

Abstracts

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Current insect pest issues in the interior of British Columbia

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Insect pests of concern during 2009 on apples, cherries, grapes and forage crops will be discussed. Pest species include apple clearwing moth (*Synanthedon myopaeformis*), apple leaf curling midge (*Dasineura mali*), woolly apple aphid (*Eriosoma lanigerum*), Western grape rootworm (*Bromius obscurus*), grasshoppers, and an unidentified alfalfa caterpillar. Research needs will be highlighted.

Seasonality and the Latitudinal Gradient of Diversity: the BC Eocene Insect Perspective

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I tested the hypothesis that the latitudinal diversity gradient is a function of seasonality, not mean annual temperature, comparing insect diversities in cool, seasonal Massachusetts; hot, equable Costa Rica, and; cool, equable Eocene BC. BC Eocene insect diversity was high, implying that high tropical diversity is associated with seasonality.

Chasing Pollinators

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Pollination by insects is vital for the production of agricultural crops growing throughout British Columbia. A decline in the abundance and distribution of native pollinators and managed honey bee colo-

nies appears to be worldwide. We used wandering transects to survey for target species at risk, such as the Western Bumble Bee (*Bombus occidentalis*), and other native pollinators on privately owned or privately managed lands. None of the target species were observed; however important land owner contacts were made for future sampling.

Expression of large lipids transfer proteins in *Helicoverpa zea*: differential regulation by juvenile hormone

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VHDL, a storage protein evolutionarily related to vitellogenin, is strongly expressed in last instar larvae when JH is absent. Treatment with JH analogs suppresses VHDL expression, while other vitellogenin gene family members are up-regulated. The results suggest that gene duplication and subsequent changes in the promoters gave rise to these proteins.

Mountain pine beetle condition and timing of emergence: who emerges when?

Alex Chubaty and Melanie Hart. *Department of Biological Sciences, Simon Fraser University, Burnaby, BC V5A 1S6*

Individual variation in energy reserves and timing of emergence are expected to constrain host selection decisions of mountain pine beetle. We examined the timing and condition of emerging beetles, describing the probability of emerging on a particular day with a particular condition, which can be used in models of individual host selection and attack.

Cranberry Tipworm, *Dasineura oxycoccana* (Diptera: Cecidomyiidae), and the

potential for host race formation in cranberry and blueberry fields

Melissa Cook. *Department of Biological Sciences, Simon Fraser University, Burnaby, BC V5A 1S6*

Cranberry Tipworm, *Dasineura oxycoccana* (Johnson) (Diptera: Cecidomyiidae), is a gall forming insect known to attack cranberry and blueberry fields in British Columbia. Cranberry tipworm has the potential for host race formation on these two crops. Here I present relevant results and some early conclusions from my first field season.

Pheromone-release behaviour of female cranberry tipworm, *Dasineura oxycoccana*, (Diptera: Cecidomyiidae)

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Cranberry tipworm, *Dasineura oxycoccana*, is a pest of concern on cranberry, *Vaccinium macrocarpon*. If pheromone could be identified and synthesized, growers would have a tool for monitoring adult male tipworms. One- to three-day-old female tipworms showed pheromone-release behaviour predominantly during the first 6 or 7 hours of a 16-hour photophase. This would be the time to obtain pheromone for identification.

Invasive and new grape pests

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Grapes and other plants of the family *Vitaceae* are not native to the southern interior of British Columbia and no pests specific to grape were present here prior to the introduction of these plants. The dozen or so native pests that fed on grape, including a complex of climbing cutworm, were augmented by other polyphagous pests, such as the European red mite, *Panonychus ulmi*, introduced on shipments of potted plants prior to the 1900s. Later, importation of grapevines from Europe and eastern North

America introduced a number of pests specific to grapes, such as grape phylloxera, *Daktulosphaira vitifoliae*, and grape erineum mite, *Colomerus vitis*. The rate of new introductions has increased recently due to rising world trade, increased travel, and rapid transportation of goods and people by air. Reflecting this change, the past two seasons have seen outbreaks of western grape rootworm, *Bromius obscurus*, in the Kelowna area and a widespread infestation of grape leaf rust mite, *Calepitrimerus vitis*, such that approximately 30 pests of grapevines now occur in BC. Although it is difficult to predict how damaging an introduced pest is likely to become, the greatest threat is posed by insects in the orders Lepidoptera, such as the grape berry moths, Coleoptera and Homoptera. At least eight species of non-native grape pests belonging to the latter group, including hard and soft scale, now occur in BC, and Homopteran pests are the largest group on most quarantine lists. Nine scale and mealybug species occur on grapes in Europe; a complex of six leafhopper species feed on grapes in eastern NA. In addition to invasive pests, more damaging biotypes or races can arise from existing pests and native species can adapt to feed on grapes. For example, the omnivorous leafroller, *Platynota stultana*, and the orange tortrix, *Argyrotaenia citrana*, became pests of grapes in NA during the 1960s. In light of the serious economic threat that new and invasive pests pose to the BC grape and wine industries, a comprehensive management program that includes changes in legislation, local production of clean nursery material, co-operation with the Canadian Food Inspection Agency, and a commitment to research is required to prevent new introductions and minimize potential damage.

Effect of residual Capture 2EC on wireworms

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Wireworms are still affected by the pyrethroid insecticide Capture 2EC (bifenthrin) one year after its application to soil in efficacy studies in the field. We present results from laboratory studies demonstrating how residual Capture 2EC affects wireworm mobility and health, and discuss some implications of this.

Fragments of the forest: Ground beetle diversity in Coquitlam, BC

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Urban development inevitably fragments remnant natural habitat in cities. Clearly, fragmentation can affect community structure in resulting habitat fragments, but such effects have rarely been quantified in urban ecosystems. Previous work in Coquitlam, BC established that ground beetle communities (Coleoptera: Carabidae) vary between disturbed areas and fragments of intact forest. In July and August of 2008, beetle communities were sampled in forest fragments in Coquitlam parks ranging in area from 4 to 180 hectares. Beetles were sampled in eight parks along 100 meter transects each with 5 pitfall traps arranged from the edge to the interior of the park. Measures of community structure and diversity were compared among sites differing in area and among trapping positions along transect lines. Results are discussed relative to the capacity of urban forests to maintain biological diversity and the effects of urbanization on biological communities.

The role of nitrogen fertilizer in a greenhouse biological control system

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Bottom-up effects of nutrient availability on host-parasitoid population dynamics were investigated in a bell pepper-pest-parasitoid system. Aphids and parasitoids showed increased population growth rates and fitness as nitrogen availability increased, indicating the impacts of habitat

fertility on tri-trophic interactions and suggesting implications for biological control.

Identification and biology of climbing cutworm (Lepidoptera: Noctuidae) from grapevines in the Okanagan Valley, B.C.

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Climbing cutworms are serious pest of grapes in the Okanagan Valley, British Columbia. Twenty species of climbing cutworm were collected as larvae from vineyards in south central BC during the spring of 2001 to 2008. *Abagrotis orbis* was the dominant species, and with *A. nefascia* and *A. reedi* accounted for over 85% of the reared moths. Life cycle aspects of *A. orbis* were assessed under three temperatures (11, 15 and 22 °C), two light regimes (16L:8D and 12L:12D photoperiod), and on two larval diets. Several observations suggested that occurrence of some crucifer plants in the vine rows decrease climbing cutworm infestations. Hence, feeding preferences and suitability of 13 host plants and post-dormant grape buds was also investigated for *A. orbis* in the lab.

Behavioral changes in parasitized aphids at episodic high-temperatures

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We investigated the effects of the severity and frequency of high-temperature events, on the survival and site of mummy formation of *Aphelinus abdominalis* Dalm. (Hymenoptera: Aphelinidae) attacking green peach aphids, *Myzus persicae* Sulz. (Homoptera: Aphididae) on pepper, *Capsicum annuum* L. plants. Experimental conditions were four factorial combinations of magnitude and frequency of temperature extremes produced in plant growth chambers. All chambers were adjusted so that the average temperature over 24 hrs was always 23°C. The temperature extremes were 32°C in the low extreme (Le) and 40°C in

the high extreme (He). Plants and insects were exposed to these extreme events either daily (high frequency, Hf) or on day 2 and 5 in a 7 day cycle (low frequency, Lf). There was no effect of the different combinations of extreme temperature and frequency on the total number of mummies formed. However, more mummies of *A. abdominalis* were formed off the plant when exposed to high temperature peaks on a daily basis (HeHf and LeHf), than when exposed to high temperature peaks twice in a 7 day cycle (HeLf and LeLf). This response was greater when the extreme temperature peak was 40°C (HeHf) than when it was 32°C (LeHf). Our results suggest that increases in the frequency and severity of extreme temperature events, may trigger adaptive behaviours in parasitoids that will facilitate their survival during such events. Such shifts in behaviour could change the frequency and severity of pest outbreaks.

Butterfly Surveys in Southeastern BC: some observations, comments and future work

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Although insects and other invertebrates represent a majority of the biodiversity in British Columbia, there have been relatively few surveys conducted across the province to inventory these groups and assess the conservation status of individual members. In response to a growing need to expand the body of knowledge on the status of rare invertebrates in B.C., a two person crew conducted surveys between June 16th and August 5th 2009 in three areas in southeast coastal BC for rare butterflies and opportunistically for other rare invertebrates. Surveys were conducted on foot along roads adjacent to suitable habitat for each target species and within the habitat itself, if possible. Butterflies were identified in flight wherever possible or caught in nets and subsequently released if identification required closer inspection. From June 16th to June 24th surveys were conducted in the Sechelt area of Sunshine Coast, primarily

targeting Johnson's hairstreak. Surveys were conducted in the Harrison Lake area between July 3rd and July 22nd primarily targeting Dun Skipper. Finally surveys were conducted for Bremner's Fritillary between July 28 and August 5 on Salt Spring, Mayne and Galiano Islands. A combined survey effort of 197 hours was spent surveying 264 km at 52 different sites. At least 20 different species of butterflies were observed (this is likely an underestimate as some individuals could not be identified to species), including three red listed species and two introduced species. Red listed species observed included a Johnson's hairstreak in Sechelt and at least 17 Bremner's fritillaries observed on Salt Spring Island, as well as a common wood nymph opportunistically observed on Salt Spring Island. No dun skippers were observed during any of the surveys and no red listed species were observed in the Harrison Lake area.

Hymenopteran parasitoids from cranberry tipworm, *Dasineura oxycoccana*, collected from a cranberry farm in BC

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We report the first instance of parasitoids emerging from cranberry tipworm, *Dasineura oxycoccana* (Johnson) (Diptera: Cecidomyiidae), collected from cranberry, *Vaccinium macrocarpon* Ait., in British Columbia in 2009. The parasitoids are Eulophidae and Platygasteridae, with the eulophid accounting for 78.3% of emerged parasitoids. If conserved, these parasitoids could contribute to biological control of cranberry tipworm in BC.

Chemical cues mediating clonal preference of *Leptoglossus occidentalis* in a lodgepole pine seed orchard

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Multiple surveys were conducted in a lodgepole pine seed orchard in British Columbia in 2008, revealing that *Leptoglossus occidentalis* (Heidemann) prefers certain clones to others. We tested the hypothesis that clone preference is based on chemical cues from host trees, sampling monoterpenes from cones of favoured and unfavoured clones. Analysis of variance and post hoc means separation tests revealed different quantities of semiochemicals in the cones of favoured and unfavoured clones. Contrary to previous studies, we also found that *L. occidentalis* favoured the same clones, and often the same trees, in consecutive years.

What makes an ideal biological control community?

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Due to the complex interactions that can occur among parasitoids sharing a common host, introducing a competitor into a system can have unpredictable results. We conducted field experiments examining the outcomes of intra-guild competition. Results, ecological implications, and ideal biological control communities are discussed.

Infrared radiation and its exploitation by coniferophagus insects

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In seed orchards, we show foraging response to infrared radiation (IR) by moths (*Dioryctria pseudotsugella*), midges (*Contarnia oregonensis*), and true bugs (*Leptoglossus occidentalis*). The latter may prefer IR in combination with visible light over IR alone, and possibly use IR also to locate mates, avoid predators, and seek overwintering sites.

