GORSE ON THE CHATHAM ISLANDS: SEED FORMATION, ARTHROPOD ASSOCIATES AND CONTROL.

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SUMMARY

Surveys in 1991 showed gorse (*Ulex europaeus*) was mainly on better farmland. On the Chatham Islands burning and goats are undesirable control strategies, because of peat fires and the risk of escaped goats destroying the endemic biota. Keeping stone quarries free of gorse and control of scattered bushes is a priority to stop gorse spreading. Seed pod formation was often low, because the few honey bees (*Apis mellifera*) pollinated the flowers inadequately. Looper caterpillars of *Chloroclystis testulatus* and *C. filata* fed on gorse flowers without affecting seed production. The gorse seed weevil (*Apion ulicis*) was not found. In December 1991, the gorse shoot thrips (*Sericothrips staphylinus*) and the gorse spider mite (*Tetranychus lintearius*) were released to start a new gorse biocontrol programme.

Keywords: Chatham Islands, gorse, weed status, pollination, arthropods, control

INTRODUCTION

Little has been written about gorse (*Ulex europaeus*) on the Chatham Islands. Gorse was introduced before 1925 (Madden and Healy 1959) and Madden (1955) noted it had spread far beyond the original shelter hedges and that herbicide control was being investigated. Before 1980, when goats began to be used for gorse control, there were only 2-4 goats kept on Chatham Island (L. Galloway pers. comm.). The 53,780 ha of Chatham islands grassland supported 156,364 sheep, 4,288 cattle and 264 goats in 1990 (Statistics Department 1991).

No introductions of biocontrol agents for weeds on the Chatham Islands have been formally recorded (Cameron *et al* 1989). There is no resident government or local body person to advise on or supervise weed control.

In England, Hamilton (1980) found only 14-22 % of the gorse flowers formed pods in spring. There is no pod formation in winter in New Zealand (Hill *et al* 1991a) and little in England, when temperatures restrict honey bee (*Apis mellifera*) flight. In England, honey bees and bumble bees (*Bombus* spp.) visit the flowers. Thrips do not pollinate the flowers and 12.5 % of hand pollinated flowers form seed pods (Hamilton 1980). Flowers pollinated by hand or, in winter, average only two seeds per pod (Hamilton 1980), while four seeds per pod are formed from flowers in spring (Hamilton 1980; Hoddle 1991). Until 1980, the Chatham Islands depended on up to 20 honey bee hives to pollinate white clover and lotus with only flies to assist fruit formation in garden and tunnel house crops (Madden 1955; Macfarlane 1980; Macmillan 1980).

This paper reports on an initial assessment of the weed status, insect associates and pollination of gorse made as part of a 1991 survey of insects on the Chatham Islands (Macfarlane *et al* 1992). This was to help implement a sound gorse control programme.

METHODS

Insects and mites were collected by beating gorse bushes in flower at three sites in March and six in November 1991. More information on insect species was obtained from the New Zealand National Arthropod Collection (NZAC), where voucher specimens from this survey have been deposited. Over 200 seed pods of gorse (from the 1990

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spring flowering) were sent to us from Te Matarae and Pitt Island. The green and ripe pods were checked for the gorse seed weevil (*Apionulicis*). Residents and government staff were questioned about gorse, its control and whether seed weevils had been introduced. The main areas of gorse were mapped and observations made on the control of gorse during the insect survey of Chatham Island (Macfarlane *et al* 1991).

In November 1991, gorse seed pod formation was measured at five sites on Chatham Island (Table 1). The sites were chosen to represent the range in seed formation apparent where there were different amounts of gorse and a range in density of active honey bee hives per ha of gorse. Two contrasts in distance from the hives were included to verify the actual working range of honey bees. At each site a total of 20 terminal shoots with green pods were taken from five bushes. Seed pods were counted on the terminal 20 cm of each stem. Elsewhere estimates were made using stems with counted pods for reference. Hives were inspected in November at 13 sites from Awatotara stream to Wharekauri and Waitangi West in November. Hive entrances were inspected for foraging bees. Inactive hives were inspected internally.

RESULTS AND DISCUSSION

Gorse status

Gorse mainly covers the better farmland on Chatham and Pitt Islands. We estimated there are between 700 and 1,200 ha of gorse on Chatham Island. The largest area (over 150 ha) is adjacent to Henga Bush and around the road junction to the airport. Four other major blocks of around 100 ha are to the west of Wharekauri homestead, on the north shore of Lake Huro, on the southern part of land between Lake Huro and the Te Whanga Lagoon and on the coastal side of the road around Ohinemamao. Blocks of gorse near Henga, Wharekauri and in the north of Pitt Island have expanded considerably since the 1970's. Isolated bushes occur in the generally peaty southern tableland and "clears" (mainly covered with bracken fern and shrubs) in the north and centre of Chatham Island often in the vicinity of roads. This suggests seed is spread by graders and also livestock (grazed pods, seed between muddy hooves and amongst wool). The main quarry for road metal towards Port Hutt was free of gorse, but there was gorse nearby.

Seed production, pollinator availability and spread of gorse

On Chatham Island gorse flowers and forms seed in the spring and autumn. At five sites seed pod formation varied by over 150 fold (Table 1) and was similar to spring flowering gorse with (1-3 pods/20 cm) to two sites in Canterbury (Hill *et al* 1991a). Elsewhere on Chatham Island gorse seed pod set per 20 cm of stem was estimated in November at 30-50 between the motel and Waitangi, at 20-40 (less on some bushes) two km west of Mount Maunganui, and below five on Te Matarae road near the school camp. It was lowest at Port Hutt, where six seed pods were seen during a three minute search of about 10 bushes. No honey bees were seen there either. In March the six ripe pods found on an isolated bush near Rangiaka, 5 km from the nearest hives, averaged only two seeds per pod, which may indicate self pollination. Nowhere has the effect of selfing on the first and subsequent generations of gorse plants been investigated, but seed formation and plant vigour are progressively impaired with each generation even in legume crops (e.g. lucerne, white clover, broad beans) with an ability to self (Hansen 1972; Fruscianthe and Monti 1980; Barker and Williams 1987).

Between 1987 and 1989 the honey bee hives kept on the Chatham Islands increased to 110 (R.W. Bambray pers. comm.) so hive density has never exceeded 1/12 of the level on farmland in New Zealand (Statistics Dept 1990, 1991). At 13 sites, 26 of 51 honey bee hives were active on the south west coast, centre and north of Chatham Island. Nine hives were noted at four other sites, but were not inspected. In 1991, there were an estimated 30-50 active colonies on Chatham Island or at most one hive per 1,000 ha of grassland. The only feral hive on Chatham Island was still active (R.W. Bambray pers. comm.). There are still no bumble bees on the Chatham Islands.

If beekeeping expands, then gorse could become a greater problem. Introducing bumble bees could help by reducing the need for honey bees where they can pollinate gorse. Bumble bees are self managing, cool hardy pollinators which visit gorse flowers

TABLE 1: Gorse seed pod density and honey bee availability on Chatham Island (November 1991)

Site	Seed pods/20 cm stem		Nearest hives in km	Gorse ha /hive	Active hive numbers	
	Average	S.E.M.*	range			
Te Matarae boundary	132.5	15.9	28-356	1	>2	5
Wharekauri	28.2	3.8	8-70	adjacent	50+	2
	0.2	0.2	0-3	2.2	50+	2
Airportbase road	1.25	0.4	0-7	1.4 and 1.9	30	5
Gate N of Tuku River	1.0	0.5	0-10	4.7	>0.1	3

* S.E.M. = Standard error of the mean.

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far less often than honey bees, because they prefer other flowers and their biology means they require little or no pollen when visiting gorse flowers. Extensive records in New Zealand have recorded only *Bombus terrestris* visiting gorse flowers.

Gorse seed weevil was introduced to Chatham Island, probably in the 1950's, and apparently released near Chatham lodge (M. Lanauze pers. comm.). Here there were honey bees to pollinate flowers. No *A. ulicis* weevils were found during the beating or in the pods. The low and patchy seed formation on gorse in the Chatham Islands could affect the ability of *A. ulicis* to establish at some sites. A fungus was found in green pods near Waitangi. Presumably this is *Cladosporium cladoporioides* that Hoddle (1991) recorded in New Zealand gorse. High sustained seed production could occur on the Chatham Islands with full pollination, because there are no seed weevils to consume up to 90% of the seed formed in spring (Hill *et al* 1991a). Gorse has a formidable ability to regenerate, with 10-23 million seeds accumulating in the top 2.5 cm of soil and seeds remain viable for up to 40 years (Hamilton 1980). In New Zealand, the seed bank may be filled and then replenished at 0.5 - 0.6 million seeds/ ha per year (Gaynor and MacCarter 1981).

Resident gorse fauna

Up to 50 looper caterpillars of *Chloroclystis testulatus* and *C. filata* were beaten from gorse per hour, and they mainly fed on the style and pollen of the flower rather than the petals. Only 0.5 - 5% of the flowers had been fed on. Caterpillars of the generalist dead wood feeding *Barea confusella* and *Erichthias chathamica* were collected from stems. Black book lice, lathriid beetles (debris and fungus feeders), spiders, orange anystid mites, reddish bdellid mites, and eleven spotted ladybirds (*Coccinella undecimpunctata*) (insect and mite predators) were beaten from gorse. The anystids and spiders were the commonest predators. A yellow gall midge fly (possible pollen feeder) was collected too. On the Chatham Islands, live stems were unaffected by insects, because there are no lemon tree borers (*Oemena hirta*) to bore in stems or *Anisopla captyoptera* to ring bark stems. We found soft brown scale (*Coccus hesperidum*) on garden plants on Chatham Island, but none of the other scale insects known from gorse (Gaynor and MacCarter 1981). No mite feeding ladybirds (*Stethorus* spp.) are present there (Houston 1990; NZAC).

Gorse control

Herbicide use on the Chatham Islands is minimal (L. Galloway pers. comm.). Spraying gorse virtually stopped (P. Smith pers. comm.) when herbicide subsidies were removed. Gorse was crushed on two farms, but the scale of mechanical clearance is restricted by the lack of suitable heavy machinery. Burning is cheap initially, but is only effective if followed up with land development work and control of regrowth. Fires encourage germination of dormant seed and ash provides nutrients for seedling growth. Burning gorse on the extensive peat soils of the Chatham Islands causes land to slump. Peat fires can take much effort to put out and indeed some have persisted for several years.

Only goats and timber planting allow for revenue recovery in gorse infested areas.

Eradication of the extensive blocks of gorse is often not economically feasible, although it is technically possible with goats, rotational grazing and intensive fencing (Radcliffe 1985). In theory, up to 20 times more goats may eventually be needed on the Chatham Islands for gorse control, but the cool wet climate and peaty soils do not favour goat health. Relying on goats for gorse control is rather inappropriate for the Chatham Islands given the need for quality fences to keep goats in place. As well feral goats have a propensity to damage flora and have never been eradicated from islands over 3,000 ha (King 1990). The unroaded southern tablelands without pastures are more vulnerable to livestock escapes and here there are 40 endemic species of native plants (Wilson and Given 1989) and over 120 endemic invertebrate species (Macfarlane *et al* unpublished data). New Zealand experience shows goat control on this size and type of area would cost around \$160,000 per year (Parkes 1990), which would have a large impact on the conservation budget for the Chatham Islands.

The Chatham Islands need a practical low input gorse programme to complement current traditional control methods. A gorse biocontrol programme was started with one property owner at his own expense. On December 15 1991, gorse spider mite (*Tetranychus lintearius*) was introduced using the release procedures of Hill *et al* (1991b) and the gorse shoot thrip (*Sericothrips staphylinus*) was released near Chatham lodge.

CONCLUSIONS AND RECOMMENDATIONS

Gorse is spreading on the Chatham Islands and poses a threat to productive farmland and reserves with endemic biota. Conventional control measures are less practical on the Chatham Islands than for most of New Zealand.

Seed production of gorse in the Chatham Islands and New Zealand is influenced by the abundance of honey bees. This means large gorse patches can have much lower rates of seed replenishment than small patches which honey bees can service properly. Selfing of seed seems to have a minor effect on seed pod formation in the field.

On the Chatham Islands gorse should be confined to currently infested blocks. Gorse control should be directed towards removing scattered bushes and small clumps. Control should be done promptly and before seed fall to limit the regeneration problem. The Council should clean road equipment after work in gorse infested areas. Quarries are a priority area to keep free of key weeds so that seeds are not spread with road metal.

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