

Mass trapping of yellowjackets in an urban setting: an operational trial

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ABSTRACT

An operational trial for mass-trapping of yellowjackets (Hymenoptera: Vespidae) was run at the Pacific National Exhibition, Vancouver, British Columbia, Canada, from 13 August to 10 September 2009, spanning the dates during which the fair was open from 22 August to 7 September. Seventy bag traps with a heptyl butyrate-based, 10-component emulsifiable concentrate lure were deployed, primarily in high-use areas of the fairgrounds. Over the four-week period, 44 489 yellowjackets were captured, 98.6% of them western yellowjackets, *Vespula pensylvanica* (Saussure). Only six honey bees, *Apis mellifera* Linnaeus (Hymenoptera: Apidae), were caught. Comments by fair workers and operators of food concessions strongly indicated that the trapping programme reduced yellowjacket problems to insignificant levels. If implemented on a regular basis, such programmes would increase enjoyment of outdoor venues, would reduce the likelihood of stings and the possibility of anaphylactic shock, and would provide evidence that due diligence was being practised in protecting the health and well-being of workers and the public.

Keywords: Vespidae, yellowjackets, operational mass trapping

INTRODUCTION

In the words of the late Justin O. Schmidt (2016), also known as “The King of Sting”, a sting from the western yellowjacket, *Vespula pensylvanica* (Saussure) (Hymenoptera: Vespidae), feels “Hot and smoky, almost irreverent. Imagine W.C. Fields extinguishing a cigar on your tongue.” The growth of yellowjacket colonies to large numbers in late summer and early fall corresponds with an increased propensity to sting and many instances in which yellowjackets switch from being beneficial predators and scavengers to becoming pests, particularly when the presence of food for scavenger species occurs in locations frequented by humans (Akre *et al.* 1980). This may lead to a range of impacts, from simple lack of enjoyment of lunch on the patio to fruit pickers or workers in food processing plants walking off the job after being frequently stung. Large outdoor events, such as fall fairs (Wegner and Jordan 2005), where food is served to crowds of people, may be a particular problem. People who are stung frequently seek medical attention. In some cases, individuals who are allergic to

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yellowjacket venom lapse into anaphylactic shock, occasionally dying as a result (Moffitt *et al.* 2004).

In British Columbia (B.C.), Canada, and other parts of western North America south of Alaska and Yukon, the western yellowjacket is by far the most pestiferous yellowjacket species (Akre *et al.* 1980). Control of western yellowjackets starts with sanitation to remove or deny access to potential foodstuffs and removal of nests if they can be located (Akre *et al.* 1980). Measures targeting the insects themselves have evolved from employing proteinaceous baits such as cooked horsemeat laced with 1% chlordane (Grant *et al.* 1968), to use of mirex-treated fish-flavoured cat food baited with the plant-derived synthetic chemical heptyl crotonate (Wagner and Reiersen 1969), to deploying toxic bait stations containing minced canned chicken mixed with fipronil (Rust *et al.* 2017). The discovery that a range of organic esters, particularly heptyl butyrate, are highly attractive to western yellowjackets (Davis *et al.* 1967, 1968, 1969) gave rise to the hypothesis that attractant-baited traps could be used to suppress pestiferous populations. Accordingly, Davis *et al.* (1973) used traps baited with heptyl butyrate to capture over 800 western yellowjackets per trap over 10 days in an Oregon, United States of America, peach orchard, effectively eliminating the need for chemical insecticides and allowing pickers to re-enter the orchard to resume harvesting.

For seven years, until it went bankrupt in 2015, Contech Enterprises (Victoria, B.C.) marketed a reusable bag trap (Fig. 1A) and a 10-component heptyl butyrate-based emulsifiable concentrate lure for capturing yellowjackets (Trottier and Borden 2025). The liquid lures (50 mL) in a tear-off sachet (Fig. 1B) could be easily emptied into the traps. The surfactant in the emulsion eliminated the need for dishwasher soap to be added to 300–400 mL of water, so that captured yellowjackets would readily break the surface tension and drown. The traps were readily hung at eye level using a twist tie. In addition to capturing very high numbers of yellowjackets, the baited traps caught almost no honey bees, *Apis mellifera* Linnaeus (Hymenoptera: Apidae), or other beneficial insects. Although the trap and lure were sold for use by consumers, we had long been impressed by the results of mass-trapping in an agricultural setting by Davis *et al.* (1973) and postulated that similar results might be possible in an urban setting. Accordingly, we received approval from the Technical Services Department of the Pacific National Exhibition (PNE) in Vancouver, B.C., and set up an operational trial to test our traps during the 2009 fair.

METHODS

Seventy trap sites were selected within an approximately 16-ha area within the greater PNE grounds (Fig. 2). Traps were set up (Fig. 1C) and deployed (Fig. 1D) on 13 August 2009, with concentrations of traps focused on locations where food concessions were to be placed for the fair, which opened on 22 August. Because of a temporary delay in supply of the bag traps, traps 1–24 were Contech's commercial jar trap (Fig. 1D). These were replaced by bag traps (Fig. 1A) in the second week. Traps were placed at least 10 m apart and 1.5 m high, above the reach of small children. Similarly, to avoid disturbance, the traps were positioned within plots of trees or high shrubbery or behind food concessions where public access was restricted.



Figure 1. Materials and procedures for operational yellowjacket trapping at the Pacific National Exhibition, Vancouver, B.C., Canada: **A**, Contech bag trap showing one of two offset conical entry ports on the front and back faces and captured yellowjackets visible in the drowning fluid below the label; **B**, sachet holding 50-mL heptyl butyrate–based emulsifiable concentrate lure; **C**, crew setting up traps on 13 August 2009 taking shelter from heavy rain inside the partially assembled “Jimmy’s Lunch” hamburger concession; persons shown (left to right are co-authors Cameron Lait and Ervin Kovacs and research assistant Stephen Jones; supermarket baskets that were ideal for carrying traps were obtained in return for a donation to the store charity; and **D**, Ervin Kovacs hanging Contech jar trap in plaza to the south of the Pacific Colosseum on the fairgrounds. Photo credits: John Borden

All traps were baited with the Contech emulsifiable concentrate lure on 13 August. Yellowjackets were collected on 20 and 27 August and 3 and 10 September. Lures were replaced on the first three collection dates. All 70 traps were removed on 10 September, three days after the fair closed. Captured yellowjackets from each trap were separated from the drowning fluid using a sieve, placed in separate labelled plastic Ziplock bags, and transported to the laboratory, where they were identified to species using abdominal markings (Akre *et al.* 1980) and counted. Weather records for Vancouver International Airport, Richmond, B.C., were retrieved from the archives of the National Oceanic and Atmospheric Administration.

RESULTS

Forty-four thousand, four hundred, and eighty-nine yellowjackets were captured over the four-week period, with the majority being caught during the first three weeks (Table 1). Catches were highest in the first week, declined in the second week, rose slightly in the third week, and fell to a low during the last week, when there were periods of rain on five days and generally cooler weather (Table 2). Western yellowjackets comprised 98.6% of the total catch, with northern yellowjackets, *Vespula alascensis* (Packard), making up 0.8% and German yellowjackets, *Vespula germanica* (Fabricius), 0.6%. Only six honey bees were captured, at a ratio of 7415 yellowjackets to one honey bee.



Figure 2. Google Earth image of the Pacific National Exhibition (PNE) fairgrounds, Vancouver, B.C., Canada, when the fair is not in session. The approximately 16-ha treatment area (estimated at 13.9 ha after deduction of the area occupied by buildings) was bordered by Hastings Street to the south, Renfrew Street to the west, the plaza in front of the Pacific Colosseum (partial circle at top left), tree-lined Miller Drive running west to east, and the tree line extending south to Hastings Street. Excluded areas were the race track (partly visible, top right) and Playland (no trees, bottom right). Landmark buildings are the rectangular Forum (reddish roof, bottom left), and the circular white-roofed Agrodome, with four livestock barns to the east. Circled numbers are traps with more than 1000 yellowjackets captured over four weeks by rank: **1**, 1222; **2**, 1197; **3**, 1122; **4**, 1089; **5**, 1034; and **6**, 1024. Traps 2 and 3 flank a Japanese garden. The food concession area occupies the paved area surrounding the dry grassy opening to the west of trap 4 and extending east to about trap 6. Traps 1 and 5 flank the paved amphitheatre with bleachers on the curved southeastern margin.

The traps proved to be durable, and there was almost no vandalism. Only six traps were damaged or lost. A trap in one location was apparently stolen in two successive weeks. Therefore, the trap catches in Table 1 are based on 274 of the total possible 280 trap-weeks.

Catches were uniformly distributed over the fairgrounds, but some areas had the highest catches, and in six cases, more than 1000 yellowjackets per trap were captured over the four-week period (Fig. 2). Particularly high catches (two traps each) were obtained near the Japanese garden at the southwest corner of the

grounds, along the East–West food concession row, and spanning the Amphitheatre area, where there were bleacher seats for vehicular events.

Table 1. Numbers of yellowjackets in three species caught by week at the Pacific National Exhibition fairgrounds, Vancouver, B.C., Canada, from 13 August to 10 September 2009, with totals by species and week, and the grand total for all yellowjackets.

Species captured	Numbers caught in one-week periods, by collection date, 2009				Total
	20 August	27 August	3 September	10 September	
Western yellowjackets, <i>Vespula pensylvanica</i>	16 981	10 608	12 666	3652	43 907
Northern yellowjackets, <i>Vespula alascensis</i>	117	73	113	31	334
German yellowjackets, <i>Vespula germanica</i>	84	96	45	23	248
Total	17 182	10 777	12 824	3706	44 489

Table 2. Weather records from Vancouver International Airport, Richmond, B.C., Canada, for the 7-day periods preceding collections of yellowjackets in 70 traps at the Pacific National Exhibition fairgrounds, Vancouver, B.C., in 2009. Data retrieved from archives of the National Oceanic and Atmospheric Administration.

Collection date	Mean temperature in the 7-day period preceding a collection		Precipitation in the 7-day period preceding a collection	
	Daily high temperature (°C)	Daily low temperature (°C)	No. days with recorded rain	Mean cm rainfall
20 August	22.0	14.2	1	0.15
27 August	22.2	14.2	1	0.01
3 September	23.1	14.4	0	0
10 September	19.0	13.2	5	0.59

DISCUSSION

Removal of 44 489 yellowjackets from the fairgrounds appeared to improve the quality of life for both workers and fairgoers. In addition to removing large numbers of yellowjackets from the fairgrounds, the PNE could be seen to be exercising due diligence in caring for its employees and customers. Food and beverage consumed at the fair could be more readily enjoyed. Moreover, because yellowjackets can inflict multiple stings, each of the captured wasps represented more than one potential sting. Also reduced was the less likely (but real) threat of anaphylactic shock following a sting on a susceptible individual. Public perception of the beneficial impact was reinforced by displaying the yellowjackets captured over the first three weeks (Fig. 3) during coverage of the operational trial in the visual and print media (*CTV Evening News* and *The Province*, respectively).

Compared to some environments, such as the heavily infested 8.9-ha Oregon peach orchard in which Davis *et al.* (1973) captured 200 000 western yellowjackets in one summer or the coastal mountains of southern California where Reiersen and Wagner (1975) captured 307 274 western yellowjackets in 126 traps spaced 150 m apart along 19 km of road rights-of-way over a nine-week period, the 13.9-ha available area in the fairgrounds (Fig. 2) would not appear to be an optimal foraging environment until the fair commenced. The large, paved areas offered few foraging opportunities, and constant sanitation that removes food on which scavenging yellowjackets could forage is a prominent objective of the PNE's Technical Services Department. Therefore, one would not expect yellowjacket populations to have reached exceedingly high levels before the fair opened.



Figure 3. Approximately 40 000 western yellowjackets captured in 70 traps at the PNE, Vancouver, B.C., Canada, during three weeks of mass trapping. The container held by John Borden was displayed for public viewing during filming of a *CTV Evening News* feature on 3 September 2009 and in an article in *The Province* newspaper, 4 September 2009. Photo credit: Cameron Lait

No studies have been done on the effective trapping radius of any yellowjacket trap and lure. However, at trap densities similar to those implemented in our study, Davis *et al.* (1973) reduced the western yellowjacket population in an Oregon peach orchard to the point at which “the wasps were no longer troublesome in any part of the orchard.” Similarly, interceptive trapping surrounding a California public picnic area by Reiersen *et al.* (2008) reduced foraging by western yellowjackets within the eating area on average by 88%. Given the yellowjacket-unfriendly environment maintained by the PNE, as well as the substantial numbers of yellowjackets captured in our traps (Table 1; Fig. 3), the traps probably diverted yellowjackets away from humans and their food and beverages, and the trapping programme likely removed sufficient numbers of the available yellowjacket population to make a difference.

Numerous concession operators and fair workers expressed interest in the trapping programme. Several indicated that it improved their working environment. For example, two women setting up a barbecued chicken stand before the fair opening said that they were no longer plagued with yellowjackets after traps were set up behind the stand. We observed several yellowjackets entering these traps within minutes of set up. Similarly, Steve Parsons, who operated three food concessions at the 2009 fair, is quoted in *The Province* newspaper (Friday, 4 September 2009, Section A34, headline “Traps free up the food fair”, sub heading “PEST CONTROL: Easier to bite into burger with wasp management”): “For us, the problem is around the pop machine... this year, whatever they are doing is helping.”

Many other locations that are plagued by yellowjackets could also benefit. These include outdoor restaurants, food and beverage processing plants, golf courses, picnic sites, campgrounds, U-pick orchards, and even apiaries.

We speculate that despite its rapid introduction into the Pacific Coast area (Akre *et al.* 1989), the low numbers of the newly introduced German yellowjacket captured indicate that this species had not yet built up large populations in East Vancouver by 2009. However, as found by Babcock *et al.* (2017) and Trottier and Borden (2025), heptyl butyrate may not be an optimal attractant for German yellowjackets. Captures of northern yellowjackets in traps baited with the Contech lure support Reiersen and Wagner’s (1975) anecdotal report and Borden and Trottier’s (2025) experimental results that this species is responsive to a heptyl butyrate-based lure.

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COMPETING INTERESTS

The authors were employed by Contech Enterprises Inc. during completion of this project. The company had no input into how the research was conducted nor into how the results were interpreted.

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