# REARING AND DISTRIBUTION OF THE INTRODUCED WASP PARASITOID *SPHECOPHAGA VESPARUM* THROUGHOUT NEW ZEALAND

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## SUMMARY

Public and private organisations were asked to contribute financially to a research project aimed at mass rearing and distributing the wasp parasitoid *Sphecophaga vesparum vesparum* (Curtis). Since 1986, 108,400 yellow, overwintering parasitoid cocoons have been produced and distributed over much of New Zealand. The parasitoid is now established at Pelorus Bridge in Marlborough, but whether it will reduce problems caused by wasps remains to be seen.

## INTRODUCTION

New Zealand was free of Vespinae until 1945, when *Vespula germanica* (F.) the German wasp, was discovered nesting at Te Rapa, north of Hamilton (Thomas 1960). The Common wasp. *V. vulgaris* (L.) was discovered nesting in Dunedin in early 1983 (Donovan 1984).

High wasp populations affect a wide range of human activities: some schools have temporarily closed, forestry operations are disrupted, tourists avoid and flee infested areas, tramping clubs have had to cancel trips, and horticultural fruits, especially grapes, are damaged. Apiculture is adversely affected by predatory attacks on beehives, mainly by German wasps, and competition for beech tree honeydew, primarily by Common wasps (Clapperton 1989). Recently, several sheep have been stung to death.

Of great concern is the intense predation by wasps on native insects, and their consumption of honeydew in beech forests which removes this energy resource from the food chain of many native insects and birds. Adverse effects on birds may be more direct. A Canterbury beekeeper observed wasps feeding on the eyes and tongues of dead, newly-hatched and still moist tui chicks (*Prosthemadera novaeseelandiae* (Gmelin)) in a nest in a beech tree while the parent birds fretted nearby (B. Young, pers. comm.).

By early 1985, the life cycle of an introduced ichneumonid parasitoid of some Vespinae, *Sphecophaga vesparum vesparum* (Curtis), had been elucidated, mass-propagation procedures had been developed, and confirmation obtained that only German and Common wasps were hosts in New Zealand (Donovan and Read 1987). To maximise the chances of biologically reducing wasp numbers throughout the country, it was essential that large numbers of parasitoids be distributed wherever wasps were numerous. Public organisations were given the opportunity to contribute to a parasitoid mass-rearing and distribution research project.

Donovan and Read (1987) showed that direct insertion of adult parasitoids and comb containing parasitoid immatures into wasp nests resulted in attack, but this method was thought to be too costly to adopt throughout the country. Following trial releases, a parasitoid cocoon was recovered in a Christchurch German wasp nest in November 1986 (Donovan *et al* 1989) indicating natural spread of a winged female parasitoid. An alternative strategy was thus developed. Yellow overwintering cocoons would be distributed, from which winged females would emerge and attack wasp nests. Use of these diapausing parasitoids would minimise time constraints on travel, and mean that location of wasps nests would not be required. A disadvantage was that the method was relatively unproven, as opposed to nest inoculation.

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## METHODS

### Approach to the public

Territorial councils were considered likely to contribute to a parasitoid research project. The project was publicised by preparing a booklet and video outlining wasp problems, a possible solution with biocontrol, contribution levels required and cocoon producton. In late 1985, the first requests for financial support were made by letter to South Island councils.

During early 1988, booklets and videos were sent to the same councils, and also to a large number of government, commercial and private organisations and individuals. During 1988 the North Island was included, and a year later existing and potential major contributors throughout the country were approached again.

### Parasitoid propagation

Weekly, from December to June each year 10-14 wasp nests were collected from the Christchurch area. During the remainder of the year when only overwintering German wasp nests survive, and numbers are low, only two to three nests per month were collected, some from further afield. At each collection site, all adult wasps were removed from the comb. In the laboratory, mature pupae were extracted from cells to ensure that combs remained free of wasps for several days. Several pieces of comb up to about 150 mm across, each containing scores of early pupae, the parasitoids preferred host, were then placed in clear ventilated 4.5 litre plastic containers, with combs separated, to approximate the spacing between combs in wasp nests. Between 30 and 100 newly-emerged female parasitoids were then added to each plastic container. Temperature was maintained at 31-33 °C (the prevailing temperature within mature wasp nests), and relative humidity at 32%. These conditions prevented development of fungi (mainly *Aspergillus* sp.) and the mould mite *Tyrophagus putrescentiae* (Schrank) and gave optimum emergence of parasitoids. To aid emergence, caps were manually removed from cells 10 days after parasitoids were presented with comb. Any wasps that emerged from cells were killed to minimise attacks on adult parasitoids. Within 10 days of oviposition, female parasitoids began emerging, and emergence continued for up to 15 days. Daily, new female parasitoids were transferred to containers with fresh wasp combs.

After parasitoid and wasp emergence ceased, the yellow, overwintering cocoons were removed from the comb. The cocoons were stored in 4.5 litre plastic containers which were buried outdoors in pea gravel within wooden boxes in a screen cage. This was to emulate conditions which cocoons would experience after collapse of wasp nests in autumn/early winter.

### Field release

After wasps abandon a nest, yellow parasitoid cocoons survive from 1 to 4 years before adult parasitoids emerge. In order to maximise the flight of parasitoids from mass-reared cocoons, protective release boxes were designed (Donovan *et al* 1989), to give maximum protection from rodents (Donovan 1989) and insects, and shelter from weather. Release boxes were made of wood, and internally were 240 mm square and 300 mm deep. Cocoons were buried in 20 mm of soil in the base of each box, and adult parasitoids emerged through 3.5 mm gauge steel mesh covering holes in the sides. Boxes were placed on bare ground in shade or covered with a heavy sod on the lid to reduce the likelihood of internal overheating from sunshine.

During winter 1987, release boxes stocked with 100 cocoons each were sited in the South Island and at Ruakura in the North Island. In winter 1988 these boxes received a further 100 cocoons and new boxes were placed in the North Island stocked with 50 cocoons each. These new boxes were replenished with 100 cocoons during winter 1989. Further new boxes were placed out in the North Island with 50 cocoons each, and in the South Island including Stewart Island with 100/box (Fig. 1).

### Nest examination

Donovan *et al* (1989) detailed the examination of nests at 18 sites in the South Island in autumn 1987. Nests were also examined at Ruakura in the North Island. At all these sites, and at four new sites in the South Island, nests were again examined in summer and autumn of 1988/89, and one nest was examined at Pelorus Bridge in mid January 1990.

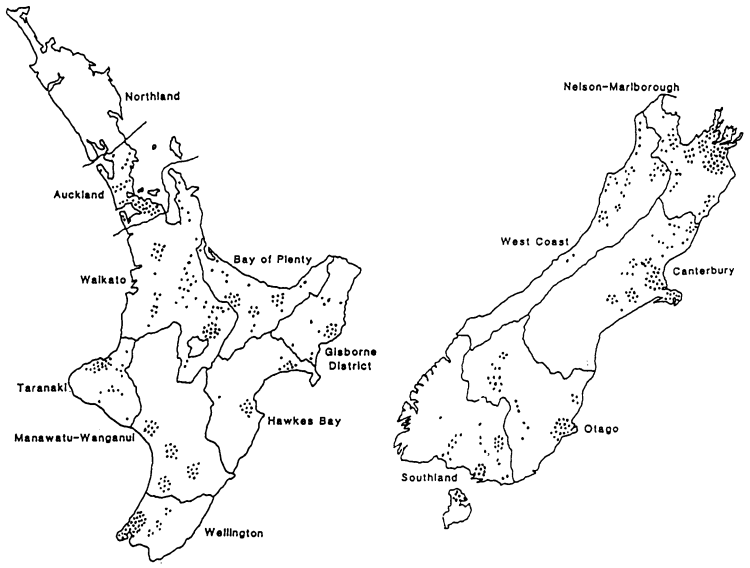


**Fig. 1: Location of parasitoid releases within regions of New Zealand.**

## RESULTS

Responses to the approaches for funds extended beyond the organisations that had been contacted because the campaign generated considerable publicity. The major parties that contributed to the project were territorial councils, beekeepers associations, forestry companies, conservationists, schools, tramping and other outdoor clubs, farmers, holiday home owners, and a harbour board. From 1986 to 1989, sufficient funding was received for the mass rearing and release of 108,400 cocoons (Table 1).

At Pelorus Bridge in Marlborough where three boxes had been placed within 400 m of each other, two nests were attacked (Donovan *et al* 1989) the same season as the release. By winter 1989, 11 further nests were discovered containing the parasitoid and at least 791 wasps had been destroyed (Moller *et al* 1989). The parasitoid was not found at other sites in the west and north of the South Island, in Christchurch, or near Hamilton in the North Island (Moller *et al* 1989; M. Goodwin pers. comm.).

During winter 1989, release boxes were removed from Pelorus Bridge, so that no cultured parasitoids were liberated there during spring/early summer of 1989/90. A nest of Common wasps excavated on 15 January 1990 was being attacked by parasitoids, and 146 developing wasps had been killed.

The attack at Pelorus Bridge must have been initiated by field developed parasitoids that had overwintered in a nest during the previous one or two summers. Because a 12 month cycle must have been completed, the parasitoid is now considered to have established in New Zealand.

**TABLE 1: Total parasitoids released to contributors annually throughout New Zealand.**

| | North Island | South Island | Stewart Island | Total released |
|---|---|---|---|---|
| 1987 | 1,000 | 30,000 | | 31,000 |
| 1988 | 10,300 | 32,100 | | 42,400 |
| 1989 | 27,500 | 6,900 | 600 | 35,000 |
| Total | | | | 108,400 |

## DISCUSSION

Participants in the wasp parasitoid project enjoyed two benefits — they acquired as many parasitoids as they wished, and parasitoids were released at sites of the participants' choice. Had the project been financed entirely by the Crown, numbers of parasitoids mass-reared would have been far fewer, and release sites would have been much more restricted geographically. Without participation of the public, the project would not have advanced as rapidly as this. The high level of public response indicates the seriousness of the wasp problem and helped advance the project. Whether parasitoids will kill sufficient wasps to reduce wasp numbers to acceptable levels remains to be determined,

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