[3573] SEASONAL ASPECTS OF FLIGHT IN WATER STRIDERS (HEMIPTERA: GERRIDAE)

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Seasonal patterns of flight activity were studied in five waterstrider species over 16 years (1984-99) by marking and weekly census, flight trapping, flight muscle dissection and experiments on small ponds in central Alberta, Canada. Two pondskater species, *Gerris buenoi* and *L. dissortis*, reproduced at near replacement levels on the focal pond; two others *G. comatus* and *G. pingreensis* were generally less successful, despite consistent spring colonization. A few individuals of *Aquarius remigis*, a stream-dwelling species, colonized but never reproduced on the focal pond. Flights were observed in four seasonally distributed categories: 1) flights to and from terrestrial diapause sites in association with overwintering; 2) inter-pond flights of post-diapause breeders; 3) inter-pond flights of summer generation (direct) breeders; and 4) inter-pond flights of pre-diapause bugs. Category 1 flights were observed in all species. Most individuals of the three most common species, *G. buenoi*, *G. comatus* and *L. dissortis*, overwintered at terrestrial sites somewhat distant from natal ponds and immigrated to breeding sites in the Spring; an apparently small proportion of *G. buenoi* overwintered close to the focal pond and walked to and from these sites. Long-winged (LW) individuals of *G. pingreensis*, emerged as adults elsewhere during the previous summer, colonized during the first few weeks after ice-off and generally left only a few progeny, *c.* 68% of which were also LW. A few *A. remigis* adults flew to the focal pond in spring, but apparently bred elsewhere. After mid-May, many reproductively active, overwintered individuals of *G. buenoi*, *G. comatus* and *L. dissortis* regularly made category 2 flights. Individuals of *G. buenoi* and *L. dissortis* were still colonizing the focal pond in mid-July; adult bugs also actively emigrated from the focal pond. Such flights were truncated by flight muscle histolysis during May for *G. pingreensis* and a little later for *G. comatus*. Category 3 flights were made by LW direct breeders of *G. buenoi*, *G. comatus* and *L. dissortis* that colonized temporary ponds re-filled by summer thunderstorms in June and July. If the pond did not dry out, per capita reproductive success of these direct breeders was 2-10 times that of the average observed for overwintered breeders 1984-1999. Pre-diapause adults of *A. remigis*, *G. buenoi* and *L. dissortis* arrived at the focal pond after mid-summer through category 4 flights; some adults of *A. remigis* overwintered near the pond. Females of all four pondskater species flew carrying mature eggs, showing that flight and reproduction occur contemporaneously in these gerrids; however, early in the season females of *G. buenoi* and *G. pingreensis* that histolysed flight muscles carried, respectively, 25.7 and 33.6% more eggs. In addition to the classical ideas that flight is retained to permit escape from high density situations and to allow adults to leave and re-colonize temporary habitats, selective advantages for retention of flight in northern pondskater populations may include use of the best foraging opportunities by pre-reproductive adults, escape from natural enemies, and bet-hedging reproductive strategies, especially in relation to natural enemy impacts.
Index terms: dispersal, oögensis-flight syndrome, flight muscle histolysis, natural enemies, life-history strategies, *Aquarius*, *Gerris*, *Limnoporus*

[3574] MATING SUCCESS IN INTRA- AND INTERSPECIFIC MATINGS OF TWO WATERSTRIDER SPECIES (GERRIDAE)

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Gerris odontogaster (*Go*) is Palearctic. The male has a pair of tooth-like appendages ('pegs') ventrally on the abdomen, in front of the genital segments. The pegs are thought to increase male's mating success in a species where courtship is exceptional, and blatant, forceful attacks are the mode of mating trials. The function of pegs would be that of a morphological attachment apparatus, helping the male to resist female's cast-off attempts while mounted. Males of *G. buenoi* (*Gb*), a Nearctic species very close to *Go*, have no pegs. The species interbreed in the laboratory, allowing assessment of male success in mating trials with con- and heterospecific females. Because the on average smaller *Gb* males lack morphological special features to boost success, *Go* males are expected to be more successful in their mating attempts than are *Gb* males. Before the laboratory experiments, males and females were kept in separate groups to maximise the suggested selective advantage of pegs. The 251 intra- and interspecific tests with one male and one female in each were controlled for female status (virgin *vs* mated, post-diapause *vs* direct breeder) to yield 16 treatments. In seven pairwise comparisons of eight (while controlling over female status), the proportion of successful *Gb* males was 1,4-8,4 times that of *Go*. In all statistically significant comparisons between both con- and heterospecific matings (after pooling the female statuses), the percentage of successful *Gb* was higher. The better success of *Gb* is at least partially due to their higher mating-attack rates. If the length of pegs is stabilised by higher losses of long-pegged males during the final moult (as has been suggested), then there is place for discussion why the pegless alternative tactic based on more persistent mating attempts has not evolved and outcompeted the costly peg tactic of *Go*.
Index terms: *Gerris odontogaster*, *Gerris buenoi*, male grasping apparatus, female resistance

[3575] LIVING AT THE EDGE OF ICE: CARABID BEETLES IN AN ALPINE GLACIER FORELAND

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Based on the alternating periods of climatic cooling and warming over geological time, the attendant changes of glacial advances and retreats can be determined. Most glaciers in the European Alps have been retreating since the maximum postglacial extension in the middle of the 19th century, although occasionally interrupted by short advances. The dramatic retreat of glaciers in the last ten years has opened up new area for the colonization of animals and plants. Glacier forelands are suitable for the study of colonization in expanding high-altitude habitats, their primary succession and the underlying factors and mechanisms. In the Hornkees glacier foreland (Zillertal Alps/Austria) the first investigation of the succession of the arthropod fauna dates back to the middle of the 20th century. These studies showed that carabid beetles are one of the major epigean arthropods. In a second phase of investigation, between 1986 and 1988, distribution patterns of carabid beetles were assessed in more detail for this particular glacier foreland. Among the Carabidae, species of the genus *Nebria* are found to be the first colonizers of new alpine area after glacier retreat. The six *Nebria*-species, which were dominant within the ground beetle assemblage of the Hornkees glacier foreland in both the number of species, as well as in the number of trapped individuals, provided an excellent opportunity to investigate the co-existence of taxonomically closely related carabid beetles in the high-mountain region. The study focused on aspects of habitat and microhabitat use of the adults and larvae, phenology and diel activity. Each of the *Nebria*-species was most active, both as adults and larvae, in different areas within the glacier foreland characterized by distinct geomorphological and ecological conditions. The most recent investigation in the Hornkees glacier foreland were carried out in the year 1999. The glacier has retreated more than 100 m in the last ten years. The youngest ice-free area is limited by a characteristic end moraine. Five *Nebria*-species co-exist in an area immediately below this end moraine but only two *Nebria*-species were found in the newly exposed area above the end moraine. Comparative investigation of the distribution patterns and environmental factors in the various areas within the Hornkess glacier foreland allow us to conclude that habitat selection seems to be a major mechanism for the colonization and co-existence of carabid beetles of new alpine areas.
Index terms: *Nebria*, Carabidae, co-existence, colonization

[3576] STUDYING HOST AND MICROHABITAT USE BY ARTHROPODS IN TROPICAL RAIN FOREST CANOPIES: ISSUES & PERSPECTIVES

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Interest for canopy arthropods in tropical rain forests is a lively component of a wider scientific agenda intended to explore and understand one of the most significant, exciting and endangered habitats on Earth. In less than 20 years, this topic has emerged as a vigorous field of entomological investigations, as the ever-increasing number of publications focusing on this habitat attests. Tropical forest canopies represent fascinating environments for entomologists because (1) the species-richness of their arthropod communities is exceptional and, arguably, tropical rain forest canopies may support much of the Earth's biodiversity; (2) their entomological faunas are still largely unknown and have been the subject of much controversy among entomologists and ecologists; (3) they represent a suitable arena where biologists can study multiple species interactions within communities and test the latest hypotheses in evolution and co-evolution; and (4) rapid logging of tropical forests makes their canopy inhabitants particularly vulnerable to extinction; therefore, dissemination of scientific information to foster scientific interest on those arthropod communities is crucial before they vanish. Many of the earlier studies of canopy arthropods focused on the taxonomic distribution and species diversity of the material collected, and have relied upon indirect sampling methods, such as light trapping or canopy fogging. Often, observers were limited to ground level, with few opportunities to study canopy organisms directly. Recent methodological developments (such as construction cranes, canopy towers, canopy rafts, aerial sledges, aerial walkways or single rope techniques) have broadened our ability to access the canopy and allow the observation and collection of canopy arthropods *in situ*. Collecting methods are accordingly much more diverse and reflect the increasing complexity of the questions that are pursued by canopy entomologists. The study of canopy arthropods has matured considerably in recent years and investigations now target specific questions, instead of comprising rather descriptive accounts. Many of the research groups are now in a position to explain how arthropods are distributed within and among tree-crowns, and how they use their food resources. A better understanding of how arthropods are distributed and use their resource in tropical canopies is crucial to refine global estimates of species richness and to facilitate management and conservation of these species-rich communities. Index terms: Food resources, Host specificity, Spatial distribution