

### **Minisatellite mutagens: What can we learn from herring gulls? (O, S)**

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The Herring Gull displays high site fidelity, is long-lived and non-migratory within the Great Lakes. These characteristics make it an ideal sentinel of the effects of contaminants in the local environment. As endothermic vertebrates, they may reflect the potential risks facing humans exposed to similar levels of genotoxins. Multilocus minisatellite DNA fingerprint analysis of Herring Gull families has shown that the greater the exposure to genotoxins, measured as distance from steel industry, the higher the germ-line mutation rate. The primary mutagens that result in induced minisatellite germline mutations are currently unknown. My work focuses on the determination of chemicals involved in the generation of minisatellite mutations. Three types of contaminants are being explored - polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and heavy metals. I am pursuing this in two ways: (1) by determining the exposures to all three contaminant classes at previously examined urban and industrial sites where PAHs are important genotoxins, and (2) by targeting specific colonies known to have high levels of PCBs.

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### **The influence of carpeting on airborne fungal spore concentration (O, D)**

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People in developed countries spend much of their time indoors and in countries like Canada, which have long, cold winters, the significance of indoor air quality becomes increasingly important. One might expect optimal hygienic conditions in modern homes and buildings, yet health hazards involving moulds are becoming more frequent and mould-related allergies are becoming more frequent and severe. Surprisingly, little is known about the factors that influence mould concentrations in indoor air. It is suspected that carpeting is related to elevated airborne mould concentrations. I compared the airborne mould of offices with and without carpet. Initial results suggest that carpeting is a contributing factor to increased mould concentrations indoors.

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### **The relationship between blood-borne parasites and plumage in the pine siskin (*Carduelis pinus*) (O, D)**

MacDougall, A.K.,\* J.C. Joseph, S.A. MacDougall-Shackleton, T.P. Hahn, and L.M. Ratcliffe. Department of Biology, Queen's University, Kingston, Ontario, K7L 3N6.

Parasite-mediated sexual selection theory links mate choice and genetic quality through an honest advertisement of health. This theory proposes that the development of male secondary sexual characters, such as bright plumage, are under sexual selection from female mate choice, and indicate quality in terms of heritable resistance to parasites. This study examined adult male pine siskins (*Carduelis pinus*) over two breeding seasons to determine whether infection by blood-borne parasites was related to the width and brightness of yellow wingbars displayed in courtship. Parasite load was evaluated through microscopic examination of thin film blood smears. Males had significantly wider and brighter wingbars than females. Wingbar width and brightness were highly correlated, and were combined into one plumage score using principal components analysis (PC1-Plumage). PC1-Plumage was significantly negatively associated with male endoparasite load in 1998, but not 1999. PC1-Plumage was significantly and positively associated with wing chord length in both years. Parasitized males had significantly smaller cloacal protuberances than non-parasitized males, suggesting parasitic infection may be

associated with inferior reproductive condition. Because PC1-Plumage and parasite burden were associated in 1998, this study offers some support for the theory of parasite-mediated sexual selection. Thus, parasite burden may affect the development of socially-relevant plumage characters in the pine siskin.

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### **Plant growth-form effects on the spatial and temporal heterogeneity of soil moisture (O, D)**

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There is increasing evidence that plants differ in their responses to heterogeneity but little evidence that they differ in their ability to create soil heterogeneity. We examined the effects of two plant growth forms (five species replicates each of woody plants and grasses) on the spatial and temporal variability of soil moisture. The experiment was conducted in three-year-old monocultures in a common garden at the University of Regina. Non-destructive soil moisture measurements were taken daily at 10 and 30 cm below the soil surface during a wet period (7 rainfall events, high soil moisture) and a dry period (no rainfall events, low soil moisture). There was significant depth partitioning of soil moisture between growth forms. Soil moisture was lower under woody species than under grasses at 30 cm, whereas soil moisture was lower under grasses at 10 cm. There were also significant differences between growth forms in temporal variability. During the wet period, soil moisture variability beneath woody plants was significantly higher than that under grasses. During the dry period, soil moisture variability under grasses was significantly higher than that under woody species. Possible mechanisms for differences in variability between growth forms, including throughfall and evapotranspiration, were also examined. Throughfall was higher for woody species during large rainfalls. Evapotranspiration was higher for woody species at 30 cm. We attribute differences in soil moisture variability primarily to differences in water uptake between these growth forms.

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### **A re-examination of the effects of fire suppression on the boreal forest (O, D)**

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A theme in forest ecosystem management is emulation of natural disturbance in forestry practices. Application of this idea requires an understanding of the role of natural disturbances and human activities in creating the landscape age mosaic of the boreal forest. Fire is the major natural disturbance and it is widely believed that fire suppression in the 20th century has resulted in reduced area burned, smaller fires and longer intervals between fires. Unfortunately, little evidence is available to test this belief. A report frequently cited as evidence for suppression impacts in the boreal forest is Ward and Tithecott (1993). We re-examine this evidence based on 15 years of fire and stand age data from Ontario and show that serious flaws in data collection, presentation and interpretation invalidate their conclusions regarding suppression impacts on fire size and frequency. Differences in detection resolution invalidate comparisons of the shapes of the fire size distributions between protected and unprotected zones. Furthermore, different plotting scales give the false appearance of large differences in the number of large fires between the two zones. Finally, while stand age data appear to show a change in fire frequency in the 20th century, no evidence is presented to allow concluding that this change in fire frequency is attributable to fire suppression and not to climate change or land use. Therefore, we conclude that these data do not provide sound evidence of fire suppression effects.

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**Taking off the birthday-suit: unmasking some of the key uncertainties in fish aging through digital image analysis (O, S)**

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Growth structure analysis is highly subjective and, in particular, estimates of fish age based on scales have often been criticized for being unreliable as compared to those taken from other calcified structures such as otoliths. This may be true when considering extremely long-lived species, however, due to the life history characteristics of Great Lakes bloater chub (*Coregonus hoyi*) and lake whitefish (*Coregonus clupeaformis*) scale analysis has proven to be a useful technique. The capture and processing of digital images of fish growth structures is more objective than conventional aging methods, lends higher resolution and statistical power and adds flexibility to the analyst by allowing for complex image manipulation. In addition, software allows for live image preview and enhancement, easy storage of digital image collections and interfacing with spreadsheet programs for the storage of quantitative data. As a result of the utility of this software, the analyst can easily export a series of images for validation; a required feature that is generally lacking in fisheries assessment programs. A further advantage to this technique is that the analyst can offer a real product to the client in the form of compact discs containing all of the analyzed images. The theory and application of digitized fish growth structure analysis will be discussed with emphasis on how this technique can increase validity and reliability through attempting to minimize subjectivity and thus maintain high levels of accuracy and precision. The advantages of this new technique are discussed and contrasted against conventional means of fish growth structure analysis.

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**Experimental estimation of biparental inbreeding in a highly selfing plant, *Aquilegia canadensis* (Ranunculaceae) (O, S)**

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As a consequence of their sessile habit and limited gamete and seed dispersal, populations of plants may develop considerable genetic substructuring. This may lead to frequent mating among relatives, which, in turn, can affect the evolution of seed dispersal and the mating system. However, biparental inbreeding (BPI) has never been directly quantified in natural plant populations. Because close inbreeding among relatives mimics self-fertilization, it is included in measures of effective selfing, and the component due to biparental inbreeding is typically estimated by comparing estimates of selfing based on a single polymorphic marker loci (which include BPI) with estimates based on multiple loci (which are assumed to be free of BPI). However, this approach is likely to seriously underestimate BPI because a large number of loci are required to eliminate BPI from estimates of self-fertilization. We estimated BPI in populations of the highly-selfing flowering plant, *Aquilegia canadensis*, using a novel experimental approach. Effective levels of selfing estimated from polymorphic allozyme loci were compared between plants that had been spatially randomized within two populations to control plants that had been dug up and replaced in the same location. In both populations, moved plants exhibited much lower levels of effective selfing than control plants, suggesting that biparental inbreeding occurs frequently, even in these highly selfing populations. Because inbreeding depression is strong in this species, mating among relatives may result in strong selection on the dispersal and mating strategies.

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**Male Japanese quail avoid a female after seeing her mate, but are attracted to females that look like her (O, O)**

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Male Japanese quail, (*Coturnix japonica*), avoid females that they have seen mating with other males. Female Japanese quail, on the other hand, increase their tendency to affiliate not only with a male seen mating, but also with other males that resemble him. We wanted to determine whether male Japanese quail, like females of their species, generalize their response to a member of the opposite sex that they have seen mate. We found that males both avoided a distinctively marked female as a consequence of seeing her mate, and showed a preference for, rather than an aversion to, other females that resembled her. We interpreted these data: (1) as consistent with the hypothesis that male quail avoid a female after seeing her mate because of a temporary reduction in her reproductive value, and (2) as suggesting that there may be costs to males, as to females, in evaluating potential sex partners.

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**The changing roles of women in ichthyology (O, S)**

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I researched the role of women in ichthyology from a historical perspective. The contributions made by women in terms of research, teaching and the maintenance of museum collections was investigated. In addition to this, prominent women ichthyologists at the University of Guelph were interviewed to gain an understanding of the challenges faced by women working in this field. I also researched trends in education by determining the number of women that continue research at the graduate level. The number of women that obtain faculty and government positions, and the number of grants awarded to women fisheries scientists will be discussed.

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**Species evenness and the spatial organization of biomass within plant communities (O, D)**

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The few existing studies that have empirically determined the relationship between species evenness and productivity (both measured in terms of biomass) exhibit mixed results, possibly due to inconsistent sampling methods. We recently showed that, in an old-field community of eastern Ontario, species evenness was negatively related to productivity. Null modeling techniques have, however, shown this to be the result of the underlying right-skewed distribution of species-specific biomass contributions (SPCs) that are typical of terrestrial plant communities. Thus, a negative relationship is the null expectation. I am currently using a series of simulated communities to explore how the spatial arrangement of species, and their individual biomass values, influences the evenness-biomass relationship, as it would be determined using standard field sampling techniques. I predict that null models of the evenness-productivity relationship will provide a means to quantitatively compare communities that are suspected of having experienced different mechanisms of spatial structuring, e.g., those undergoing "natural" structuring versus those that humans have altered in the past.

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## **Conditioned taste aversion in four species of Microchiropteran bat (O, D)**

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Gases, water, and food represent the major external factors influencing an organism's internal environment - of these factors, food is the least predictable. Conditioned taste aversion (CTA), as a mechanism, functions by preventing an organism from consuming a food that has been associated with gastrointestinal malaise. In the absence of other cues, this avoidance behaviour will be based on taste alone. Proximately, it can prevent future poisonings and, when associated with other cues, increase foraging efficiency. CTA is ultimately a means of maintaining homeostasis. Bats have not been adequately studied with respect to CTA. Of the four species I used as subjects, three (2 frugivores and 1 insectivore) developed taste aversions to novel foods paired with an emetic. However, CTA was not observed in an obligate blood-feeding species (sanguinivore). I will discuss the results of the 3 non-blood consuming species in the context of the evolutionary history and adaptive value of CTA. Further, I will outline several possible hypotheses to explain the apparent loss of this primitive character in the sanguinivorous species.

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## **Effects of parental condition and group size on offspring sex ratio in White-winged Fairy-wrens (*Malurus leucopterus*) (O, D)**

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Empirical evidence widely supports adaptive sex ratio manipulation in birds in different ecological conditions. In addition, recent evidence suggests that both maternal and paternal condition may also influence offspring sex ratio. In this study, we examined the effects of parental condition and social system on brood sex manipulation in two populations of cooperatively breeding White-winged Fairy-wrens; one island population with few helpers and a mainland population with many helpers. We expected differences in sex ratio manipulation between these two main populations because helping behaviour selects for a skewed sex ratio towards the helping sex. We identified the sex of nestlings using polymerase chain reaction of two homologous genes CHD1W (females) and CHD1Z (males). In each of population we examined parental nutritional condition using ptilochronology and individual weight controlled for body size. To examine the effects of social conditions, we investigated the influence of group size on sex ratio adjustment within and between populations. We discuss our results in relation to recent theories of sex ratio manipulation.

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## **Mortality due to sunfish predation in the least killifish: effects of predator species and vegetation (O, S)**

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Populations of least killifish (*Heterandria formosa*) are found throughout Florida in habitats that vary in both the predators present and in the type and amount of vegetation. Long-term population studies also reveal that populations differ consistently in density. To test whether differing mortality rates due to predation may create observed differences in population densities, we measured mortality rates of *Heterandria* when in the presence of the predominant sunfish species from a low density and a high density site. The two sites also differed in predominant vegetation type and we crossed the predator treatment with vegetation type and amount. Mortality from warmouth (the low density site sunfish) was significantly greater for juvenile, female and male fish with either

vegetation type at low levels. At high vegetation levels, warmouth captured more fish when in the vegetation type found from the high density site, but not when in high levels of vegetation from the low density (their natal) site. The significant interaction between vegetation type and vegetation amount suggests that structure of vegetation may be important for prey species.

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### **Recovering ancient fish: Demographic analyses of sturgeon (O, D)**

Robertson, Cory T.,\* and Mart R. Gross. University of Toronto, Department of Zoology, 25 Harbord St., Toronto Ontario, M5S 3G5.

Sturgeons are an ancient fish lineage. Most species are now endangered, vulnerable or threatened, and an incomplete understanding of their biology and demography has hindered conservation efforts. Here we report on demographic analyses that tackle the conservation challenges arising from the sturgeon's long lifespan, delayed maturity, and intermittent spawning. Matrix projection models and elasticity analyses for three sturgeon species reveal a characteristic sturgeon 'elasticity profile'. This profile includes equally high survivorship elasticities across the young-of-the-year (YOY) and juvenile age classes, rapidly declining elasticities with each year after maturity, and negligible fecundity elasticities. Improvements to survivorship are restricted to less than 20% for all juvenile and adult years, and population growth rate ( $\alpha$ ) is similarly restricted. By contrast, improvement to YOY survivorship is virtually unlimited, and  $\alpha$  is most responsive to this age class. Localization of the highest potential for population growth within the YOY class has important ramifications for species recovery. Hatcheries, harvest regulations, and habitat restoration programs are likely to achieve little population-level response if they do not target YOY survivorship.

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### **The functional significance of dichogamy (O, D)**

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Dichogamy, the temporal separation of male and female function in hermaphroditic flowers, has traditionally been interpreted as a mechanism for preventing inbreeding. Alternatively, the two sexual functions may interfere with each other when simultaneously deployed. This interference may increase geitonogamous transfer of pollen and, consequently, reduce male reproductive success. Under the interference-avoidance hypothesis, dichogamy reduces this between-flower interference and enhances pollination efficiency. To test this alternative hypothesis, arrays consisting of 16 *Chamerion angustifolium* (Onagraceae) plants were constructed with two experimental treatments imposed. In one treatment inflorescence sizes were manipulated to produce plants with 2, 6, or 10 flowers. The second treatment consisted of all flowers manipulated to be adichogamous or half the plants in an array with dichogamous and half adichogamous flowers. Male reproductive-success was estimated from allozyme-loci paternity analysis of progeny collected from each array. Dichogamous plants sired the majority of offspring produced in each mixed dichogamy-type array, supporting the interference-avoidance hypothesis for the functional significance of dichogamy.

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## **On the importance of studying stable population of a common species in conservation biology (O, D)**

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In 2000, approximately 65 percent of turtles so far assessed are IUCN red listed. Freshwater turtles went from 10 to 24 critically endangered species in just four years. Management plans for the recovery of these species must take into account sound demographic analyses to insure that optimal cost-efficiency actions are taken. Matrix population model analysis gives us powerful tools to assess the effect of potential plans. Turtles are the paragon of vertebrate longevity and their life histories make them interesting subjects for demographic analyses. For practical reasons, long-term studies are scarce albeit demographic analyses for organisms with high longevity require such studies. Moreover, there are no data published for turtle populations that are not declining. We will use a 25 year data set for a population of painted turtles (*Chrysemys picta*) from Algonquin Park to investigate demographic traits and their relation to population growth rate. The importance of this study lies in three things: 1) the paucity of turtle demographic models, 2) the positive growth rate of this population, and 3) the Algonquin Park environment that represents the northern part of painted turtle distribution. Other available demographic studies (only 2) for this species have been conducted in the United States and comparisons between these three populations will potentially give us powerful insight on the selective pressure producing latitudinal variation in demographic traits.

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## **Can habitat rarity explain the humped-back richness/productivity relationship? (O, D)**

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The unimodal distribution of species richness across productivity gradients at the within-region scale has been a common pattern in ecological investigations. Most often, this pattern is explained using local interactions such as competition that are presumed to change in strength across productivity gradients. Recently, it has been demonstrated that local richness is consistently related to regional richness and subsequently, evolutionary theories explaining local patterns of species richness are receiving more attention. One such theory is the Species Pool Hypothesis, which contends that the unimodal pattern of species richness may result from the relative rarity of extremely unproductive, and extremely productive habitats. I investigated this possibility using meta-analysis of several investigations of productivity and diversity relationships that use random sampling. Such studies not only test the relationship between productivity and diversity, but also test the relative commonness of habitats as characterized by productivity. A randomization technique was used to objectively test whether the extremes of productivity gradients consist of significantly fewer sites. Results and their implications are discussed in light of explaining the determinants of the richness/productivity relationship.

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## **Sexual selection and speciation in threespine stickleback from Washington State (O, D)**

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The role of reinforcement in speciation is controversial. Most of the numerous putative examples of reinforcement from wild populations are based on analyses of complete species rather than of incipient species. Divergent parapatric populations should offer evidence if reinforcement is a common contributor to speciation. However, there are no convincing examples in the literature. One promising example involves divergent populations of

threespine stickleback (*Gasterosteus aculeatus*) in the Chehalis River drainage, WA, U.S.A. In this drainage, anadromous populations possessing the ancestral mate recognition system overlap, and hybridize in narrow zones at the mouths of streams with freshwater populations possessing a derived mate recognition system. If reinforcement is operating in this system, then freshwater populations at hybrid zones are expected to have derived male nuptial signals and female preferences, whereas allopatric populations are expected to retain the ancestral form of both male nuptial signals and female preferences. In Conner Creek, a Chehalis drainage that flows directly into the Pacific Ocean, freshwater males at a hybrid zone and those from an allopatric, headwater location exhibited a derived male nuptial signal. Also, females from the same locations showed clear preferences for males with the derived nuptial signal. Anadromous males from a location allopatric to Conner Creek exhibited the putative ancestral male mosaic signal and the anadromous females tended to prefer ancestral males. The pattern of mate recognition systems observed in Conner Creek is inconsistent with the predictions of reinforcement. Instead, the pattern of male nuptial signals and female preferences observed in this study is consistent with geographically variable sexual selection.

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#### **Development of genetic profiles to assess variability and population structure of St. Lawrence beluga whales (*Delphinapterus leucas*) (O, S)**

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The St. Lawrence beluga whale is classified as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), having been reduced from at least five thousand in the late 1800's to the present estimate of 1200 animals. We have been developing a photo-identification catalogue of individuals and taking skin biopsies of known animals. We are producing individual-specific DNA profiles using molecular sexing and genotypes from both the mitochondrial control region and microsatellite loci. Ninety-seven animals biopsied from 1994-1998 have been sexed and genotyped. The profiles include eleven mitochondrial haplotypes identified through Single Stranded Conformation Polymorphism (SSCP) analysis, as well as seven polymorphic microsatellite loci which give an overall probability of identity (POI) of  $1.63 \times 10^{-6}$  (or approximately 1 in 610,000). As more of the population is photo-identified and DNA profiled, levels of genetic variability and population structure can be better evaluated. The DNA and photo-identification data will be integrated to investigate aspects of population structure such as female philopatry, parentage of calves, and relatedness within and among groups. This will allow an evaluation of factors contributing to the lack of recovery of this population and will ultimately be applied to population conservation and management strategies.

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#### **Effects of selective logging on terrestrial mammal and arthropod communities (O, D)**

Simard, Jennifer,\* and J.M. Fryxell. Department of Zoology, University of Guelph, Ontario, N1G 2W1.

A goal of selective logging is to provide an adequate seed crop to facilitate natural forest regeneration. To test this hypothesis, we contrasted the abundance of seeds, deer mice (*Peromyscus maniculatus*), and terrestrial arthropods from eight replicate stands of "old" (~90yrs since logged) and "young" (~30yrs since logged) forests in Algonquin Provincial Park, Ontario. Stands were of similar size and were dominated by *Acer saccharum*. Old stands produced significantly greater density of seeds/m<sup>2</sup> and contained more *P. maniculatus*. The ratio of seeds predicated to seed output was similar between young and old stands, suggesting that seed predation by *P. maniculatus* was proportional to seed availability. Exclosure of small mammals had no detectable effect on arthropod abundance whereas terrestrial arthropod distributions from the old and young stands exhibited

significantly different patterns. Old stand populations showed a two-fold increase in both abundance and diversity over the course of the growing season whereas the abundance and diversity of arthropods from young forests was relatively lower and more constant. These results suggest that selective logging reduced seed production with consequent effects on the forest community structure and dynamics.

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#### **Recovery of the threatened economic plant, goldenseal (*Hydrastis canadensis*): evaluation of population trends, limiting factors, and transplanting with simulated disturbance (O, S)**

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The native woodland herb, goldenseal (*Hydrastis canadensis*), is considered threatened in Canada. Removal from the risk category is desirable given its medicinal and potential crop value leading to health and economic benefits. Increasing its abundance requires accurate data on status and experimental assessment of limiting factors. Survey of goldenseal sites indicated population stability, or a slight increase, with no evidence of sexual reproduction. Pollination, fertilization, and dispersal appeared non-limiting based on field observations. Analysis of spatial occurrence revealed a significant association with paths and woodland edges, suggesting a positive disturbance effect. Additional indications included lack of association with both natural area and habitat size, and a significant positive relationship between number of young stems and phosphorus. This relates to the hypothesis that lack of certain disturbances may contribute to rarity of woodland herbs. These woodland herbs evolved in an environment with more severe and frequent disturbances, including massive floods and impacts of extinct and extirpated fauna. A random block field experiment was used to test the effect of substrate disturbance. Transplants were evaluated in four treatment plots, substrate turned, fertilized, both and control. Analysis of variance indicated significantly greater growth in plots with substrate turnover after one growing season. This represents the first experimental evidence for a positive effect of substrate disturbance on growth of a woodland herb. Results support the hypothesis that woodland herbs are rare due to lack of certain disturbances and illustrate that transplanting into substrate turned plots within existing habitat may recover goldenseal from the risk category.

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#### **Evaluating the consequences of alternate harvesting strategies: An experimental approach (O, D)**

Smith, I.M.\*; Fryxell, J.M., and D.H. Lynn. Department of Zoology, University of Guelph, Guelph, Ontario, N1G 2W1.

This study was conducted in order to better understand the effects of alternate harvesting policies on populations in a controlled environment. It was hypothesized that fixed quota harvesting would cause a lower overall mean density and higher variance in the harvested population than fixed proportion or threshold policies. Four levels of intensity of harvesting were applied to populations of the ciliate *Tetrahymena thermophila*. These populations were maintained in test-tube microcosms under controlled environmental conditions. Two-factor ANOVA tables suggested that the interaction between harvest strategy and intensity also had an effect on density but not on variance. Single-factor ANOVAs and pair-wise comparisons showed that fixed quota harvesting produced a lower overall density at Medium-High and High levels of intensity ( $P<0.01$ ). The intensity of the harvest had an effect on population density for every harvesting strategy ( $P<0.00001$ ). Mean population variance was higher for fixed quota harvesting at the Medium-Low level of harvesting intensity. Due to the cost and difficulty of performing harvesting experiments in the field, repeatable experimental tests of management actions are rarely undertaken. The results from this study show that there were important ramifications on population density for different harvesting strategies. Fixed quota harvesting is far more detrimental to *T. thermophila* populations than fixed proportion and threshold harvesting.

## **Geographical variation in body size and cranial morphology of the muskox, *Ovibos moschatus* (O, D)**

Smith, P. A.\* Department of Biology, Trent University, Peterborough, Ontario, K9J 7B8.

Recent studies have suggested that Bergmann's rule, the longstanding biogeographic rule predicting larger size in cooler climates, may not be upheld at latitudes above 60° N. The muskox, with a range extending from 60° N to 83° N, provides a valuable opportunity to investigate this possibility. Geographical variation in body size was explored using cranial measurements of 128 muskoxen collected from three museums in eastern North America. Specimens were grouped by locality and body size was estimated from a principal components analysis (PCA) of five cranial characters, with the first component interpreted as a measure of size. No significant latitudinal trend in body size was observed in either sex. The observed pattern of an invariant body size across the species' range fails to support any of the current hypotheses for the evolution of geographical size variation. Despite invariant body size, significant latitudinal variation in male dental architecture was identified. A framework of adaptive significance is presented, linking the observed latitudinal increase in maxillary tooth row length to a selective pressure for increased food processing efficiency at high latitudes. I suggest that this pressure arises from a higher proportion of low quality, high roughage gramininoids in the diet of muskoxen inhabiting the islands of the Canadian Arctic archipelago.

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## **The breeding ecology of the Red Phalaropes (*Phalaropus fulicaria*) of Southampton Island, Nunavut (O, D)**

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I document several aspects of the breeding ecology of the Red Phalaropes (*Phalaropus fulicaria*) of Southampton Island, Nunavut (63.5° N 81.4° W), with an emphasis on identifying the factors influencing nest site selection. Twenty-two Red Phalarope nests were found and monitored (9.2 nests/km<sup>2</sup>), and survivorship was estimated at 30-40%. A set of 58 random sites was generated and nest site selection preferences were inferred through a comparison of nests and random sites on the basis of habitat variables measured at scales of 1 m<sup>2</sup> and 75 m<sup>2</sup>. Principal components analysis suggested a significant preference for nest placement in drier sites with less exposed substrate than random sites. Macroscale variables (e.g., the distance from ponds and the distribution of habitat types in a 75 m<sup>2</sup> circle around the nest) did not differ between nests and random sites. Average concealment of nests was higher than for random sites (nests: 30±17%, random: 10±14%), but concealment did not differ between depredated and successful nests. Around nests only, the degree of concealment was highest in the direction of the prevailing winds. Therefore, concealment probably functions primarily as a windbreak, rather than as a means of protection from predators. I suggest plausible selective advantages to nest placement in a favourable microclimate. Two distinct groups of nests were noted, with the distribution inferred to be the product of a nesting association between Red Phalaropes and Sabine's Gulls (*Xema sabini*) and Arctic Terns (*Sterna paradisea*). Differences in the survivorship between these two groups were marginally significant.

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## **Why are most selfers annuals? Comparing life history traits in selfing and outcrossing annuals (O, S)**

Snell, R.S.,\* and L.W. Aarssen. Department of Biology, Queen's University, Kingston, Ontario, K7L 3N6.

Most self-fertilizing plants are annuals. According to the 'time limitation' hypothesis, this association between selfing and the annual life cycle has evolved as a mechanism to minimize the time between flower maturation and ovule fertilization and hence, minimize the time needed to complete seed production in ephemeral habitats.

Predictions arising from this hypothesis were tested using phylogenetically independent contrasts (PIC) of various life history traits in selfing versus outcrossing annuals. A meta analysis provided a dataset of life history characteristics for 125 species across 14 families. Selfers had significantly shorter plant heights, smaller flowers and smaller seed sizes. Data for life history traits specifically related to development and fertilization times were obtained by monitoring the start and completion of various stages of reproductive development in a greenhouse study of selfing and outcrossing annuals, involving 25 species from 5 families. Age at first flower did not differ significantly between selfers and outcrossers. However, bud development time and flower longevity were generally shorter in selfers, although there were exceptions (in the family Fabaceae and the genus *Ipomoea*). These results are all consistent with the time limitation hypothesis. A preliminary analysis of habitat selection also supports the prediction from this hypothesis, that selfers should be more common than outcrossers among the annual species associated with two of the most ephemeral habitats in which plants are found: deserts and cultivated agricultural land.

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#### **Environmental pollution and germline DNA mutation: What can lab mice tell us about wildlife management? (O, S)**

Somers, Christopher M., \* and James S. Quinn. Department of Biology, McMaster University, 1280 Main St. West, Hamilton, Ontario, L8S 4K1.

Recent studies using multilocus DNA fingerprinting have demonstrated that rates of germline minisatellite mutation are elevated in herring gulls (*Larus argentatus*) nesting at polluted sites on the Great Lakes. It is unknown whether other wildlife or humans living in these or comparable areas are similarly affected. To begin risk evaluation, we are performing controlled experiments using lab mice to determine the predominant route(s) of exposure to chemical mutagens in Hamilton Harbour, a polluted site on western Lake Ontario. In the fall of 1999, we exposed mice for 10 weeks to ambient air conditions in Hamilton Harbour, and simultaneously at a clean-air site near the rural town of Freelton, Ontario. We repeated this exposure in the spring of 2000, and added a group of mice at each location that was protected from ambient air by a HEPA filtration device. These mice were bred within their groups, and we are currently performing single and multilocus DNA fingerprinting of the families to assay for inherited mutations. To evaluate the food chain as a mutagen exposure route, we will feed mice a diet composed of baitfish caught in Hamilton Harbour in the spring of 2001. The results of our analysis may be pivotal in guiding management decisions for the greater Hamilton Harbour ecosystem.

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#### **The possible role of the Vogel's Organ in predator detection in the common wood nymph butterfly (*Cercyonis pegala*) (O, D)**

Soutar, A., \* and J. Fullard. Department of Zoology, University of Toronto at Mississauga, Mississauga, Ontario, L5L 1C6.

The Vogel's organ of Satyridae butterflies was first described by Richard Vogel in 1912, and since then, restricted study has been unable to conclusively attribute a function to this organ. As such, many different functions have been suggested, with auditory perception assumed most likely. Satyridae remain stationary during the night, primarily in undergrowth, and thus an auditory organ could play a critical role in predatory detection. This study set out to test this possibility of predatory evasion, and its potential implications to auditory function. *Cercyonis pegala*, both ablated and non-ablated, were exposed to a nocturnal, insectivorous predator *Peromyscus leucopus*. Capture time was recorded and behavioural analyses were performed. No significant difference in capture time was found between ablated and non-ablated groups. However, ablated butterflies did show a significant increase in small movements, as well as an overall increase in movement rate. These results suggest that although the

Vogel's organ does not appear to prevent or delay capture by this predator, it may play a role in controlling movement during nocturnal, stationary behaviour.

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### **Effects of phosphorus availability on the growth and mycorrhizal colonization of the emergent aquatic *Lythrum salicaria* L. under flooded conditions (O, D)**

Spender, Sean,\* Kevin Stevens, and R. Larry Peterson. Department of Botany, University of Guelph, Guelph, Ontario, N1G 2W1.

The impact of human activities on many wetlands has altered patterns of nutrient cycling by the addition of sewage discharges and fertilizer runoff, as well as accelerated runoff from the watershed. Phosphorus (P) fertilizer and animal waste applications over the long-term have resulted in large fluxes of P to receiving waters in many areas across North America including the Great Lakes region. Mycorrhizal fungi play an important role in plant health and productivity. Increased plant growth, decreased root:shoot ratio, and increased internal P concentration are responses commonly attributed to the AM fungal relationship, as well as pathogen protection and stress alleviation. Studies using terrestrial plants have found that high levels of phosphorus in soil inhibits formation of AM or impairs their growth. Therefore the uncoupling of the plant-fungal relationship, as a result of high levels of P, could have serious implications on plant health and the composition of the plant community. *Lythrum salicaria* L. was used as a model to test the effect of varied soil-water P concentrations on plant growth and AM fungal colonization.

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### **The trouble with Bambi (O, D)**

Stockton, Stephen S.,\* S. Allombert, J.L. Martin, and A.J. Gaston. Department of Biology, University of Ottawa, 30 Marie Curie St., Ottawa Ontario, K1N 6N5.

Ten islands in the Laskeek Bay area (Haida Gwaii, British Columbia, Canada) were examined to measure the effect of introduced black-tailed deer (*Odocoileus hemionus sitkensis*) on old-growth coastal rainforest plant communities after 103 years. The islands, consisting of three deer-free islands (DFI) and seven deer-affected islands (DAI), were each intensively sampled, assessing species richness, and cover of vegetation. Nine exclosures were erected on three of the DAI. Comparison of DAI and DFI showed (1) that species richness, and cover of vegetation were significantly reduced when the herbivore was present; and (2) that plant communities were more homogeneous and their composition simplified on DAI. The exclosures demonstrated that biomass can quickly accumulate when the deer are excluded.

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**Oak savanna plant communities in Southern Ontario: assessing plant community composition, the effect of prescribed burn, and deer pellet distribution (Pinery Provincial Park, Rondeau Provincial Park and Pelee National Park) (O, D)**

Tagliavia C., \* D. Bazely, and S. Koh. Department of Biology, York University, North York, Ontario, M3J 1P3.

Oak savanna is a rare plant community in Ontario. The goals of this research were: 1) to assess the response of the plant community after deer herd reductions and prescribed burns, 2) to monitor the remnants of oak savanna, and 3) to describe deer distribution during the summer in Pinery. The three parks have a common history of intense deer overgrazing. In the summer of 2000 at Pinery, the cover and frequency of understorey species were collected in 24 sites (90, 1-m<sup>2</sup> quadrats), twenty of which have deer exclosures. In April 2000, in four of the sites in Pinery a prescribed burn was applied. After the burn, some of the sites at Pinery and at Rondeau (accidental fires) have shown an increase in species such as *Andropogon gerardii*, which was depressed by deer overgrazing and therefore not present in most of the sites. In Rondeau the no-burn sites showed lower species richness but the species present are mostly native, which suggests the potential for fast recovery. In Pelee, remnants of oak savanna have been sampled in 2000 and many of the species found were characteristic of a forest community. This suggests that the savanna is in an advanced stage in the succession. In addition a study of deer pellet density and distribution was conducted in May, July and August 2000 at ten sites in Pinery. The intent was to track deer movement, and so grazing pressure, but no time or site effects were found to be significant ( $p>0.05$ ).

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**Reciprocal transplant experiments to determine the resistance and resilience of benthic macroinvertebrate communities in Yukon streams (O, D)**

Taylor, R.M., \* and R.C. Bailey. Ecology and Evolution Group, Department of Zoology, University of Western Ontario, London, Ontario, N6A 5B7.

In the Yukon Territory, effluent discharges associated with mining for gold in 'placer' deposits results in elevated inputs of both settleable and suspended solids to receiving streams. Such disturbances are thought to alter the structure of benthic macroinvertebrate (BMI) communities. When assessing the impact of such a disturbance on BMI community structure, two questions are of importance. First, how resistant is the community structure to the disturbance? The magnitude of the immediate (short-term) response of a community is an inverse measure of its resistance. Second, are BMI communities resilient when exposed to such a disturbance, such that they recover to their former state upon removal of the disturbance? Placer mining exposure was simulated by reciprocally transplanting artificial substrates at selected confluence locations where a mined and unmined stream met. In doing so, it was possible to monitor response and recovery patterns of Yukon stream benthic macroinvertebrate communities to placer mining discharge. Our study was the first use of an experimental system with artificial substrates as a means of measuring the time-scale and magnitude of impact and recovery of benthic macroinvertebrate communities to Yukon placer mining activity.

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## **Evolutionary loss of sexual characters in asexual populations of an invasive aquatic plant, *Butomus umbellatus* (Butomaceae) (O, S)**

Thompson, Faye L.,\* K. Lui, and C.G. Eckert. Department of Biology, Queen's University, Kingston, Ontario, K7L 3N6.

Most perennial plants combine sexual reproduction with some form of vegetative, asexual reproduction. There are many anecdotal reports of plants having abandoned sexual reproduction for clonal reproduction, yet the evolutionary causes and consequences have rarely been investigated. Flowering Rush (*Butomus umbellatus*) is an invasive aquatic plant introduced to North America from Europe. Individuals can potentially reproduce sexually by seed and asexually through rhizome fragmentation and bulbil production. Our extensive field surveys in North America revealed wide variation in sexual fertility: some populations, particularly in the southeast, produce abundant seed whereas others, predominantly in the northwest, produce no seeds and are obligately asexual. Chromosome counts and pollen size data reveal that sexual sterility is due to triploidy. In plant populations where most recruitment occurs through asexual reproduction, traits associated with sex should degenerate genetically because they no longer enhance fitness. We tested this prediction by comparing three sexual characters in sexual, diploid and asexual, triploid populations: flowering frequency, dichogamy, and the size and developmental stability of flowers. In the field, diploids exhibited a higher incidence of dichogamy within both flowers and inflorescences. In a common greenhouse environment, triploids flowered very infrequently (~ 1%) compared to diploids (~ 99%). Floral measurements on flowers collected in the field indicate that triploid flowers were larger than diploid flowers, probably as a consequence of the increased cell size associated with polyploidy. These results provide some support for the evolutionary degeneration of sexual characters in asexual populations.

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## **Changes in abundance of soil organisms along a successional gradient in southern Ontario gravel pits (O, D)**

Turner, Vanessa,\* and John N. Klironomos. Botany Department, University of Guelph, Guelph, Ontario, N1G 2W1.

Succession has been extensively studied, but the processes occurring belowground remain unclear. However, this "black box" can influence aboveground processes and could prove to be an important factor in succession. Arbuscular-mycorrhizal fungi (AMF) form symbiotic relationships with plants within the soil, performing many functions such as increased nutrient uptake and pathogen and drought resistance. In this study, a chronosequence of abandoned gravel pits located along the Oak Ridges Moraine was chosen which represented time since abandonment from 0-35 years. Soil fungal, bacterial and nematode counts were characterized. Sites representing recent abandonment (0-5 years) had marginal counts for all biotic components tested. Results suggest that the presence of all biotic components increased over time following a disturbance. AM fungi also increased in diversity over time. This preliminary study indicates that AM fungal communities do change over time following a disturbance, and it is suggested that these changes can have immediate effects on the succession of aboveground vegetation. A further study is investigating the significance of the age of AM fungal communities in promoting late-successional communities.

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## **Why biennials are so few: habitat availability and the species pool (O, D)**

Viswanathan, D.V.,<sup>1\*</sup> and L.W. Aarssen.<sup>2</sup> 1. Department of Botany, University of Toronto, Toronto, Ontario, M5S 3B2. 2. Department of Biology, Queen's University, Kingston, Ontario, K7L 3N6.

Plant ecologists have long been intrigued by the relatively small number of biennial plant species. We considered a simple explanation for this pattern based on the predicted relationship between the size of a species pool and the availability of habitat type to which the pool is adapted. Hence, we predicted that there are few biennial species (relative to annuals and perennials) simply because they are adapted to a relatively uncommon habitat type. We tested this idea using vegetation surveys from a region surrounding Kingston, Ontario, where the vascular flora has been well documented and recently published as a species checklist of over 1600 flowering species. We found that the relative number of annual (18.1%), biennial (3.7%), and perennial species (78.2%) recorded in this region paralleled the contemporary relative abundance of habitat types with which they are each most commonly associated. Specifically, habitats disturbed within the previous 12 months, where annuals were more common than biennials, comprised 6.2% of the surveyed area. Conversely, habitats disturbed one to three years prior to the survey but not subsequently re-disturbed, where biennials were more common than annuals, comprised only 1% of the surveyed area. Most of the area surveyed (92.8%) consisted of habitats undisturbed for more than three years, where annuals and biennials were both absent. These results suggest that biennials are so few because the type of habitat to which they are adapted, and in which they can be expected to speciate, is and always has been relatively rare.

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## **Benefits of mate choice in captive breeding protocols (O, D)**

von Ompteda, K., \* and M.R. Gross. Department of Zoology, University of Toronto, 25 Harbord St., Toronto, Ontario, M5S 3G5.

Captive breeding programs are critical for the preservation of endangered species, and have had their foundations in population genetics theory. The 'mean kinship' breeding protocol is highly recommended and utilized, and guides the 'artificial pairing' of animals for the purpose of retaining maximal genetic diversity. In contrast, a behavioral-ecology perspective suggests that a protocol allowing 'mate choice' could improve the short- and long-term viability of captive populations in at least three major ways. First, females reap fitness benefits for their offspring through mate choice for either "good genes" or "compatible genes". Second, expression of mate choice allows for the preservation of natural mating behavior and thus increased success in reintroduction. Third, these benefits do not necessarily come at the cost of genetic management, since mate choice is a known mechanism for the maintenance of genetic variability. We also discuss our current experiment (using guppies, *Poecilia reticulata*) designed to quantify the fitness, genetic, and behavioral benefits of a mate choice versus a mean kinship protocol.

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## **Pond invertebrate community response to increasing chloride levels from road salt input (O, D)**

Watson, T.L.\* Department of Zoology, University of Toronto at Mississauga, Mississauga, Ontario, L5L 1C6.

Concern has been raised over the intensive application of road salt in densely populated areas of Canada. There is evidence that chloride levels encountered in some urban streams are toxic to some aquatic organisms. Little is known about what effect chloride input from road salt application may have on invertebrate community structure, particularly in ponds. I collected samples of invertebrates from littoral habitats of ponds in Southern Ontario as well as data on distance of ponds from the nearest road, size of nearest road and chloride concentration. Ponds were between 10 and 500 m away from roads which ranged from 2 lane gravel roads to multi-lane highways. Chloride levels ranged from 0 to 3977 mg/L. Chloride contribution to the variation in species composition across ponds, determined by multivariate analysis, will be presented.

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## **Growth of lake charr, *Salvelinus namaycush*, from Great Bear Lake, Northwest Territories, in relation to diet and spawning location (O, D)**

Weese, Dylan.\* Department of Zoology, University of Guelph, Guelph, Ontario, N1G 2W1.

Comparisons were made on growth rates among lake charr, *Salvelinus namaycush*, collected from Great Bear Lake during the summer of 2000. Growth rates were compared between piscivorous and insectivorous fish, and between fish from different spawning shoals. Otoliths were examined to provide age-at-size data. There were no differences in the growth rates of piscivorous and insectivorous lake charr. However, differences in growth rates were found between fish from different spawning shoals. This study supports the hypothesis that resource polymorphism is occurring in the lake charr of Great Bear Lake.

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## **Landscape ecology and GIS: research in national parks without putting on your hiking boots (O, S)**

Wiersma, Yolanda.\* Department of Zoology, University of Guelph, Guelph, Ontario, N1G 2W1.

From the perspective of standing along a remote hiking trail in one of Canada's national parks, the surrounding landscape may seem relatively intact and pristine. Although there is much valuable knowledge to be gained from on-the-ground work in parks, a different perspective may yield new insights. Through the use of Geographic Information Systems (GIS) and digital historic range maps, the composition of mammals was estimated for the areas of Canada that are now national parks. When these lists are compared with present-day species lists, many parks appear to have lost disturbance-sensitive mammals. Although small parks have lost more species than large ones, consistent with theory, park size does not sufficiently explain the observed losses. Digital topographic maps for twenty-four national parks in Canada were analyzed in a GIS to calculate the "effective area" of a park after the space allocated to human-built features had been quantified. This effective area may be a better correlate with the observed species losses than the overall park size. However, topographic maps do not give information on landcover, so satellite data was incorporated in the GIS analysis to give a more complete picture of the amount of natural habitat available. Together with data on visitor densities, as well as spatial features outside of park boundaries, such large-scale analyses help to infer meaningful estimates as to the relative importance of different factors responsible for species loss of certain species within the system of national parks, and guide decision making for mitigation of future losses or restoration.

## **Interactions between sources of mortality and the evolution of parasite virulence (O, D)**

Williams, P.D.,\* and T. Day. Department of Zoology, University of Toronto, 25 Harbord St., Toronto, Ontario, M5S 3G5.

A well-known result from theory for the evolution of virulence is the prediction that the virulence of a pathogen (i.e., the rate of host exploitation) always evolves to higher levels when host background mortality rates increase. Such a view, however, is derived from models that assume host mortality sources combine additively to determine an overall host mortality rate. The purpose of this paper is to suggest that such additivity is probably quite rare for many host-pathogen systems, and to explore how the predictions for the evolution of virulence are altered when interactions between host mortality sources are incorporated into the theory. Our results indicate that if mortality source interactions are sufficiently strong and positive (as we expect many of them will be), then the ESS (evolutionarily stable strategy) level of virulence actually decreases as background mortality rate increases. Our results also suggest that a mechanistic, detailed description of how parasites and other mortality sources combine to cause host mortality is required before reliable predictions about virulence evolution can be made.

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## **An examination of the degree of cooperation by workers of the obligately eusocial sweat bee, *Lasioglossum (Evylaeus) malachurum* Kirby (Hymenoptera: Halictidae) in southern Greece (O, D)**

Wyman, Laura M.,\* and Miriam H. Richards. Department of Biological Sciences, Brock University, St. Catharines, Ontario L2S 3A1.

*Lasioglossum malachurum* is the most abundant sweat bee in southern Greece and is a model for the paradigm of a strongly eusocial sweat bee. It has a well developed caste system (Knerer 1992) where workers are highly cooperative. Queens monopolize egg-laying, while workers 'sacrifice' personal reproduction in order to raise their mother's offspring. Studies performed in 1996-1998 by Richards (2000) in southern Greece threaten this paradigm since 66% ( $N = 35$ ) of mid-summer workers were mated and 50% ( $N = 35$ ) had well-developed ovaries, suggesting a high rate of worker egg-laying (Richards 2000). However, continued field studies on the same population in 2000, appear to contradict these earlier findings. Only 1.3% ( $N = 227$ ) of workers were mated and 60% ( $N = 299$ ) of workers had a high degree of ovarian development with peak ovarian development scores corresponding with the timing of male production, providing strong evidence that some or all of the male eggs are laid by workers. Furthermore, 57% ( $N = 302$ ) of workers had a high degree of mandibular wear, indicating high worker activity. Gyne (future queens) production appears to be under the control of the queen since the initiation of the reproductive brood begins when no males are available for workers to mate with. The current data reveal that there is a distinct caste system, with queens being 10.9% larger than workers. This size differential corresponds to those observed in previous years. The implications of these findings are that queens monopolize reproduction of gynes while workers may produce many of the male offspring. Thus the behaviour of *L. malachurum* in southern Greece does not threaten the paradigm of *L. malachurum* as a strongly eusocial sweat bee.

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**The role of propagule pressure in causing variation in the invasion of purple loosestrife within and between wetlands (O, S)**

Yakimowski, S.B.,<sup>1\*</sup> H.A. Hager,<sup>2</sup> and C.G. Eckert.<sup>1</sup> 1. Department of Biology, Queen's University, Kingston, Ontario, K7L 3N6. 2. Department of Biology, University of Regina, Regina, Saskatchewan, S4S 0A2.

Since its introduction in the 1800's, purple loosestrife (*Lythrum salicaria*) has spread across Canada and the USA and become one of the most high profile invasive exotic species. However, the factors that limit its distribution as well as its effect on native species diversity are largely unknown. We investigated some of the factors affecting its distribution within and among wetlands in a 100 km<sup>2</sup> area of central Minnesota by quantifying variation in seedling recruitment from sediments collected in 10 invaded wetlands and 11 uninvaded wetlands. We also compared the seed bank between occupied (L+) and unoccupied (L-) patches within invaded wetlands. Many *Lythrum* seedlings (2.9/mL) were recruited from L+ sediments, fewer (0.3/mL) from L- sediments, and none from uninhabited sediments. To distinguish between sediment characteristics vs. seed supply in causing this variation, we added *Lythrum* seeds (400/sample) to autoclaved sediments from all sites, and virtually all of them (92%) emerged. This indicates that the distribution of *Lythrum* between wetlands is limited by dispersal, while variation within wetlands may be affected by dispersal, time and site characteristics. Recruitment of *Typha* (*Lythrum*'s main competitor) was not consistently related to *Lythrum* recruitment between wetlands, however, more *Typha* emerged from L- than L+ sediments within invaded wetlands. The richness of other species emerging from the seed bank was higher in samples from uninhabited than invaded wetlands but did not vary within invaded wetlands. This may suggest that *Lythrum* invasion reduces species diversity, or its introduction is more likely in low diversity wetlands.

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**Immune expression in a damselfly is related to time of season, not to fluctuating asymmetry or host size (O, S)**

Youth, Christopher P.,\* Mark R. Forbes, and Bruce P. Smith. Biology Group, University of Toronto at Mississauga, Mississauga, Ontario, L5L 1C6.

Variation in immune responsiveness within and among species is the subject of the emerging field of ecological immunology. This study shows that individuals of *Lestes forcipatus* Rambur differ in their likelihood of mounting immune responses, and in the magnitude of those responses, against a generalist ectoparasite, the water mite *Arrenurus planus* Marshall. Immune responses took the form of melanotic encapsulation of mite feeding tubes, occurred in the few days after host emergence, and resulted in mites dying without engorging. Such immune responses were more probable and stronger for hosts sampled later rather than earlier in the season. Such responses may act as selection affecting seasonal patterns of egg hatching and larval abundance of mites. Contrary to expectation, metrics of host size (wing length) and wing cell fluctuating asymmetry were not related to the likelihood of immune responses. The importance of season on immune expression of insects has not been explored in detail. These results suggest possible trade-offs in allocation of melanin (or its precursors) to maturation versus immunity. Furthermore, these results indicate the need for studies on the synergistic effects of weather and parasitism on host species that use melanotic encapsulation to combat parasites and pathogens.

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## **POSTERS**

### **Increased evolutionary rates in haplodiploid vs. diploid insects (P)**

Beattie, R.D.,\* and M.H. Richards. Department of Biological Sciences, Brock University, St. Catharines, Ontario.

In this study, our primary objective was to investigate the rate of evolution of nuclear versus mitochondrial genes in insects. To investigate this, DNA and amino acid sequences from three mitochondrial genes, COI, COII, and cytochrome b, and one nuclear gene, EF-1alpha were studied. The sequences were obtained from Genbank and multiple alignments were constructed using CLUSTALW (ver.1.8). The alignments were forced onto independantly derived phylogenies of insects using MacClade, ver 1.01, revealing phylogenetic patterns of synonymous and non-synonymous nucleotide substitution in these genes. Based upon the number of substitutions that have occurred along each branch of a phylogeny, and assuming the time of divergence was equal for he insects studied, mitochondrial genes do indeed evolve faster than nuclear genes in insects. Futhermore, the rate of substitution appears to be higher in haplodiploid insects than in diploid insects. This effect is not an artifact of the tree topology or of alignment length.

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### **Population Growth of Reintroduced Southern Flying Squirrels (*Glaucomys volans*) at Point Pelee National Park (P)**

Bednarczuk, E. M.\* Department of Zoology, University of Guelph, Guelph, Ontario, N1G 2W1.

Southern flying squirrels (*Glaucomys volans*) classified as vulnerable in Ontario, Canada, are hypothesized to have disappeared from Point Pelee National Park (PPNP) due to the park's geographical isolation. One aim of the reintroduction was to test this experimentally. If insularization was the cause of the squirrel's extirpation, then a reintroduced population should not increase, due either to demographic or genetic stochasticity. To test this 99 southern flying squirrels were reintroduced in 1993-94 and the population was monitored in 1997 and 1999. In 1999, 88 individuals were captured and the population size was estimated at 221 (172-280), the highest estimate yet. Thus, at present there is no evidence to suggest that the original extirpation of the species was due to the insularization of PPNP; by implication, there is no evidence that genetic bottle necks, if one occurred, compromised the viability of this population. Future genetic studies will help to understand the relative importance of inbreeding and the loss of genetic diversity in the success of reintroductions to isolated areas.

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### **Assessment of gross morphological deformities in the common snapping turtle (*Chelydra serpentina serpentina*) from Algonquin Provincial Park (P)**

Browning, Nicole E.,\* Sara L. Ashpole, and R.J. Brooks. Department of Zoology, University of Guelph, Guelph, Ontario, N1G 2W1.

Current literature on reptile research suggests that the rate of gross morphological deformities increases with site contamination. This suggests that contamination is related to the development of deformities. Eco-toxicological studies involving the common snapping turtle (*Chelydra serpentina serpentina*) in Southern Ontario typically use Algonquin Provincial Park as a reference site. Literature on hatchling deformities rates in turtles at this site are reported to be quite low (< 5%). This value has been used to represent a normal background deformity rate.

However, a recent study looking at hatchling deformity rates over a five-year period indicated a high level of variation between years, anywhere between 6 and 31%. Toxicological studies have focused on hatchling deformity rates primarily for logistics. However, it might be more meaningful to know the adult population rate to interpret a more accurate biological effect of contaminants. In the present study, we assessed the background adult deformity rate as well as the effect these deformities might have on survivorship. In addition, the potential for a genetic transmission of deformities between mothers and hatchlings was investigated. This project was accomplished by statistical analyses of a comprehensive database collected over a 35 year period.

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### **Use of Electrical Barriers to Limit Movement of Eurasian Ruffe (P)**

Dawson, Heather,<sup>1</sup> Ulrich Reinhardt,<sup>1\*</sup> and Jacqueline Savino<sup>2</sup> 1. Department of Biology, Eastern Michigan University, 306 Mark Jefferson, Ypsilanti, Michigan, 48197. 2. USGS, Great Lakes Science Center, Ann Arbor, Michigan.

The effectiveness of an electrical barrier in controlling the migration of a Great Lakes invasive species, the Eurasian ruffe, was tested. Voltage and pulse settings proposed for the prototype Illinois Waterway System barrier were tested on naive ruffe in the lab. The number of passes through the electrified barrier was found to be reduced compared with a control. Results were compared to a study using round gobies in which lab studies and a field study using a barrier of a larger scale were conducted. Further studies on the ruffe are needed to determine how effective an electrical barrier would be in limiting their spread.

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### **Going Down: Can Downstream Drift Predict Low-Head Barrier Impact? (P)**

Dekar, M. P. and R. L. McLaughlin\* Axelrod Institute Of Ichthyology, University of Guelph, Guelph, Ontario, N1G 2W1.

Low-head barriers are increasingly used as a method for sea lamprey (*Petromyzon marinus*) control in the Great Lakes. The impact of barriers on non-target stream fishes, particularly species exhibiting downstream drift, is a significant concern. It has been suggested that species with downstream egg or larval drift are more likely to be extirpated above barriers. Based on this hypothesis, we predicted that species under-represented above barriers would display (i) small egg size, indicating small hatch size and weak swimming ability, (ii) open substratum spawning, increasing the vulnerability to stream current, and (iii) a propensity for drift. Literature data failed to support our predictions, suggesting that indicators of drift are not good general predictors of low-head barrier impact.

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### **A geospatial analysis of the effects of land-use on the local distributions of reptiles and amphibians in the Hamilton area (P)**

Edwards, Darryl,\* David Galbraith, and Bradley White. Department of Biological Sciences, McMaster University, Hamilton, L8S 4K1.

The Hamilton area is an urban, agriculturally and industrially dominated landscape. The reptiles and amphibians that still exist in the surrounding area show much variation in their abundance, with many species that are uncommon and others that are continuously distributed. Thus, the hypothesis was tested that abundance is a