, close-up of flowers. Photos: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4423948>).

Kaniere School

After visiting Franz Josef Glacier School our Westland weeds roadshow finished at Kaniere School (Fig. 36) where we visited Jenny Barrow's Y4–5 class of 25 students during 19–20th October.



Fig. 36 Kaniere School, Westland. Photo: Murray Dawson.

On our first afternoon with the school, we held our inside activities programme which fully engaged the students, who were all very keen (Fig. 37–39).



Fig. 37 Kaniere School students assembling jigsaws of weeds to learn about the traits of each. Photo: Murray Dawson.



Fig. 38 Kaniere School students designing gardens to learn values of plants. Photo: Murray Dawson.



Fig. 39 Kaniere School student explaining why she chose different types of plants in her garden design. Photo: Murray Dawson.

During the following morning, Murray, Robinne, teacher Jenny Barrow and several parent helpers supervised the students for a field trip around the edge of the Kaniere Tailings, located immediately behind the school.

After we finished our visit, the school nominated their Y5 student Sam to attend our two-day education programme at Landcare Research in Lincoln.

What were some of the plants that we found in the Kaniere Tailings?

Because this area had been highly disturbed through the past activities of gold mining, and was probably cleared of all native vegetation at some stage, it provided ideal conditions for the invasion of weeds.

Sure enough, large bushes of Franchet's cotoneaster (*Cotoneaster franchetii*) were dominating the tailings (Fig. 40A–B) and there was also abundant butterfly bush (*Buddleja davidii*), Himalayan honeysuckle (*Leycesteria formosa*; Fig. 41), and tutsan (*Hypericum androsaemum*).

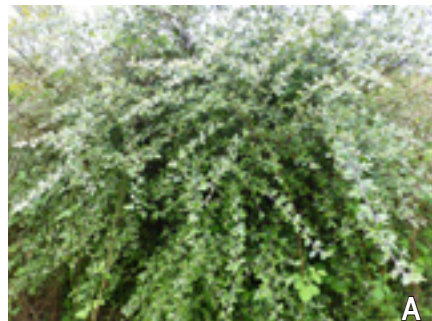


Fig. 40 Franchet's cotoneaster (*Cotoneaster franchetii*). **A**, habit of plant. **B**, close-up of leaves. Photos: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4580739>).



Fig. 41 Himalayan honeysuckle (*Leycesteria formosa*), observed and photographed by students of Kaniere School, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4397909>).

Other environmental weeds were common, including: blackberry (*Rubus fruticosus*), crack willow (*Salix × fragilis*), European holly (*Ilex*

aquifolium), gorse (*Ulex europaeus*), purple foxglove (*Digitalis purpurea*), Scotch broom (*Cytisus scoparius*), and wild brassica.

There were also a couple of patches of aluminium plant (*Lamium galeobdolon* 'Variegatum'; Fig. 42) and a large area of English ivy (*Hedera helix*) sprawling along the undergrowth and banksides.



Fig. 42 Aluminium plant (*Lamium galeobdolon* 'Variegatum'), observed and photographed by students of Kaniere School, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4409431>).

We also saw some well-established sycamore (*Acer pseudoplatanus*) and English oak (*Quercus robur*) trees, which must have been originally planted. These specimen trees were producing seedlings by the thousands (Fig. 43A–B). This is a very weedy site!



Fig. 43 Sycamore (*Acer pseudoplatanus*). **A**, numerous seedlings. **B**, close-up of seedling. Photos: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4580732>).

The few native shrubs we noticed included: coprosma, kōtukutuku (*Fuchsia excorticata*), leather-leaf fern (*Pyrrosia eleagnifolia*), patē (*Schefflera digitata*), pōhuehue (*Muehlenbeckia australis*), and wineberry (*Aristotelia serrata*).

Mt Albert Grammar School

We visited Mt Albert Grammar School (Fig. 44) on 26–27th October.



Fig. 44 Mt Albert Grammar School, Auckland. Photo: Murray Dawson.

This trip provided several firsts. After delivering our weeds programme to primary schools on the West Coast of the South Island, this was our first trip to the North Island, the first to a secondary school, and also the first visit partnering with the Auckland-based Tread Lightly Caravan (TLC) team as our educators.

Hugh Gourlay, also from Landcare Research at Lincoln, joined Murray to contribute his biocontrol expertise – as well as bringing along some biocontrol insects for the students to examine (Fig. 45).



Fig. 45 Hugh Gourlay showing off his biocontrol insects. Photo: Murray Dawson.

Although Mt Albert Grammar School is somewhat outside our target demographic of usually low decile, remote and hard-to-reach rural schools, there were good reasons to visit this school in Auckland city. Mt Albert Grammar have taken on an active conservation project to monitor mothplant (*Araujia hortorum*), in partnership with Auckland Council, so wider exposure to our weed education programme that engages the latest technology for identifying and recording plants was seen to be of special benefit that could also contribute towards their ongoing work. It was the school that contacted us when they learned of our successful funding.

Michael Ashby and Helen Dunham were the two school teachers that we engaged with along with two of their classes comprising 34 students.

We were based in the school hall for the first day, and our educator Monique Russell of the TLC did a great job presenting the content and activities, which she adjusted for the older Y9–11 audience. We finished the first day by using the weeds identification app in a foray to a wildland area within the school grounds.

The following day, we undertook a full field trip to the nearby Roy Clements Walkway.

In addition to the above named people, others who joined us for the field day were Katie Jones (General Manager of the TLC), Adrienne De Melo (Outreach and Education Coordinator, DOC Auckland), and Sel Arbuckle (a local volunteer and plant expert). Sel has worked extensively maintaining the walkway and is part of the St Lukes Environmental Protection Society.

The students were well mannered and attentive, and enjoyed being outdoors (Fig. 46–48), especially considering the pressures of their imminent end of year exams. The school nominated their Y11 student Lois to attend our Lincoln weeds workshop, who proved to be an excellent choice.



Fig. 46 Hugh Gourlay with Mt Albert Grammar School students on the field trip. Photo: Katie Jones.



Fig. 47 Educator Monique Russell with a Mt Albert Grammar School student. Photo: Katie Jones.



Fig. 48 Murray Dawson with Mt Albert Grammar School students adding plants to the herbarium press. Photo: Katie Jones.

What were some of the plants that we found around Mt Albert?

During our weed 'treasure-hunt' within the school grounds we used the identification app to learn how to identify widespread and common weeds, such as: broad-leaved dock (*Rumex obtusifolius*), creeping buttercup (*Ranunculus repens*), ivy (*Hedera*), and large bindweed (*Calystegia silvatica*; Fig. 49).



Fig. 49 Mt Albert Grammar School student with large bindweed (*Calystegia silvatica*). Photographed by one of the students.

Thanks to the efforts of local volunteers, the boarded Roy Clements Walkway itself was relatively weed free. However, a side track at the western end of the walkway led to a very weedy spot, due to plants 'jumping the garden fence' from an adjacent empty section. This provided an excellent site to study and record numerous weed species. In addition to the common weeds found the previous day, at the walkway we found numerous invasive species, including: brush wattle (*Paraserianthes lophantha*), mignonette vine (*Anredera cordifolia*), onion weed (*Allium triquetrum*), tradescantia (*Tradescantia fluminensis*; Fig. 50), and woolly nightshade (*Solanum mauritianum*).



Fig. 50 Tradescantia (*Tradescantia fluminensis*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4460151>).

We found a tree privet (*Ligustrum lucidum*) actively resisting control measures by resprouting after having been cut down (Fig. 51).



Fig. 51 Tree privet (*Ligustrum lucidum*) actively resprouting. Observed and photographed by students of Mt Albert Grammar School, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4452486>).

We found several attractive garden plants, widely grown but obviously escaping cultivation at our study site. These included: bartlettina (*Bartlettina sordida*; Fig. 52), black-eyed Susan vine (*Thunbergia alata*; Fig. 53A–B), florist's cineraria (*Pericallis × hybrida*; Fig. 54), ivy-leaved toadflax (*Cymbalaria muralis*; Fig. 55), jasmine (*Jasminum polyanthum*; Fig. 56), nasturtium (*Tropaeolum majus*; Fig. 57), pale pink-sorrel (*Oxalis incarnata*; Fig. 58), and shrub balsam (*Impatiens sodenii*; Fig. 59).



Fig. 52 *Bartlettina sordida*, observed and photographed by students of Mt Albert Grammar School, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4452959>).



Fig. 53 Black-eyed susan vine (*Thunbergia alata*). **A**, habit of plant. **B**, close-up of flower. Photos: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4460150>).



Fig. 54 Florist's cineraria (*Pericallis × hybrida*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4579241>).



Fig. 55 Ivy-leaved toadflax (*Cymbalaria muralis*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4460087>).



Fig. 56 Jasmine (*Jasminum polyanthum*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4460149>).



Fig. 57 Nasturtium (*Tropaeolum majus*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4460033>).

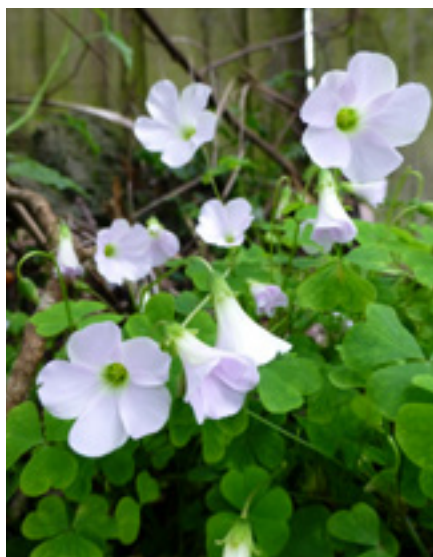


Fig. 58 Pale pink-sorrel (*Oxalis incarnata*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4460091>).



Fig. 59 Shrub balsam (*Impatiens sodenii*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4460148>).

Native species observed by the students were: *Haloragis erecta* ssp. *erecta*, karaka (*Corynocarpus laevigatus*), kawakawa (*Piper excelsum*), māhoe (*Melicytus ramiflorus*), mānuka (*Leptospermum scoparium*), putaputawētā (*Carpodetus serratus*), tōtara (*Podocarpus totara*), and whau (*Entelea arborescens*). Many of these natives form part of restoration plantings at the Roy Clements Walkway.

Mission Heights Junior College

Following our visit to Mt Albert Grammar School, Hugh and Murray again partnered with our educator Monique to visit Mission Heights Junior College (Fig. 60) on 9–10th November.



Fig. 60 Mission Heights Junior College, Auckland. Photo: Murray Dawson.

The Tread Lightly Caravan has previously taught their sustainability programme at Mission Heights, so Monique was already well known to the school. This helped for our weed education delivery on this trip.

The Mission Heights area is a relatively new subdivision, situated on a redeveloped hillside and with small sections in relation to the house sizes. There seems little scope for large vegetable gardens or extensive landscaping on these properties, so our teaching hopefully helped to reconnect the students with the natural world. The 27 Y7 students that we taught are culturally diverse, and get along with each other very well.

The first day followed our now familiar schedule of explaining what weeds are, perceptions and values of plants, and teaching about ecological relationships of plants and animals (Fig. 61–62). The class then went outside to examine some weeds growing locally on the school grounds, and used the pre-loaded apps on our smartphones to record and identify them (Fig. 63).



Fig. 61 Mission Heights students assembling weed jigsaws. Photo: Murray Dawson.



Fig. 62 Hugh Gourlay and Mission Heights students examining biocontrol insects. Photo: Murray Dawson.



Fig. 63 Mission Heights students using apps to record and identify arum lilies. Photo: Murray Dawson.

Our field trip on the second day was at nearby Silvana Reserve (Fig. 64–65), which follows a stream with an adjacent retention pond. The reserve has a mixture of older indigenous and exotic trees and younger restoration/landscape plantings. There was also a good selection of weeds for the students to discover.



Fig. 64 Mission Heights students starting the field trip in Silvana Reserve. Photo: Andrew Jenks.



Fig. 65 Mission Heights students adding plant specimens to the field press. Photo: Andrew Jenks.

Joining us on this field day were several of the school's teachers, along with Hugh, Murray and Monique. Andrew Jenks (from Wai Care) and his colleague Jorge also joined us, and they were interested in seeing the resources and the apps that we were using. Wai Care works with communities to care for waterways and catchments.

Mission Heights Junior College selected their Y7 student Raiyan to travel to our research centre in Lincoln.

What were some of the plants that we found in Silvana Reserve?

We found several mature trees of hawthorn (*Crataegus monogyna*; Fig. 66A–B), that obviously predate the residential subdivision of the area. These established hawthorns are producing weedy saplings in the reserve. Similarly, we found an oak sapling that would have come from an established tree nearby.



Fig. 66 Hawthorn (*Crataegus monogyna*). **A**, habit of mature tree. **B**, leaves and flowers. Photos: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4572820>).

Both Chinese privet (*Ligustrum sinense*; Fig. 67) and tree privet (*Ligustrum lucidum*; Fig. 68) were common in the reserve. Growing under the shade of trees, hedge nettle (*Stachys sylvatica*) was also very common (Fig. 69).



Fig. 67 Chinese privet (*Ligustrum sinense*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4572807>).



Fig. 68 Tree privet (*Ligustrum lucidum*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4572670>).



Fig. 69 Hedge nettle (*Stachys sylvatica*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4572432>).

A selection of other environmental weeds that we found were: creeping buttercup (*Ranunculus repens*; Fig. 70), gorse (*Ulex europaeus*), inkweed (*Phytolacca octandra*; Fig. 71), Japanese honeysuckle (*Lonicera japonica*), and pampas grass (*Cortaderia*).

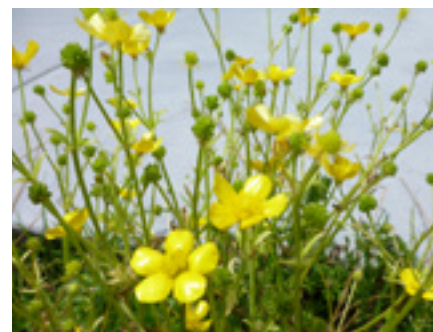


Fig. 70 Creeping buttercup (*Ranunculus repens*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4572663>).



Fig. 71 Inkweed (*Phytolacca octandra*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4572576>).

Water-loving environmental weeds growing alongside the stream included: arum lily (*Zantedeschia* 'Green Goddess'; Fig. 72), crack willow (*Salix × fragilis*), slender knotweed (*Persicaria decipiens*; Fig. 73), watercress (*Nasturtium officinale*), and yellow flag (*Iris pseudacorus*; Fig. 74).



Fig. 72 Arum lily (*Zantedeschia* 'Green Goddess'). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4572575>).



Fig. 73 Slender knotweed (*Persicaria decipiens*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4573647>).



Fig. 74 Yellow flag (*Iris pseudacorus*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4572813>).

After their collecting and weed recording activities, we showed the students an area where local residents had dumped their gardening waste onto the reserve. Plants that were persisting from these obvious garden discards were: century plant (*Agave*; Fig. 75), garden geranium (*Pelargonium* × *hortorum*; Fig. 76), and jade plant (*Crassula ovata*; Fig. 77).



Fig. 75 Century plant (*Agave*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4572808>).



Fig. 76 Garden geranium (*Pelargonium* × *hortorum*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4572664>).

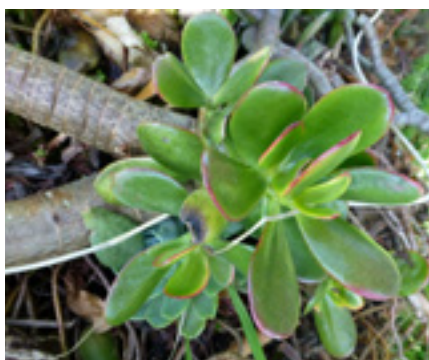


Fig. 77 Jade plant (*Crassula ovata*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4573616>).

We also found an exotic orchid species that was persisting. The online science community identified it for us as pink rock orchid (*Dendrobium* / *Thelychiton kingianum*; Fig. 78).



Fig. 78 Pink rock orchid (*Thelychiton kingianum*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4573611>).

This demonstrated first-hand how weeds can establish from indiscriminate dumping of garden waste and it was disappointing to see how one of the few green spaces in the area was being mistreated.

TKKM O Kawakawa Mai Tawhiti

For our last school visit in 2016, we visited TKKM o Kawakawa Mai Tawhiti (Fig. 79) in Hicks Bay from the 30th November to 2nd December.



Fig. 79 TKKM school, Hicks Bay, Gisborne Region. Photo: Murray Dawson.

TKKM is a Decile 1 full-immersion Te Reo (Māori language) school. Teacher Kararaina Ngatai-Melbourne looked after us very well and also explained some of the lessons we gave in English to her class in Te Reo. We were also introduced to Principal Papa Campbell who made us feel welcome. This visit proved to be one of our most rewarding and interesting.

Our Auckland-based educator Monique again partnered with Murray on this trip. Keen NatureWatch NZ contributor Mark Tutty of Gisborne joined us as a helper for our school visit. Mark proved to be great value and fully pitched in.

The three of us arrived at Hicks Bay on Wednesday afternoon and we just had time to teach a class of 12 Y8s in their science room (Fig. 80).



Fig. 80 TKKM students examining weeds using microscopes and hand lenses. Photo: Murray Dawson.

The school kindly made the whole of Thursday available for a Y9–10 class of another dozen students, plus a few of the keener Y8s who rejoined us from the previous day. In the morning we studied weeds growing in the school grounds and in the afternoon we ventured further afield, across the road along the stream-side and out towards the local marae (Fig. 81–83). Being such a rural school, the students are well connected with the land and were extremely adept at getting into hard to access places in their hunt for weeds – often in bare feet and providing a major contrast to the urbanised experience at Mission Heights!



Fig. 81 TKKM students collecting wild roses in the field. Photo: Murray Dawson.



Fig. 82 Mark Tutty with TKKM students labelling the weed specimens they collected. Photo: Murray Dawson.



Fig. 83 TKKM students adding specimens to the press with Trudi Ngawhare from DOC and Murray Dawson. Photo: Mark Tutty.

Trudi Ngawhare from DOC (Gisborne) joined us on the Thursday field trip.

At the school prize-giving on Friday morning, Murray had the honour of speaking about our project in front of the school and local community. Murray presented prizes to three students who were selected by the school as showing the greatest interest in our project. Frank received a smartphone and won the trip to Lincoln the following week; Phoenix and Kaia each won LED-illuminated hand lenses.

What were some of the plants that we found at Hicks Bay?

We found *Tradescantia* growing around the nearby stream sides. When visiting our research centre in Lincoln, Hugh Gourlay gave Frank a container of *Tradescantia* biocontrol beetles. Upon his return to Hicks Bay, Frank released them under the bridge where we found a large patch of this troublesome weed.

Other notable weeds in the district included abundant Chinese privet (*Ligustrum sinense*) and brush wattle (*Paraserianthes lophantha*; Fig. 84). These seemed to be the dominant weedy tree species of our study area.



Fig. 84 TKKM students collecting brush wattle (*Paraserianthes lophantha*) in the field. Photo: Murray Dawson.

A selection of minor weeds not seen during visits to schools from other areas of New Zealand included: dragon's-head lily (*Gladiolus dalenii*; Fig. 85), Indian-shot (*Canna indica*; Fig. 86), large quaking grass (*Briza maxima*; Fig. 87), and love-in-a-mist (*Nigella damascena*; Fig. 88).



Fig. 85 Dragon's-head lily (*Gladiolus dalenii*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4769675>).



Fig. 86 Indian-shot (*Canna indica*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4759956>).



Fig. 87 Large quaking grass (*Briza maxima*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4760511>).



Fig. 88 Love-in-a-mist (*Nigella damascena*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4759855>).

Although we were concentrating on weeds, the students observed a few native plants too, including: kawakawa (*Piper excelsum*), shore bindweed (*Calystegia soldanella*), taupata (*Coprosma repens*), and tree tutu (*Coriaria arborea*).

A plant that we originally misidentified as the invasive hanging sedge, *Carex pendula*, was later identified by the NatureWatch NZ community as *Carex geminata*, a native plant. This highlights the importance of accurate identification before considering any weed control measures.

Further afield, we observed raukūmara (*Brachyglottis perdicioides*; Fig. 89), also called East Cape brachyglottis, a local rare native shrubby daisy found growing just below our lodgings, and on our way home we paid homage to the famous Te Waha o Rerekohu (Fig. 90), said to be the largest and the oldest pōhutukawa (*Metrosideros excelsa*) in the world.



Fig. 89 Raukūmara (*Brachyglottis perdicioides*). Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4771246>).



Fig. 90 Te Waha o Rerekohu, a famous and chiefly pōhutukawa tree. Photo: Murray Dawson, via NatureWatch NZ (<http://naturewatch.org.nz/observations/4771356>).

Curious Minds visit to Lincoln

One student from each of the participating schools, and their caregiver, was given the opportunity to visit Landcare Research's Lincoln campus for two days (8–9th December) to develop their botanical and entomological skills. The students 'won' the Lincoln visit by being the top project student nominated by their school.

To start the first day, Ines Schönberger gave them a tour of the Allan Herbarium, New Zealand's largest herbarium containing a research collection of more than 630,000 specimens. The group saw selected weed and special interest specimens (Fig. 91–92) and historic collections made by Captain Cook's botanists. Students learned about the role and function of the herbarium and how to add the specimens collected by their school group to the research collection (Fig. 93–94). The first day ended with a visit to the nationally significant harakeke (New Zealand flax) collection with Katarina Tawiri (Fig. 95–96).



Fig. 91 Ines Schönberger explaining about herbarium specimens to students and their caregivers. Photo: Murray Dawson.



Fig. 92 Ines Schönberger explaining about the large herbarium specimens. *Lodoicea maldivica*, the double ('bum') coconut is in the middle. Photo: Murray Dawson.



Fig. 93 Students and caregivers concentrating on mounting and labelling their specimens which will go in the herbarium. Photo: Murray Dawson.



Fig. 94 Student mounting a specimen of privet. Photo: Murray Dawson.



Fig. 95 Katarina Tawiri explaining about the harakeke collection. Photo: Murray Dawson.



Fig. 96 Students extracting muka (flax fibre). Photo: Murray Dawson.

To begin their second day at Lincoln, the students digitised their specimens mounted from the previous day (Fig. 97), which were added to the Allan Herbarium collections database. Then it was onto biocontrol of weeds with Hugh and Robinne. Hugh showed them around the containment facility, where the insects used for biocontrol are studied and reared (Fig. 98). Students also looked for and collected gorse (Fig. 99A–C) and thistle (Fig. 100A–C) biocontrol insects from around the Lincoln grounds and studied them under microscopes (Fig. 101). Robinne led them through some educational activities on biocontrol, including a small-scale food preference experiment to show how testing to determine whether potential agents are suitably specific or not is determined. When the caterpillars were put into small containers with a choice between three different plant species, the results clearly showed the students that specialist biocontrol insects will voraciously consume only their preferred plant species and nothing else (Fig. 102).

The two-day visit finished with written feedback and prize-giving, including a smartphone given to each student (Fig. 103). The feedback was very positive and the students obviously had a great time. The caregivers also fully pitched in and learnt a lot from their time with us (Fig. 104).



Fig. 97 Kate Boardman helping a student to digitise his mounted specimen. Photo: Murray Dawson.



Fig. 98 Hugh Gourlay giving a tour of the insect quarantine facility. Photo: Murray Dawson.



Fig. 99 Biocontrol insects on gorse. **A**, students hunting for gorse seed weevil in the Landcare Research experimental grounds. **B**, student with gorse seed weevil. **C**, close-up of gorse seed weevil (*Exapion ulicis*). Photos: Murray Dawson.



Fig. 100 Biocontrol insects on thistle. **A**, student hunts for green thistle beetles in the Landcare Research experimental grounds. **B**, collecting green thistle beetles. **C**, close-up of green thistle beetles (*Cassida rubiginosa*). Photos: Murray Dawson.



Fig. 101 Hugh Gourlay explaining about biocontrol insects and examining them under the microscope. Photo: Murray Dawson.



Fig. 102 Student examines the results of her insect preferential feeding experiment. Photo: Murray Dawson.



Fig. 103 Murray presenting a smartphone as a prize to the Mission Heights student. Photo: Greg Ford.



Fig. 104 Group photo of Landcare Research staff, educators, caregivers and students. Photo: Greg Ford.

Summary

The 'Winning the War against Weeds' project engaged more than 200 students from nine schools in three regions of New Zealand. More than 600 observations were made on NatureWatch NZ and more than 200 new herbarium specimens were collected (Table 1).

At each school, we gave away a resource pack comprising *An Illustrated Guide to Common Weeds of New Zealand* (Popay et al. 2010), National Pest Plant Accord (NPPA) booklets, and Weedbusters resources (weedbusting guides, plant-me-instead booklets, weed control handbooks and stationary).

The project uncovered some interesting finds. A suite of well-known environmental weed species were found practically everywhere, such as blackberry (*Rubus fruticosus* agg.), creeping buttercup (*Ranunculus repens*), gorse (*Ulex europaeus*), ivy (*Hedera* spp.), privet (*Ligustrum* spp.), Scotch broom (*Cytisus scoparius*) and tradescantia (*Tradescantia fluminensis*). Because gorse is so widespread and recognisable (with yellow flowers and prickly stems), it was often used to demonstrate the weed identification app.

Although cotoneaster (*Cotoneaster* spp.) was found in most places, it was particularly abundant in Westland, at the Kaniere and Franz Josef field sites. Auckland had the most ornamental plants that had 'jumped the garden-fence', and Hicks Bay in Gisborne had several weed species not seen in the other locations.

What did we learn from the students?

It was amazing how quickly even primary school students understand science apps. Students also enjoy hands-on science such as looking through microscopes and putting their plant specimens into our field presses. We hope that this project has inspired a future generation of new weedbusters and researchers.

That the project could meet an education need and excite curious minds was confirmed – some of the comments back from the students were "best day ever!", "I'm right into this!", and "when are you coming back?"

"Thank you so much to Murray, Robinne, Hugh and the weedbusting team that came to our school. I had the best time and learnt so much." (Charlotte, Y6).

"I really enjoyed my time at Landcare but I think that my favourite activity was the caterpillar experiment... I found this trip very interesting and inspiring... Suggestions: Please do more trips so that other people can have this same experience. Thank you for having me!" (Lois, Y11).

Table 1 Contribution made to science.

School	No. of students involved	No. of NatureWatch NZ observations	No. of species found at each location	No. of herbarium specimens lodged
Fox and Franz Josef	27	84	36	41
Haast	11	74	45	43
Hokitika	45	39	24	28
Kaniere	25	134	57	36
Mission Heights	27	78	48	18
Mount Albert Grammar	34	85	58	17
TKKM	24	144	71	10
Whataroa	22	35	26	30
Total	215	673	–	223

Acknowledgements

This project would not have been possible without the Unlocking Curious Minds MBIE funding (UCM C09X1524) for the entirety of the Winning the War against Weeds project.

The Brian Mason Scientific & Technical Trust co-funded more intensive engagement in the West Coast of the South Island.

Thanks to the schools, teachers, volunteers and local communities that were so willing to work with us. DOC staff also generously came along to share days out with us.

Lastly, we thank the students themselves – all those willing and interested curious minds.

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- Landcare Research: Online key to the weed species of New Zealand: www.landcareresearch.co.nz/resources/identification/plants/weeds-key
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- NatureWatch NZ project: Pest Plants (weeds) of NZ: <http://naturewatch.org.nz/projects/pest-plants-weeds-of-nz>
- Weedbusters: www.weedbusters.org.nz/

