Observations of yellow flower wasp activity at Butlers Creek, Ninety Mile Beach

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ABSTRACT

The yellow flower wasp (*Radumeris tasmaniensis*: Scoliidae) is a recent invasive species from eastern Australia or New Guinea. Its phenology here in New Zealand is poorly understood. A systematic series of transect counts took place in the open dune system at Butlers Creek (Waikoropupunoa Stream), Ninety Mile Beach, between 28 April 2004 and 14 May 2005. Wasps were most active in the mid-morning to early afternoon on the foredunes and backdunes. Wasps fed on gum (*Eucalyptus* spp.), manuka (*Leptospermum scoparium*), Australian coastal manuka (*L. laevigatum*), North Cape fivefinger (*Pseudopanax* "Surville"), fleabane (*Conyza albida*), toetoe (*Cortaderia splendens*) and pohutukawa (*Metrosideros excelsa*) flowers in the adjacent garden and native shrublands. Male wasps rested on or near food sources after feeding. No wasps were detected within the pine forest which was adjacent to the inner dune and planted garden and shrubland areas. Incidental observations were obtained from the field within the Aupouri and Karikari Peninsula areas.

Keywords: *Radumeris tasmaniensis,* Scoliidae, yellow flower wasp, invasion, biosecurity, New Zealand

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1. Introduction

The yellow flower wasp (*Radumeris tasmaniensis*) is a native species of mainland eastern Australia from South Australia to Queensland, and New Guinea (Dodd 1917; Illingworth 1921; Krombien 1963; Allsopp 1992; Logan 1999). It is a solitary parasitoid of members of the scarab beetles family (Scarabaeidae) including the subfamilies Melolonthinae, Rutelinae (not known in New Zealand) and Dynastinae (Berry et al. 2000). The biology of the yellow flower wasp in Australia is well known because it attacks some scarab larvae (Logan 1999) which are pest species in the Queensland sugar cane fields (Allsopp 1992). Research there has indicated that the yellow flower wasp is a major controlling parasitoid of many of the sugar cane pest scarab beetles (Robertson et al. 1995; Yeates et al. 1999) and some experiments carried out to attract cane beetles have attracted yellow flower wasps (Allsopp 1992).

Two female yellow flower wasps were first collected on Twilight Beach, Cape Reinga (Fig. 1), by Ian Stringer in October 1999 (I. Stringer, DOC, pers. comm.), however, this discovery was not reported before Andrea Booth saw large swarms of males wasps at Te Paki in February 2000 (Berry et al. 2000; Barratt et al. 2002). This was the first species of the family Scoliidae in New Zealand (Berry et al. 2000). Initial surveys indicated that the wasp was well established over 1700 ha in the North Cape, and Cape Reinga areas, and on the beaches of north Herekino Head, west of the Ahipara gumfields (Willoughby et al. 2001, 2002).

A biosecurity programme was initiated to see if the wasp could be eradicated (Willoughby et al. 2001). This programme was unsuccessful because the tested attractants failed, and because between 1999 and 2002 the wasp had been detected at scattered sites north of the Manukau Harbour on the west coast of Auckland and Northland, and down as far as Mangawhai on the east coast of Northland (Willoughby et al. 2003b; Beauchamp 2003). In addition, during the earlier data collection it was noted that yellow flower wasps were active at temperatures as low as 12°C. Adult wasps active at the same time showed considerable differences in size, which suggested an array of hosts or instars of the same host may be being used for breeding. There was a clear need to establish which hosts were being used, and their potential impact on the phenology and spread of the wasp.

The biosecurity programme ended in June 2003 (T. Beauchamp, pers. comm.), and was replaced by a research programme to assess the impact of the wasp on known hosts, and to see whether the yellow flower wasp potentially could be using a greater range of hosts. We also needed to gain a greater understanding of the biology of the wasp (Barratt 2003), to define its temperature and light needs and their impact on potential distribution, and to further investigate attractants in case we needed to protect threatened Scarabaeidae.

Part of the research programme was carried out within 700 m of the coast surrounding Waikoropupunoa Stream (hereafter referred to by its local name of Butlers Creek). The stream is the southern boundary of the Te Paki Scenic Reserve and is 3 km south of Te Paki Stream, northern Ninety Mile Beach

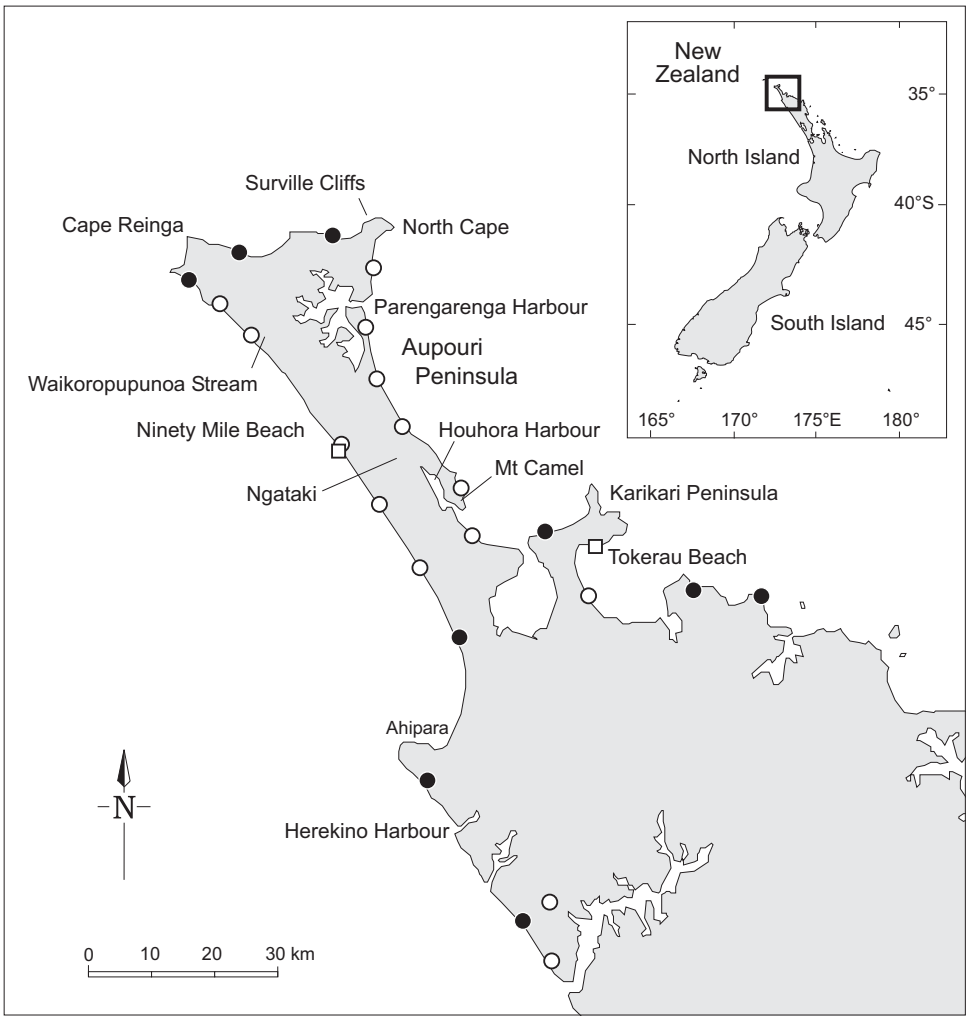

Figure 1. Yellow flower wasp distribution around northern North Island, New Zealand. Solid dots ● = where yellow flower wasps were present in March–April 2003; open circles ❍ = location where wasps were not detected in March–April 2003 surveys (Beauchamp 2003; Willoughby et al. 2003b); open squares ❑ = locations where yellow flower wasps have been detected since April 2003.

(Fig. 1). The area north of the creek was a mobile dune system (10 m a.s.l.) with patchy cover of marram (*Ammophila arenaria*), pingao (*Desmoschoenus spiralis*), spinifex (*Spinifex sericeus*) and toetoe (*Cortaderia splendens*) and had wetlands near the creek. The area to the south of the creek was private stabilised land, planted with native and exotic species and formed the northern extent of the Aupouri pine (*Pinus radiata*) forest.

This report provides the incidental records and sightings collected while undertaking transect work at Butlers Creek, plus the incidental records of wasp distribution and activity in the areas north of Kaitaia collected while I was undertaking other activities. This information is in addition to the wasp transect counts and *Pericoptus* larvae survey data that has been supplied to the Department of Conservation (DOC) as part of this contract. This data forms part of the wider study of yellow flower wasp and host phenology and will be reported separately.

2. Methods

2.1 TRANSECT WORK

A systematic series of transect counts took place in the open dune system from 28 April 2004 to 14 May 2005. This work was modified at the start of this contract (December 2004), to cover some expected changes in foraging by the wasps during the summer and autumn (Willoughby et al. 2003b; Beauchamp 2003), and to ascertain if there was a female emergence peak in late summer, as indicated by previous observations on the Surville Cliffs (A. Booth and V. Rawnsley, unpub. data).

Yellow flower wasps were observed at Butlers Creek on the 31 December 2004, 4, 15, and 25 January 2005, 4, 15, and 28 February 2005, 8, 27, and 28 March 2005, 7, and 23 April 2005, and 14 May 2005 while I was carrying out wasp transect surveys. On the 4, 15, and 28 February 2005 yellow flower wasps were observed while digging for *Pericoptus* beetle larvae in the foredunes. The four wasp transects used were a 250-m-long upper unstabilised dune above and parallel to the stream (transect 1), a 300-m strip of kikuyu (*Pennisetum clandenstinum*) grassed valley floor amongst native and introduced flowing shrubs and regenerating kanuka (*Kunzea ericoides*; transect 6), a 200-m transect under 25-year-old pines (transect 7) and a 300-m transect through spinifex and *Coprosma acerosa* (transect 8). Transect counts comprised three successive passes in each time period. Transect 1 was aligned from south west to north east along the top of the dune on the northern side, and transects 6 and 7 were parallel on the southern side of Butlers Creek. These transects were counted in the following periods: 07:15–09:00, 10:00–11:30 and 15:30–17:00 hours. In addition, transect 1 was also counted during 13:00–14:30 hours. Transect 8 was 400 m to the west of the other three transects and on the northern side of the creek, and was counted during 10:00–11:30, and 15:30–17:00 hours. The differences in the number of counts on each transect was a compromise, because we needed to retain comparability with previous data collection on transect 1, and I also needed a lot more time to move to and from transect 8 than the other transects.

At the start of each transect the time, temperature, and sunlight conditions were recorded. During the transect counts, wasp encounters and passes were counted for each sex separately, and the flight ability was scored as sluggish (resting on surface of sand), active (slow flight) and very active (rapid flying and searching the sand surface). Other wasp activity which was also recorded included the digging of newly created submergence sites of wasps and sand scarab (*Pericoptus* spp.) larvae and adults. When wasps were encountered their association with host *Pericoptus* larvae was noted. When moving between transects all flowering plants were scanned for yellow flower wasps that were feeding upon them.

2.2 INCIDENTAL OBSERVATIONS

Within the Aupouri and Karikari Peninsulas, incidental observations were obtained whenever I was in the field carrying out other activities (horse riding, farm work, DOC weed spraying). Some observations were carried out at night to confirm the presence of wasps at sites used during the afternoon and late evening.

3. Results

3.1 WASP ACTIVITY PATTERNS AT BUTLERS CREEK

Male recoveries far outnumbered female recoveries in all habitats except the pine forest. No wasps were seen in the understory of the pines (Table 1). Wasps were most active in the mid to late morning and less active in the afternoon in all habitats (Fig. 2). Wasps were seen emerging amongst spinifex, toetoe, marram, kikuyu (*Pennistum clandestinum*) and open sand from 08:00 to 09:30 hours during all months of the year. Wasps required up to 30 minutes after emergence to warm and become active. When temperatures exceeded 15°C both male and female wasps flew within the first hour after sunrise.

TABLE 1. NUMBER OF YELLOW FLOWER WASPS COUNTED ON TRANSECTS.

HABITAT	TRANSECT NO.	MALES	FEMALES
Foredune	8	16	7
Inner dune	1	2874	82
Garden and shrubland	6	89	9
Pine forest	7	0	0

The most common height of male scouting activity was 3–20 cm above the sand surface, and they flew at between 1 m and 2 m at other times. Males were seen feeding on two garden plants: Australian coastal manuka (*Leptospermum laevigatum*), fivefinger (*Pseudopanax* "Surville") and the weed fleabane (*Conyza albida*) (Table 2). Males appeared more lethargic after feeding and did not return to the ground, but rested on and within vegetation up to 3 m from their feeding sites. Sluggish movements were seen on Canadian fleabane (*Conyza canadensis*) at 08:23–08:30 hours on 28 February 2005, and active feeding was generally confined to between 15:30 and 17:00 hours. Five males were seen resting on a Canadian fleabane flower spikes at night (20:45–21:00 hours) on the 15 February 2005.

Most male activity was confined to the dunes, but on the 24 February 2005 males were flying along the high tide mark 10 km south of Butlers Creek.

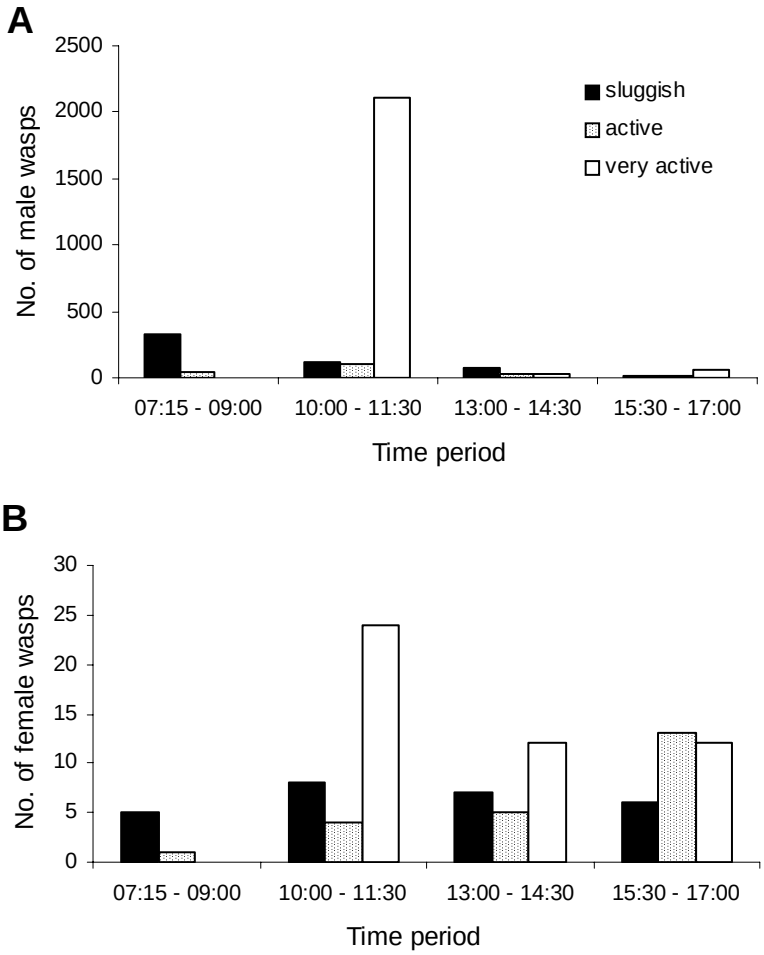

Figure 2. Yellow flower wasp activity on transects at Butlers Creek from 31 December 2004 to 14 May 2005. **A**. Male. **B.** Female.

Female wasps feed on most of the same plants as males, but also used gums (*Eucalyptus* spp.), manuka (*Leptospermum scoparium*), toetoe (*Cortaderia splendens*), pohutukawa (*Metrosideros excelsa*), and cottonwood (*Ozothamnus leptophyllus*) (Table 2). Female wasps scouted at between 3 cm and 40 cm above the sand, or flew flying quickly over hundreds of meters at c. 1.5 m above the ground. Most females were seen emerging on the dunes, and only one emergence was seen from within kikuyu in an area dominated by wattles and gums on the 2 January 2005. Females scouted on the dunes after 18:30 hours in early March 2005.

3.2 WASP DISTRIBUTION AT OTHER FAR NORTH LOCATIONS

Male wasps were seen at the northern end of Tokerau Beach (Fig. 1) on 22 March 2005 and 21 April 2005.

Females were seen flying in winds gusting up to gale force in direct sunlight at the entrance to Houhora Harbour on the 31 March 2005. A female wasp was also found in a small pond at Kimberly Road, Ngataki, on the 20 February 2005. This wasp was 8 km direct flight from the west coast sand dunes. Three female wasps were also seen resting in direct sunlight, and one was seen trying to dig into a clay surface on the Surville Cliffs on 14 April 2005.

TABLE 2. THE FLOWERS USED BY YELLOW FLOWER WASPS.

PLANT	FLOWER	MALE WASPS			FEMALE WASPS		
	COLOUR	DATE	TIME (h)	NUMBER	DATE	TIME (h)	NUMBER
Gum flowers	Cream				18/1/05	08:41	1
Australian coastal manuka	White	14/12/05	10:45	10	14/12/05	10:45, 10:57	3
Five-finger	Green	4/2/05	10:33, 15:42	50+	4/2/05	10:33, 15:42	10
		15/2/05	15:44	100+	7/4/05	10:18	1
		8/3/05	10:30	1	7/4/05	10:24	1
		7/4/05	10:18	7			
		7/4/05	10:24	25+			
		7/4/05	10:31	38+			
		7/4/05	15:49	29+			
		7/4/05	15:54	35+			
		7/4/05	16:02	35+			
Fleabane	Green	15/2/05	19:00	7			
Toetoe	White				14/12/04	10:45, 10:51, 10:57	3
					14/12/04	13:33	1
Pohutukawa	Red				22/12/04	12:30	1
Cottonwood	Cream				18/11/04	10:38	1

3.3 OTHER OBSERVATIONS

Only one wasp mating was observed. Male wasps were seen pursuing a female at 10:01 hours on 8 March 2005 on transect 1.

Sand scarab tracks (*Pericoptus* larvae) were seen on the surface of the sand in all seasons. Submergence sites were round sand mounds 30–50 mm high. Wasps and sand scrab larvae were dug up by hand from submergence sites at 10 cm and 20 cm deep. Yellow flower wasps were seen under (or associated with) 11 sand scarab larvae that had not submerged into the sand on 5, 11, and 18 November 2004, 14 December 2004, 18 January 2005, and 15 February 2005. On other occasions female wasps had been seen beside or under large sand scarab larvae (*Pericoptus truncatus*) that had not buried themselves before dawn. On the 18 January 2005 a female wasp pursued and stung a sand scarab larvae which was still on the surface, while other larvae, comprising all three sizes of larval instars, lay motionless on the surface of the sand.

Pupal cases of the yellow flower wasp were found in situ in the dunes with the remains of *Pericoptus truncatus* and a smaller sand scarab larvae (T. Beauchamp, DOC pers. comm.). They were found up to 30 cm below the surface in the foredune and inner dune areas, and were seen frequently blown out of eroding dunes in the vicinity of transect 1.

Yellow flower wasps varied greatly in size throughout the survey period. Two large male wasps collected on the 15 February 2005 had total body lengths of 20.3 mm and 20.1 mm, and two small wasps collected at the same time were 11.5 mm and 12 mm. The reason for this size difference is not known.

4. Discussion

4.1 ADDITIONAL DISTRIBUTION

Male and female wasps were seen at the Ngataki area on Ninety Mile Beach, 48 km south of Butlers Creek, and were seen in the Mount Camel area (Fig. 1). These records indicate that the yellow flower wasp has expanded its distribution in the past 2 years in the far north of New Zealand.

4.2 OBSERVATIONS IN AUSTRALIA

The yellow flower wasp in Queensland is reported to confine its activity to above 20°C, while in New Zealand activity has been seen at lower temperatures (Willoughby et al. 2003a). This study has indicated that yellow flower wasps are most likely to be active in temperatures exceeding 15°C. Yellow flower wasps are reported as being able to dig into heavy soils (Berry et al. 2000), however, much of the yellow flower wasp activity that has been documented in Queensland is in sandy soils (Logan 1999). There is limited evidence in New Zealand that yellow flower wasps are currently using substrates other than sand. At Surville Cliffs three wasps were seen on clay and one was seen trying to dig into clay.

There is no indication in other publications that yellow flower wasps differ dramatically in size elsewhere, yet in New Zealand the largest yellow flower wasps are up to 80% bigger that the smallest individuals. At Butlers Creek the wasps used two species of *Pericoptus* larvae as host (T. Beauchamp, pers. comm.) and the size of larvae seen on the surface varied greatly. It is likely that the size of wasp larvae were dictated by the size of host larvae used.

4.3 CURRENT WASP ACTIVITY PATTERNS IN NORTHLAND

At Butlers Creek very active wasps have been seen in temperatures between 7°C and 30°C. Yellow flower wasps are most visibly active on open sand dunes in the mid-to-late morning throughout the year, despite it being often hotter later in the day. Wasps were most obvious in the afternoon near food plants, and they were detected on vegetation near these plants before the time of substantial activity in the early morning. These observations and the presence of wasps on fleabane at night, suggest that male wasps rested above the ground in vegetation near food sources in summer.

Wasps were not detected in the pine forest below the canopy of 25-year-old trees despite these trees being less than 50 m from the open sand margin, and from manuka areas where wasps were detected (transects 1 and 6). The reason for this is unknown. There are possibly other potential hosts for yellow flower wasps in pine forests, including the large green cockchafer beetle (*Odontria*

sp.). The large green cockchafer are likely to be using pine roots as a food source and this habitat abuts many kilometres of the backdunes of Ninety Mile Beach. Adults are greater than 15 mm long and consequently are likely to have a third instar larvae weighing greater than a gram, and be a potential host for the yellow flower wasp (Berry et al. 2000). The only wasp that was noted on the landward side of the beach at Ngataki had either flown over or through this forest type.

Currently it appears that yellow flower wasps are only using sand-associated habitats along exposed coastline and their margins, but not all sand-associated habitats. Yellow flower wasps are on the west coast beach 8 km from my farm at Kimberly Road, Ngataki, but none have been seen on the farm. The appearance of a female wasp in a neighbour's pond indicates that the wasps can get to these habitats. Six male and two female wasps were seen over farmland at Mount Camel Peninsula while horse-trekking on 9 April 2005 (Fig. 1). The lack of observations outside the immediate foredunes area is consistent with other surveys (Willoughby et al. 2003b).

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