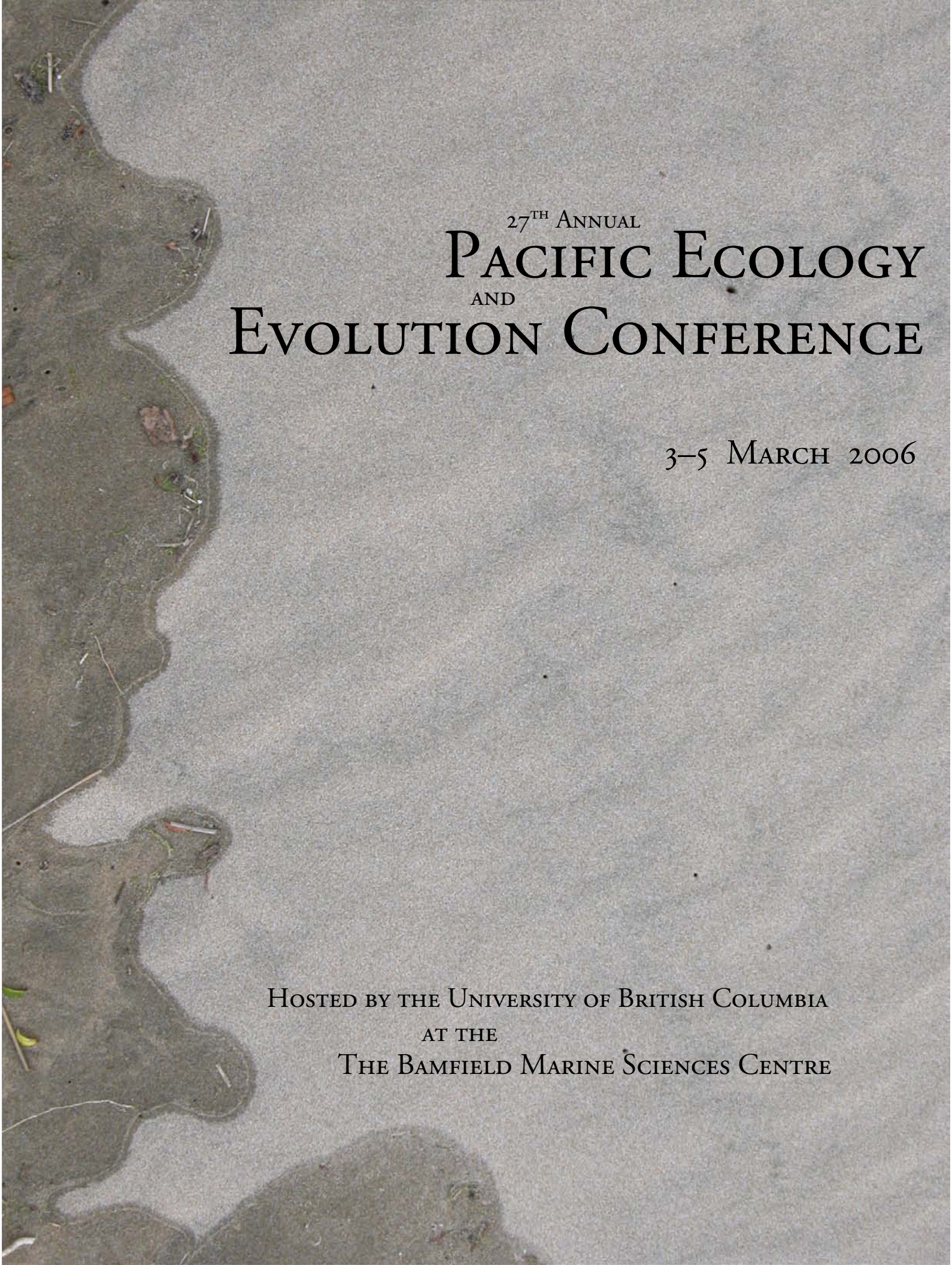

27th Annual

Pacific Ecology and Evolution Conference

3–5 March 2006

Hosted by the University of British Columbia
at the
The Bamfield Marine Sciences Centre

Welcome

Welcome to the 2006 Pacific Ecology and Evolution Conference in Bamfield, BC.

Thank you for participating in the 27th Annual PEEC and contributing to the ongoing success of this conference. This event traditionally serves as a relaxed and open forum for people to think about ecology and evolution, exchange ideas and information, and just as importantly have a good time. This year's conference has again gathered together an exciting group of people, from a variety of disciplines, with wide range of research, results, and techniques to share.

We are honoured that Dr. Jennifer Ruesink from the University of Washington has accepted our invitation to give this year's plenary lecture. Undoubtedly, she will contribute a valuable perspective as well as an interesting and topical address.

Our sincerest thanks to all the volunteers and sponsors who provided the momentum necessary to organize this event. Aya Reiss and Sophie Boizard were exceptional managing the registrations and finances. Wendy Tymchuk was especially helpful organizing the printing and packets. We are grateful for our hosts, the University of British Columbia and Bamfield Marine Sciences Centre, both of whom have been very accommodating. The Canadian Department of Fisheries and Oceans provided conference materials. And Biobio Cheese provided the delicious organic cheeses that you will be enjoying during the festivities Saturday evening.

We are happy to welcome everyone to Bamfield and hope you enjoy your time here at the conference.

Allyson Longmuir & Spencer Wood

Schedule Outline

Friday, March 03

7:00 PM	Lady Rose departs Port Alberni Registration on Lady Rose
10:00 PM	Lady Rose arrives in Bamfield Settle into accommodation

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Saturday, March 04

7:30 - 8:15	Breakfast
8:15 – 8:30	Welcome & opening remarks
8:30 - 10:30	Contributed talks - session 1
10:30 - 10:50	Coffee break
10:50 - 12:30	Contributed talks - session 2
12:30-1:30	Lunch
1:30 - 3:10	Contributed talks - session 3
3:10 - 3:30	Coffee break
3:30 - 5:30	Contributed talks - session 4
5:30 - 6:30	Dinner
6:30 - 8:00	Poster session
9:00 - ??	Live music by Bamfield's own "The Broken Group"

Sunday, March 05

7:30 - 9:30	Optional field trip to local shore
9:30 - 10:30	Brunch
10:30 - 11:30	Plenary address – Dr. Jennifer Ruesink "Know your system. Know your species. Know your statistics."
11:30-12:00	Closing comments
12:00	Lady Rose depart Bamfield
3:00	Lady Rose arrive in Port Aberni

Contributed Talks – Session 1

Room 1

8:30-8:50 Using game theory to evaluate host acceptance decisions in Mountain Pine Beetle.
A. Chubaty, B. Roitberg, C. Li and B. Ma

8:50-9:10 The evolution of reproductive duration: its ecological causes and reproductive consequences.
W. Davies

9:10-9:30 Shit happens. Sex helps.
A. Blachford

9:30-9:50 Morphological divergence in multiple traits between asymmetrical forms in a polymorphic flatfish.
C. Bergstrom

9:50-10:10 Evolution of novel brooding modes in spirorbin polychaetes.
T. A. Macdonald

10:10-10:30 The role of pleiotropy in the maintenance of sex in yeast.
J. A. Hill and S. P. Otto

Room 2

8:30-8:50 Begging signals and parental responsiveness in fledgling American dippers.
H. Middleton, D. Green and E. Krebs

8:50-9:10 Behavioural time allocation of blackeye gobies - effects of SCUBA diver disturbance and body size.
B. J. Chuchman and L. M. Dill

9:10-9:30 Initial evidence for multi-hierarchical influences of sea otter habitat selection.
J. T. Fisher and D. A. Duffus

9:30-9:50 Nest-site selection patterns by yellow warblers in an altered riparian landscape.
S. Quinlan and D. Green

9:50-10:10 The role of edge type and predator identity in mediating edge effects on nest predation risk in the marbled murrelet.
J. M. Malt and D. B. Lank

10:10-10:30 Population genetic structure in the recently-glaciated range of the bat star (Patiria miniata) and implications on the history and dispersal of this species.
J. Sunday, C. Keever and M. Hart

Contributed Talks – Session 2

Room 1

10:50-11:10 Managing human bear conflicts using non-invasive genetic sampling and GIS habitat quality mapping in Whister, Canada.
R. D. Appleton, K. Rothley, A. Harestad and W. McCrory

11:10-11:30 Peanut butter can bias habitat modeling: A spatial analysis using northern flying squirrels.
M. Wheatley and K. Larsen

11:30-11:50 Methods for marking and tagging marine organisms.
A. Griffiths and L. Gosselin

11:50-12:10 Fishery selection on length and age at maturity of sockeye salmon in Bristol Bay, Alaska.
N. J. E. Kendall and T. P. Quinn

12:10-12:30 GPS bias correction and mountain goat habitat analysis.
A. G. Wells and D. O. Wallin

Room 2

10:50-11:10 Distribution and abundance of juvenile coho salmon (Oncorhynchus kisutch) during colonization of newly accessible habitat.
J. H. Anderson, P. M. Kiffney and T. P. Quinn

11:10-11:30 Are spawning anadromous salmon providing an important nutrient subsidy to estuarine ecosystems?
J. Chow, M. Johannes and A. Mazumder

11:30-11:50 Transmission dynamics of parasitic sea lice from farm to wild salmon.
M. Krkosek, M. Lewis and J. Volpe

11:50-12:10 Why do exotic species cause problems in some systems but not others? Evaluating the impacts of species introductions and stocking measures on kokanee (Oncorhynchus nerka) populations in a large, oligotrophic lake.
E. Schoen, D. Beauchamp, N. Overman and C. Sergeant

12:10-12:30 Abundance and distribution of northern pikeminnow (Ptychocheilus oregonensis) in Cultus Lake, British Columbia and implications for predator control.
J. Amos, M. J. Bradford and J. M. B. Hume

Room 3

10:50-11:10 Interactions between sharks and seals around a small island colony: a predator-prey behavioural game?
R. Laroche, A. Kock, L. Dill and W. Oosthuizen

11:10-11:30 Contrasting the lifecycles of two invasive spider species.
S. Vibert and M. Salomon

11:30-11:50 Elevational effects on ectomycorrhizal communities: Results from a soil bioassay
J. Karst, M. D. Jones and R. Turkington

11:50-12:10 No talk scheduled

12:10-12:30 No talk scheduled

Contributed Talks – Session 3

Room 1

1:30-1:50 Producer, consumer and microbial diversity: feedbacks and independence.
A. Longmuir and J. Shurin

1:50-2:10 Gray Whales and Marine Protected Areas: A multi-trophic level approach to assessing functional ecological association.
C. Short and D. Duffus

2:10-2:30 Community level consequences of non-prey species.
P. Kratina, M. Vos and B. R. Anholt

2:30-2:50 Close-range orientation to and recognition of prey by Dicyphus hesperus Knight (Heteroptera: Miridae).
T. Hazard, D. Gillespie and B. Roitberg

2:50-3:10 The presence of neighbours causes western black widow spiders to modify their web building tactics.
M. Salomon

Room 2

1:30-1:50 Phylogenetic relationship among deep-sea wood-boring clams from the NE Pacific (Xylophagainae, Bivalvia, Mollusca).
M. Stoeckle and V. Tunnicliffe

1:50-2:10 Rapid population divergence of sockeye salmon in a volcanic lake.
S. A. Pavey, T. R. Hamon and F. Breden

2:10-2:30 Regional heterogeneity and gene flow maintain variance in a quantitative trait within populations of lodgepole pine.
S. Yeaman and A. Jarvis

2:30-2:50 Selection against hybrids in natural populations of sympatric threespine sticklebacks.
J. Gow, C. Peichel and R. Taylor

2:50-3:10 Food web components of species-area curves: tests with phytotelm insect communities.
D. Srivastava, M. Trzcinski, B. Gilbert and B. Richardson

Contributed Talks – Session 4

Room 1

3:30-3:50 Marine vs freshwater: Perspectives from viral abundance data.
J. L. Clasen, J. J. Elser, R. W. Sterner, E. K. Hall and C. A. Suttle

3:50-4:10 Evolution in the North Pacific: a molecular analysis of Pan-Pacific smelt genus Hypomesus (Pisces: Osmeridae).
K. Ilves and E. Taylor

4:10-4:30 Nice genes, where did you get 'em? A phylogenetic look at photosynthetic genes in cyanophages and their hosts.
C. Chenard, L. McDaniel, J. Paul and C. A. Suttle

4:30-4:50 Parallel evolution by correlated response? Lateral plate reduction in threespine stickleback.
K. Marchinko and D. Schluter

4:50-5:10 Integrating population, quantitative and molecular genetics: adaptive variation in cold tolerance in Sitka spruce.
J. Holliday, S. Ralph, J. Bohlmann and S. Aitken

5:10-5:30 Rapid habitat change and apparent life history evolution of sticklebacks in the Chignik Lake system, Alaska.
P. A. H. Westley

Room 2

3:30-3:50 Sects, drogues, rocks & roll(ing waves): Host morphology and wave exposure can determine diversity of invertebrates living on seaweeds.
C. Bates

3:50-4:10 Between the waves: A revision of the universal features of zonation between tide marks.
C. E. Bird and C. M. Smith

4:10-4:30 Habitat selection and feeding specialization in a symbiont-hosting gastropod.
A. Bates

4:30-4:50 Southern Resident killer whale (Orcinus orca) summer distribution patterns: effects of changing temporal scales.
D. Hauser, M. Logsdon, G. VanBlaricom and E. Holmes

4:50-5:10 Global warming and cloud forest orchids
R. L. Sewell Nesteruk

5:10-5:30 Assessing the relative influence of local ecological interactions and regional species pools on local species richness.
S. A. Wood and R. Russell

Poster Session

Rix Centre Ballroom
6:30 - 8:00

Sea louse mediated salinity preferences in juvenile Pacific salmon.
B. M. Connors and L. M. Dill

An assessment of radial growth in Pinus contorta Dougl. relative to changing climate patterns in British Columbia: Genetic response to annual climate variations, 1973-2005.
S. Curtis-McLane and S. Aitken

Proxy development for a method of reconstructing mountain pine beetle (Dendroctonus ponderosae Hopk.) outbreak in central British Columbia.
S. Goring

Adaptive plasticity in parasitoid behaviour.
L. Henry, B. Roitberg and D. Gillespie

Modeling larval survival of a checkerspot butterfly, Euphydryas anicia, and the effect of soil moisture on its host plants, Castilleja miniata and C. rhexifolia, in the North Cascades National Park.
S. Imholt and J. McLaughlin

Watershed scale factors affecting freshwater production of Pacific Salmon in Whatcom County.
L. Kaminski

Population Genetics of Pacific Dogwood.
K. Keir and S. Aitken

Instream structures as barriers to upstream passage by freshwater sculpins (Cottus spp.) in Puget Lowand streams of Whatcom and Skagit counties.
M. LeMoine and L. Bodensteiner

The early marine survival of juvenile pink salmon: The effects of sea lice on predation risk.
P. A. Mages and L. M. Dill

Benthic ecology and gray whale foraging in Clayoquot Sound
A. G. Patterson and D. A. Duffus

Response functions of lodgepole pine to temperature and CO2: Implications for genetic resource management for future climates.
P. Smets, R. Guy, T. Wang, A. Yanchuk and S. Aitken

A spatial analysis of cougar-human interactions on the west coast of Vancouver Island.
D. Thompson, D. Eastman, S. Boychuk and B. Hansen

Reproductive isolation in a contact zone between two divergent forms of winter wren (Troglodytes troglodytes).
D. P. Toews and D. E. Irwin

ClimateBC and its applications in forest genecology and resource management in BC.
T. Wang, A. Hamann, D. L. Spittlehouse and S. N. Aitken

210Pb-derived Sedimentation and Mixing Rates in Hood Canal, WA.
S. Wingert

Plenary Address

Know your system. Know your species. Know your statistics.

Jennifer L. Ruesink
University of Washington

"Biocomplexity" is the emerging term for coupled human-natural systems that are dynamic, replete with nonlinearities and feedbacks, and difficult to predict and manage. The whole is more than the sum of the parts. I propose three rules of thumb to tackle this cutting edge of ecology and evolution. First, know your system. There is no substitute for profound awareness of facts: natural history. In the absence of a lifetime to acquire this first-hand experience, much can be learned from local and traditional knowledge. Second, know your species. The recent focus on "biodiversity and ecosystem functioning" has been blind to the differential importance of species. More attention should be paid to interaction strength, and less to richness. Third, know your statistics. It is tempting to explore complexity through multi-factor analyses. Avoid this temptation. Modern computer-intensive methods to extract pattern from data are providing insights never before available. Nevertheless, complicated study designs do not necessarily clarify: interactions among factors are often significant and difficult to interpret. The best studies should pass the interocular test (hit you right between the eyes) and not require statistics at all.

Contributed Talks

Abundance and distribution of northern pikeminnow (Ptychocheilus oregonensis) in Cultus Lake, British Columbia and implications for predator control.
J. Amos, M. J. Bradford and J. M. B. Hume
1.) Simon Fraser University. 2.) Fisheries and Oceans Canada & Simon Fraser University. 3.) Fisheries and Oceans Canada

The Cultus Lake sockeye salmon (Oncorhynchus nerka) population is among the most intensively studied salmon stocks in British Columbia. Despite the long research history the Cultus Lake sockeye stock has exhibited dramatic declines in abundance over the past few decades, and was classified as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2003. While the primary cause of the decline is considered to be over fishing, predation of juvenile sockeye by northern pikeminnow (Ptychocheilus oregonensis) within the lake has been identified as potentially limiting stock productivity. Consequently, there is an interest in predator control as a means to increase juvenile salmon survival and ultimately assist in the recovery of the Cultus Lake sockeye population. We used a series of mark-recapture studies during 2004-2005 to describe the current abundance and distribution of northern pikeminnow within Cultus Lake. The mark-recapture results were then used to parameterize a simple simulation model used to determine the likely impacts of a sustained northern pikeminnow removal effort at Cultus Lake. Over the two years, we captured a total of 9,105 northern pikeminnow, and estimated the adult (>200mm) population size to be approximately 60,000 fish. These results suggest that the current northern pikeminnow population is much higher than previously estimated. We also documented that northern pikeminnow have a high degree of fidelity to summer feeding and spawning sites within Cultus Lake. These results will assist in evaluating the potential effectiveness of a predator control program.

Distribution and abundance of juvenile coho salmon (Oncorhynchus kisutch) during colonization of newly accessible habitat.
J. H. Anderson, P. M. Kiffney and T. P. Quinn
1.) University of Washington 2.) US National Oceanic and Atmospheric Administration 3.) University of Washington

Post-glacial colonization by Pacific salmon (Oncorhynchus spp.) in their native range and rapid dispersal by some introduced populations reveal that salmon are remarkably capable of exploiting unoccupied habitat. However, the initial stages of colonization events are seldom documented. Landsburg Dam on the Cedar River, Washington had excluded salmon from over 27 km of high quality habitat for over a century but was modified to allow passage in 2003. Adult coho salmon (N = 47 in 2003, 99 in 2004) circumvented the dam, and initial research detailed adult movement patterns within the new habitat. Here we present results of juvenile salmon surveys describing the distribution and abundance of juvenile coho in relation to known adult spawn sites. In both seasons, snorkel surveys indicated the highest densities of juvenile coho were located in the lower reaches of the Cedar River, which also contained the greatest number of adult spawn sites. Results also indicated significant dispersal away from spawn sites, in particular evidence that juvenile coho colonized a tributary of the Cedar River in which no adult spawning activity was detected. At a finer scale, aggregations of juvenile coho were typically found along margins of the Cedar River associated with large woody debris. In addition to the snorkel surveys, a small seine net was used to collect tissue samples and length measurements from juvenile coho. Future work will employ molecular genetics for a parentage analysis of juvenile coho in order to assess adult reproductive success and juvenile dispersal behavior.

Managing human bear conflicts using non-invasive genetic sampling and GIS habitat quality mapping in Whister, Canada.
Appleton, RD, K. Rothley, A. Harestad and W. McCrory
1.) Simon Fraser University 2.) Simon Fraser University 3.) Simon Fraser University 4.) McCrory Wildlife Services Ltd

The Resort Municipality of Whistler, British Columbia, Canada (RMOW) consists of 165-km2 of forests, wetlands, rocky alpine, and developed land. Development to support this resort has resulted in the conversion and fragmentation of forested areas and has insidiously intruded on functioning, viable ecosystems, thereby increasing the number of human and black bear (Ursus americanus) conflicts. In this study we will develop and test a black bear habitat quality map using ArcView GIS and non-invasive genetic sampling. The map will be created by developing a black bear habitat quality ranking system which will be applied, based on local knowledge and literature, to a combination of biogeoclamatic zone, sub zone, variant, site series and structural stage, which is a classification system in British Columbia that groups similar segments of the landscape (ecosystems) into categories based on climatic, vegetation, and site. The biogeoclamatic ecosystem data will be collected using the Terrestrial Ecosystem Mapping System (TEM). Fifty-one barbed wire hair traps will be constructed and baited for 14 one-week sessions throughout early summer

and fall and submitted to The Wildlife Genetics International Ltd. Laboratory in Nelson, British Columbia for DNA analysis. From these results, population estimates will be calculated and distribution patterns will be examined. Furthermore, a compilation of human and black bear conflicts will be conducted based on data collected by conservation officers, to spatially describe areas of distinctive management concern. This data will be used to test the habitat quality mapping system by overlaying it onto GIS-based datasets. Upon completion, this study will provide baseline information by which to assess the long-term management and monitoring of black bear habitat quality and high bear-human conflict areas within the Resort Municipality of Whistler, British Columbia, Canada.

Habitat selection and feeding specialization in a symbiont-hosting gastropod.

A. Bates
1.) University of Victoria

Lepetodrilus fucensis is a dominant limpet in hydrothermal vent habitats on the Juan de Fuca Ridge. This species exhibits novel adaptations: L. fucensis hosts a putative nutritional symbiosis with filamentous bacteria found partially embedded in the gill epithelium and also forms prominent stacks in vigorous vent flows where its densities are an order of magnitude greater than congeners and co-occurring gastropods. It is possible that the abundance patterns of L. fucensis are driven by habitat preferences that reflect its feeding strategy. My objectives were (1) to determine if L. fucensis exhibits a preference for vent flows, (2) to understand the nature of the bacterial association and (3) to identify morphological features that might indicate a specialized feeding strategy. (1) Quantitative collections along transects documented the abundance patterns of L. fucensis with respect to distance from vent flows. The maximum density (200,000 individuals m-2) of adult L. fucensis occurred in vent flows between 5 and 15°C; in situ and shipboard experiments indicate that these habitats are preferred. (2) Molecular approaches revealed that the gill bacteria are a phylotype-specific assemblage of γ-Proteobacteria, identical within specimens from different sites. These results indicate a specific and stable symbiosis. The bacteria are probably thioautotrophic, as the abundance of gill bacteria increased with greater venting vigour. In addition, exposure to 14C-labeled bicarbonate in the presence of sulphide showed a positive relationship between CO2 fixation and bacterial abundance. FISH images documented the incorporation of the symbiont phylotype into the food roll, suggesting a nutritional advantage to the symbiosis. (3) Morphological comparisons among Lepetodrilus species revealed that the radula size and stomach volume of L. fucensis are significantly reduced, while its gill is enlarged and free of the mantle. These modified features are consistent with a specialization towards suspension feeding and/or farming of gill bacteria. Shipboard experiments in pressure vessels documented the ingestion of a food roll consisting of particulates accumulated on the gill, confirming suspension-feeding by this species. Therefore, the preference exhibited by L. fucensis for vent flow habitats can be explained by a requirement for sulphide substrates to encourage the generation of symbiont biomass and suspended particulates for feeding. The remarkable success of L. fucensis may be attributable to its ability to farm its bacterial symbionts and suspension feed.

Sects, drogues, rocks & roll(ing waves): Host morphology and wave exposure can determine diversity of invertebrates living on seaweeds.

C. Bates
1.) University of British Columbia & Bamfield Marine Sciences Centre

In most biological communities, organisms use other species as habitat. Recent progress in marine community ecology theory predicts that a) the strength of such facilitation interactions is positively correlated with levels of ambient stress and b) the degree to which this positive correlation is seen can depend on the traits of the facilitating species. I tested these predictions using a seaweed-epifauna system on the west coast of Vancouver Island, British Columbia, using wave impact as the stressor and host morphological characters as the moderating traits. I will present results from collections of over 1800 algal thalli (and associated invertebrate epifauna) collected across six sites over one year. Fifteen different species of algae were selected to encompass a range of host morphologies, and mean maximum wave velocity per site ranged from less than two m/s to over six m/s. Preliminary analysis suggests that a) for algal species without complex features, epifauna richness and abundance decrease after a host-dependent wave velocity threshold has been reached. For example, Fucus gardneri, which lacks abundant branchlets or folding, supports a decreasing epifauna load above 2 m/s; b) there is a host-dependent upper threshold of water velocity at which invertebrate species can utilize a particular algal species for habitat (e.g. Mazzaella splendens = 2.4 m/s; Fucus gardneri = 4.0 m/s); and c) host species with complex features (such as Ulva fenestrata, which is highly foldable) maintain invertebrate abundance and richness across the spectrum of tested wave velocities. These results support the contention that host trait values are important determinants of facilitation levels in this system, and that this importance is positively correlated with wave exposure.

Morphological divergence in multiple traits between asymmetrical forms in a polymorphic flatfish.
C. Bergstrom
1.) University of Alberta & Bamfield Marine Science Centre

Discontinuous polymorphisms are widespread and can provide species with greater phenotypic diversity with which to exploit niche space. However, it can be difficult to determine whether a polymorphism is maintained by stochastic processes or natural selection unless niche segregation between morphs is evident. Starry flounder (Platichthys stellatus) are pleuronectid flatfish that exhibit a rare polymorphism for the direction of eye migration during metamorphosis. Remarkably, proportions of left-eyed P. stellatus range from 50% to 100% across the species range, yet the evolutionary mechanisms maintaining this variability in asymmetrical development remain unknown. As part of a broad investigation into whether this polymorphism has adaptive significance, I investigated morphological variability between left and right-eyed P. stellatus in ten traits from twelve samples. The two morphs were not mirror images of each other, but differed consistently in several traits including gill raker number, caudal peduncle size, and snout length, suggesting that the two morphs may be ecologically segregated and responding to variable selection.

Between the waves: A revision of the universal features of zonation between tide marks.
C. E. Bird and C. M. Smith
1.) University of Hawaii 2.) University of Hawaii

Stephenson & Stephenson (1949 & 1972) proposed that all shorelines shared universal features of zonation between tide marks. These zones were said to be determined primarily by tidal fluctuation and secondarily modified by waves and other climatic factors. The zones specifically consisted of the infralittoral fringe, the midlittoral, and the supralittoral fringe. While subsequent studies have explained patterns of zonation further, most notably Connell (1961), the concept of universal zonation features remains unchanged today. The wave-exposed shores of Hawaii are subject to a mean yearly wave height approximately three times greater than the tidal range - drowning the tidal signal. We propose that waves not only expand littoral zones, but also are fundamental in the creation of novel physical zones. On wave-dominated shores, where wave height is much greater than tidal range, the midlittoral is divided into three distinct physical zones: the submerged littoral zone, the wave zone, and the effective littoral zone. The climate on wave-dominated shores differs fundamentally from that of tide dominated shores, primarily in the frequency and predictability of emersion and subsequent desiccation. Along a wave exposure gradient in Hawaii, the distribution of organisms closely matches our wave-dominated zones. On tropical Indo-Pacific islands, specialized organisms such as Colobocentrotus atratus and Octopus oliveri thrive on wave dominated shores but are absent on tide dominated shores. Our zonation scheme liberates the universal features of zonation from a dependence on tides and specific organisms, while providing insights to some of the physical factors affecting the biota on any shoreline.

Shit happens. Sex helps.
A. Blachford
1.) University of British Columbia

Although sexual reproduction is ubiquitous among living organisms, theory has had trouble identifying general advantages of sex. I consider a role for sex in the suppression of noise in the transmission of chromosomes from one generation to the next. In nature, some individuals within a local population can have good luck, others bad, and the resulting noise in gene transmission interferes with the action of natural selection. I find that if variance in fecundity is greater than the mean, then sexual reproduction can suppress such noise better than clonal reproduction.

Nice genes, where did you get 'em? A phylogenetic look at photosynthetic genes in cyanophages and their hosts.
C. Chenard, L. McDaniel, J. Paul and C. A. Suttle
1.) University of British Columbia 2.) University of South Florida 3.) University of South Florida 4.) University of British Columbia

Cyanobacteria of the genera Synechococcus and Prochlorococcus are susceptible to viral infection, which has exerted strong selective pressure on the evolution of both phage and host. Genes (psbA and psbD) encoding for essential proteins (D1 and D2) in photosystem II have recently been discovered in cyanophages. Using degenerate primers and the polymerase chain reaction, fragments of psbA and psbD were amplified from cyanophage isolates from the Gulf of Mexico. Both psbA and psbD were found

in 12 of 31 cyanophages, and gene-based phylogenies revealed similar tree topologies. Cyanophage sequences clustered together, separate from Synechococcus and Prochlorococcus sequences. As well, there were distinct clades within the phage sequences. These findings confirmed that cyanophage psbA and psbD have their own evolutionary history that is distinct from that of their hosts, and that psbA and psbD have not been recently acquired. Furthermore, our data suggest that both genes have a common evolutionary history within the cyanophages.

Are spawning anadromous salmon providing an important nutrient subsidy to estuarine ecosystems?
J. Chow, M. Johannes and A. Mazumder
1.) University of Victoria 2.) University of Victoria 3.) University of Victoria

As the fall rains descend upon the Pacific Northwest, hundreds of thousands to millions of anadromous salmon return to their natal streams to spawn and subsequently die. Their bodies contain marine-derived nutrients (MDNs) collected during the oceanic phase of their life history. By way of migration to their spawning grounds, the MDNs carried by salmon can be converted into food energy for freshwater and riparian ecosystems. The value of this upstream movement of MDNs by anadromous salmon has become widely recognized among biologists and managers; however, streams continue to channel water and nutrients down toward the ocean. I am currently investigating whether MDNs from spawning anadromous salmon provide an important nutrient subsidy to estuarine ecosystems associated with salmon-bearing watersheds.

Using game theory to evaluate host acceptance decisions in Mountain Pine Beetle.
A. Chubaty, B. Roitberg, C. Li and B. Ma
1.) Simon Fraser University 2.) Simon Fraser University 3.) Northern Forestry Centre 4.) Simon Fraser University

Mountain Pine Beetle, a native species of North American forests, searches out and colonizes live trees such as lodgepole pine. Female beetles have a limited period of time to find a suitable tree to breed and lay her eggs in. However, to successfully reproduce the beetle must overcome host defences and kill the host tree. How beetles distribute themselves on particular host trees will be largely affected by the density of other beetles, since individual beetles on their own are incapable of successfully colonizing and killing a host tree. I use a combination of theoretical and experimental approaches to explore how Mountain Pine Beetle searches for and selects host trees in which to reproduce. I develop a dynamic state variable model to first evaluate individual host acceptance decisions. However, individual decisions may be contingent on the decisions of conspecifics, therefore, the decision-making policies of the beetles as a population should be treated as a game. Thus, I use a game theory approach to evaluate the policies of beetles leading to stable decision policies. A combination of field and experimental work will be used to test various components of the model before it is scaled up into a spatially-explicit forest landscape model.

Behavioural time allocation of blackeye gobies - effects of SCUBA diver disturbance and body size.
B. J. Chuchman and L. M. Dill
1.) Simon Fraser University 2.) Simon Fraser University

I studied the effects of SCUBA diving activity on the behavioural time allocation of a marine fish, the blackeye goby, Coryphopterus nicholsi, at the Bamfield Marine Sciences Centre. Fish were predicted to respond to divers as they would to an approaching predator, and increase time allocated to avoidance behaviours. Furthermore, larger fish with higher expected reproductive success were predicted to behave more risk prone. I conducted both field and lab experiments using remote observation. In both field and lab experiments, gobies exposed to diver activity spent less time perching, eating, and chasing, but only during actual diver passes. Size class affected behaviour, though opposite predictions; smaller fish behaved more risk prone, and larger fish behaved more risk adverse. This was especially true in the lab, where the environment was more predictable. I suggest these size-dependent differences in behaviour are the result of large fish becoming risk adverse while caring for eggs. No habituation occurred in the field, but I did find some evidence for habituation in the predictable environment of the lab.

Marine vs freshwater: Perspectives from viral abundance data.
J. L. Clasen, J. J. Elser, R. W. Sterner, E. K. Hall and C. A. Suttle
1.) University of British Columbia 2.) Arizona State University 3.) University of Minnesota 4.) University of Minnesota 5.) University of British Columbia

Viruses are abundant and dynamic members of aquatic ecosystems. In marine systems, viral abundance often strongly correlates with bacterial abundance (r2>0.7) or chlorophyll a concentrations (r2>0.5). However, in freshwater systems the variables influencing viral abundance are largely unknown. To asses the variables influencing viral abundance in lakes, a large data set (~ 200 samples) of viral abundance and ancillary limnological data was assembled from 88 lakes in North America. Viral abundance varied both spatially and temporally within the data set, ranging from 1x106 mL-1 to 9x107 mL-1 (average = 1.4 x107 mL-1). To determine the variables influencing viral abundance, abundance data was regressed against bacterial abundance, chlorophyll a concentrations, unicellular cyanobacterial abundance, total phosphorous, soluble reactive phosphorous, total nitrogen, total dissolved nitrogen, pH, light and temperature. Preliminary analysis indicates that no one variable correlated strongly with viral abundance. However, bacterial abundance (r2=0.195), soluble reactive phosphorous (r2=0.279) and total dissolved nitrogen (r2=0.324) showed weak, but significant, relationship with viral abundance. These initial results suggest that viral abundance in lakes is likely influenced by more variables than marine systems, perhaps suggesting that freshwater ecosystem are more complex.

The evolution of reproductive duration: its ecological causes and reproductive consequences.
W. Davies
1.) Simon Fraser University

The hypothesis that timing of reproduction has evolved to insure a match between peak reproductive demand and peak resource supply is one of the most actively studied, and widely supported hypotheses in life-history theory. However, the related problem of reproductive duration (i.e. how long a single reproductive cycle should be) has in comparison received much less attention, and is often considered to be a non-adaptive trait driven by developmental constraints. Running counter to non-adaptive interpretations are examples from nature of sympatric species showing variation in reproductive duration within their common environments. In such cases it is interesting to ask what ecological factors drive this variation, and also how this variation in duration influences the evolution of reproductive life-history traits. Here, I present field data for five sympatric seabirds showing that reproductive duration is correlated with the number of consecutive prey-resources included in the reproductive schedule. This result is shown in the stable isotope profiles of the seabirds collected throughout three consecutive stages of reproduction (egg-formation, incubation, rearing). In general, species using a single resource have shorter reproductive durations than those using two resources. Moreover, this variation in reproductive duration appears to have an affect on the evolution of life-history traits, in that species with shorter reproductive durations appear to work harder (rate maximizers) than those with longer durations (efficiency maximizers). This work provides data to suggest an adaptive hypothesis for the evolution of reproductive duration, and makes predictions for its consequences on the evolution of life-history traits.

Initial evidence for multi-hierarchical influences of sea otter habitat selection.
J. T. Fisher and D. A. Duffus
1.) University of Victoria 2.) University of Victoria

Scalar ecology is often investigated as phenomena occurring over differing spatial extents. While germane, this approach neglects process-specific causal mechanisms that differ in both form and in spatial effect. Hierarchy theory predicts that, for example, both top-down and bottom-up processes will effect a response on some variable at all scales of consideration, but to differing degrees. To test a component of this prediction, we are conducting an observational experiment to compare relative influences of differently scaled processes on a single variable - sea otter occurrence. To make the research applicable to conservation, our additional goal is to evaluate biotic and abiotic regulators of sea otter occurrence as a basis for 'critical habitat' identification and management. We are surveying and mapping re-introduced sea otter (Enhydra lutris) occurrence on the coastline of Vancouver Island, British Columbia, along a recolonisation gradient ranging from 30-years occupation to 3-years occupation. We are testing five hypotheses related to stepping-stone dispersal; prey abundance; coastal topography; predator abundance; and shared-predator community members; to determine the relative contributions of each process to the prediction of sea otter occurrence. This research is in its initial stages; this talk will illustrate methods and rationale, and highlight very preliminary results that will structure ongoing efforts in coming years.

Selection against hybrids in natural populations of sympatric threespine sticklebacks.
J. Gow, C. Peichel and R. Taylor
1.) University of British Columbia 2.) Fred Hutchinson Cancer Research Center 3.) University of British Columbia

Many types of reproductive isolation may contribute to ecological speciation. Of these, only ecologically-dependent post-zygotic isolation is unique to this model of speciation. Whilst experimental evidence has established the existence of ecological components to reduced hybrid fitness, there is little documentation of the role that this ecologically-dependent isolation plays in speciation and maintaining species integrity in the wild. We address this issue by testing for reduced hybrid fitness between natural populations of sympatric benthic and limnetic threespine sticklebacks (Gasterosteus aculeatus), by tracing the relative abundance of natural hybrids across two life-cycles. Our genetic assessment of hybrid frequencies amongst juvenile, sub-adult and adult fish found a significant decline in the proportion of hybrids across the stickleback life-cycle. This provides compelling evidence for selection against naturally-produced hybrids in the wild. Furthermore, put in the context of experimental evidence supporting a role for ecologically-dependent, rather than intrinsic, post-zygotic isolation, it is highly likely that there is a strong ecological component to this selection in the wild. With long term gene flow estimates an order of magnitude lower than estimates of adult hybrid frequency, which reflect recent gene flow, our data also support a role for sexual selection against hybrids in minimizing admixture.

Methods for marking and tagging marine organisms.
A. Griffiths and L. Gosselin
1.) University of Victoria & Bamfield Marine Sciences Centre 2.) Thompson Rivers University

Marking and tagging marine organisms are useful procedures commonly used in mark-recapture studies and to identify hatchery-reared organisms. Marine organisms such as gastropods, fishes, echinoderms and algae have been used in studies in the past. Plastic cable ties, bee tags, and fluorescent elastomers are just a few methods of tagging used. In this talk I describe these marking and tagging procedure as well, the considerations that need to be made in order to successful apply marks and tags. I also discuss an example of an application of a marking and tagging procedure used in my thesis work with juvenile northern abalone.

Southern Resident killer whale (Orcinus orca) summer distribution patterns: effects of changing temporal scales.
D. Hauser, M. Logsdon, G. VanBlaricom and E. Holmes
1.) University of Washington 2.) University of Washington 3.) University of Washington 4.) US National Marine Fisheries Service

Patterns of environmental variation range over spatial and temporal scales to influence ecological processes and population responses. A consideration of temporal scale is one necessary component of landscape ecology. In the case of the Southern Resident killer whales (Orcinus orca), recent concerns over declining population numbers have led to conservation listings in the United States and Canada. Habitat protection, such as critical habitat designation, is a condition or recommendation of each listing, but little is known about the changing patterns in spatial behavior of this population. Using historical Southern Resident killer whale (SRKW) location information within the semi-enclosed marine waters of British Columbia and Washington State, we modeled summer distribution patterns as measured variation in the density of sightings on a uniform spatial grid. Data consist of validated sightings by commercial whale-watch operators from 1996-2001, and sightings were summarized over the entire six year period, inter-annually, monthly, and weekly. Our objectives were to describe SRKW distribution along this gradient of temporal scales, use landscape metrics to quantify composition and configuration of the distribution pattern at each scale, and identify temporal trends in space use for SRKW. Our results suggest that SRKW exhibit dynamic patterns of space use, which should be considered in any habitat management scheme. Although there appears to be limited inter-annual variation, SRKW space use varied at monthly and weekly temporal scales. Management approaches must be explicit to a given temporal scale and there is a need for continued studies into the ecological processes motivating the observed patterns.

Close-range orientation to and recognition of prey by Dicyphus hesperus Knight (Heteroptera: Miridae).
T. Hazard, D. Gillespie and B. Roitberg
1.) Simon Fraser University 2.) Agriculture and Agri-Food Canada 3.) Simon Fraser University

Dicyphus hesperus Knight is an omnivorous predator used in tomato greenhouses to control soft-bodied arthropod pests such as whiteflies. It is generally accepted that strict predators use visual cues locate prey items. True omnivores, which consume both plant and animal material, thus need to locate both; although it is not clear which sensory modalities are used. For D. hesperus, we tested recognition of surface food chemicals in the absence of visual cues, and recognition of prey-like objects in the absence/presence of olfactory or gustatory cues. To examine surface chemical recognition, individuals were placed on filter paper with either methanol extract of Ephestia kuehniella eggs or methanol as a control. Arrestment to experimental treatment chemicals and prolonged extension of the proboscis to the substrate was observed for all individuals (16 of 16); whereas only 2 of 16 subjected to the methanol control responded positively. No directional movement toward treatment spots was observed. In the absence of olfactory and gustatory cues, D. hesperus adults oriented to and touched glass beads, used to mimic typical prey items. In addition, beads coated with E. kuehniella egg extract appeared to stimulate feeding behaviour. These data suggest that D. hesperus, at least in part, utilizes visual cues at close range to orient to prey and that olfactory or gustatory cues are important for prey recognition.

The role of pleiotropy in the maintenance of sex in yeast.
J. A. Hill and S. P. Otto
1.) University of British Columbia 2.) University of British Columbia

The vast majority of eukaryotic organisms reproduce sexually, yet the origin and maintenance of sexual reproduction is not well understood. Many theories of sex exist, and it is difficult to distinguish among many of the predictions made by these models. In order to evaluate the plausibility of different hypotheses, it is important to have an understanding of how often sex may be lost, as this provides an estimate for the time frame over which the advantages of sex must act to maintain sexuality. Here, we determined the proportion of mutations that adversely affect sexual function in the facultatively sexual budding yeast Saccharomyces cerevisiae. One hundred small asexual populations were propagated for 800 generations using regular bottlenecks to reduce the genetic variance and efficacy of selection within each line (Small Mutation-Accumulation lines; SMA). Sexual function was lost slowly, at a rate of 6.2 x 10-5/generation. When yeast are propagated asexually, mutations that are deleterious only to sexual function are effectively neutral. Thus, we can estimate the rate of mutations deleterious to sexual function (only) by measuring the decline over time in sporulation ability in large, asexually propagated lines (Large Mutation-Accumulation lines; LMA). Mutations that are deleterious to sexual function may also reduce asexual function (a phenomenon known as pleiotropy), and these will be selected against in the LMA lines. To estimate the total rate of mutations that are deleterious to sexual function. By comparing the inferred rates of mutations reducing sexual function between the two types of lines, the extent to which sexual function is maintained by pleiotropic selection on asexual function can be assessed and the rate at which we would expect sex to be lost altogether will be estimated.

Integrating population, quantitative and molecular genetics: adaptive variation in cold tolerance in Sitka spruce.
J. Holliday, S. Ralph, J. Bohlmann and S. Aitken
1.) University of British Columbia 2.) University of British Columbia 3.) University of British Columbia 4.) University of British Columbia

Adaptation to winter cold by conifers involves extensive physiological remodeling, the timing and extent of which varies greatly along latitudinal gradients for a variety of tree species. Studies of cold tolerance in Arabidopsis thaliana suggest that the cognate process in conifers will correspond to large-scale changes in gene expression. However, fundamental differences exist between transient increases in cold tolerance in response to sudden stress in annuals such as Arabidopsis, and seasonal cold acclimation in conifers. In addition, the extent to which among-population phenotypic variation in cold hardiness in forest trees corresponds to differences in gene expression is unknown. We have thus undertaken a transcript profiling study through the fall hardening period in Sitka spruce, using a 22K Picea cDNA microarray. Four-year-old seedlings originating from a population at the core of the species range (Prince Rupert, BC) were sampled from a common garden experiment in Vancouver, for RNA extraction at five timepoints between August and December, 2004. To assess cold hardiness, each individual, on each sampling date, was artificially freeze-tested. High levels of among-population differentiation for Sitka spruce cold hardiness-related traits have been demonstrated previously. Therefore, in addition to expression profiling across all five timepoints in the core population, we have

conducted among-population hybridizations between individuals originating from the northern and southern limits of the species range (southern Alaska and northern California, respectively). Results from this study reveal the complexity of the transcriptional reorganization that occurs during cold acclimation in conifers. In addition, intriguing differences were observed among northern, central and southern populations in terms of the timing, extent and constitution of their respective autumn gene expression programs. The ultimate goal of this project is to identify nucleotide variation that correlates with observed phenotypic variation. As such, cold hardiness candidate genes identified as upregulated by the microarray will be surveyed for nucleotide variation in the form of single nucleotide polymorphisms (SNPs), and correlations will be sought between SNP variants and the cold hardiness phenotype in an association study.

Evolution in the North Pacific: a molecular analysis of Pan-Pacific smelt genus Hypomesus (Pisces: Osmeridae).
K. Ilves and E. Taylor
1.) University of British Columbia 2.) University of British Columbia

Whether a speciose geographic area is a centre of origin or a centre of accumulation requires an understanding of evolutionary relationships across multiple taxonomic groups. As a further step in understanding the roles of the eastern and western parts of the North Pacific Ocean as evolutionary centres here we present a detailed molecular investigation of the phylogenetic relationships among the six species of the Pan-Pacific smelt genus Hypomesus (Pisces: Osmeridae), based on sequence data from two mitochondrial (cytb and 16S) and three nuclear (ITS2, S71, and RAG1) markers. Analyses of individual loci and combined datasets showed marked concordance for several key relationships. First, combining all data strongly suggested a western Pacific origin for the genus. Furthermore, the two eastern Pacific species H. pretiosus and H. transpacificus clustered together, in contrast to original classifications based on scale-counts, suggesting parallel evolution of this phenotype on each side of the Pacific Ocean. Finally, we found a lack of genetic differentiation between the recently described lacustrine H. chishimaensis of the Kuril Islands, Japan and its anadromous congener H. nipponensis of Hokkaido, Japan, leading us to conclude the newly named lake populations are ecotypes of an existing species and should not be recognized at the species level. Additional sampling of the wide-ranging H. olidus and more focus on the western Pacific taxa in other groups with similar Pan-Pacific distributions will undoubtedly add to our understanding of important evolutionary centres in the North Pacific Ocean.

Elevational effects on ectomycorrhizal communities: results from a soil bioassay.
J. Karst, M. D. Jones and R. Turkington
1.) University of British Columbia 2.) University of British Columbia 3.) University of British Columbia

Species turnover within ectomycorrhizal (EM) fungal communities may facilitate host species establishment along environmental gradients. In particular, variation in soil moisture along elevational gradients may drive changes in the composition of EM communities. We tested the influence of elevation and watering regime on the abundance and species composition of EM fungal inoculum. Ectomycorrhizal inoculum was sampled at low (350-750m asl) and high (1300-1400m asl) elevations, two ends of a gradient along which soil moisture was hypothesized to play a particularly important role in structuring both plant and mycorrhizal fungal communities. We planted non-mycorrhizal Douglas-fir (Pseudotsuga menziesii var. glauca) seedlings into these soils and watered them at various rates to obtain gravimetric soil moisture conditions ranging from <10 to 30%. Seedlings grown in soil collected from low elevations had a lower richness of EM morphotypes and had colonization levels that were less than half of those grown in soil collected from high elevations. These responses coincided with changes in soil characteristics. We observed an inverse relationship between EM colonization and soil moisture, suggesting that variation in soil moisture does not influence changes in colonization with elevation. Contrary to our prediction, elevation and watering regime had no effect on EM community composition. Our findings suggest that pioneer EM fungi, such as would be expected on seedlings establishing after disturbance, occupy a broad range of soil moisture conditions.

Fishery selection on length and age at maturity of sockeye salmon in Bristol Bay, Alaska.
N. J. E. Kendall and T. P. Quinn
1.) University of Washington 2.) University of Washington

How does fishing affect life history traits of the fish populations exposed to the fishery? Fishing gear, specifically gillnets, selectively remove certain individuals within a population and can affect size and age at maturity. A sockeye salmon gillnet fishery has been located at the Wood River system of Bristol Bay, Alaska, for over 100 years. This fishery is selective for sockeye size and age based on mesh size and fishery timing. In addition, fishing pressure and effort have varied greatly year-to-year due to run size fluctuations

and evolving fishing technology. We investigate whether and how the gillnet selectivity has affected sockeye life history patterns using over 50 years of fishery catch, escapement, and spawning ground data. Variability in fishery strength results in differing yearly selection pressure on the system population as a whole. Patterns are also examined in individual spawning populations within the system. Certain fish passing through the fishery are more heavily selected by the gillnets. Because of morphology differences in the various spawning populations, fishing pressure is not uniform on individual runs that are destined for the different spawning localities. Certain populations are more or less affected by the fishery, having more or fewer of its members removed. In the future we will model the effects of fishing on different life history traits shown by the different spawning populations.

Community level consequences of non-prey species.
P. Kratina, M. Vos and B. R. Anholt
1.) University of Victoria 2.) University of Victoria 3.) University of Victoria

Heterogeneity in the edibility of prey may result from the expression of inducible defenses by some prey species or from the presence of non-prey species that are permanently inedible for predators. Analyses of mechanistic population models that include either of these factors show an increased area of stability in parameter space. The stability is enhanced because the predator spends time dealing with defended or non-prey individuals and consequently has less time to search for its preferred prey. This can lead to a damping of predator-prey population cycles. We experimentally tested one component of this theory by comparing the functional response of a model predator in the presence and absence of non-prey species. The predatory flatworm Stenostomum virginianum captured fewer prey, Paramecium aurelia, when non-prey species were present in the system. The effect was consistent across all prey densities. In the second experiment we have measured predator-prey dynamics with and without non-prey species over a long period of time. Our preliminary results suggest that addition of three non-prey species did not stabilize species interactions and that we need to include competitive effects in our models.

Transmission dynamics of parasitic sea lice from farm to wild salmon.
M. Krkosek, M. Lewis and J. Volpe
1.) University of Alberta 2.) University of Alberta 3.) University of Victoria

Emerging infectious diseases can result from novel pathogen interactions between domesticated animals and wildlife. Marine salmon farming has changed the spatial structure of natural marine salmon host-parasite systems, resulting in the emergence of chronic parasitic sea lice infestations of sympatric wild juvenile salmon populations. We studied the stage structured dynamics of sea lice parasitizing wild juvenile salmon as they migrated past salmon farms. The methods couple intensive field sampling with novel quantitative tools to estimate the magnitude and spatial extent of sea lice transmission from farm to wild salmon. Sea lice transmission from farm salmon can be extensive, exceeding ambient levels for over 30 km of migration routes and initiating population growth and spread of the parasites in the wild juvenile salmon populations. Recent controversy has arisen with the publication of competing models that make different predictions on the spatial details of transmission. These conflicts can be resolved in the light of existing and novel data that demonstrate high levels of transmission near salmon farms.

Interactions between sharks and seals around a small island colony: a predator-prey behavioural game?
R. Laroche, A. Kock, L. Dill and W. Oosthuizen
1.) Simon Fraser University 2.) University of Cape Town 3.) Simon Fraser University 4.) South African Marine and Coastal Management

Behavior of both species in predator-prey systems often leads to the evolution of predator-prey behavioral games, the result of which should be an equilibrium defined by equal payoffs for every behavioral tactic adopted by each species. Here we present evidence suggesting a potential predator-prey game between white sharks Carcharodon carcharias and Cape fur seals Arctocephalus pusillus pusillus around a small island colony in South Africa. Behavioral tactics recorded for the sharks corresponded well with the generally accepted hypothesis for how sharks hunt pinnipeds, while seal tactics appeared to account for the hypothesized variance in risk associated with the difference in group sizes between seals moving to or from the island. However, when seal and shark behavior were analyzed in relation to estimated shark risk and seal availability, respectively, it appeared that adult seals were taking risk into account, whereas sharks were not considering seal availability. This paradox was resolved when the behavior of all seal age classes was included in the analysis, indicating that seal pups acted in a manner which left them at substantial risk. Consequently, recorded shark tactics were found to correspond more closely to the behavior of pups than

to that of the adults, implying that a game has not evolved because adult seal behavior has no major impact on shark evolutionary fitness. The results of this study clearly demonstrate that separate subunits within a population may behave differently, and that this diversity needs to be accounted for when modeling the behavior of a species.

Producer, consumer and microbial diversity: feedbacks and independence.
A. Longmuir and J. Shurin
1.) University of British Columbia 2.) University of British Columbia

Positive correlations in diversity among producers and consumers can occur by facilitation between trophic levels through food web assembly. In addition, producer and decomposer diversity may be linked through the biochemical composition of autotroph tissues and the variable abilities of microbes to recycle them. There is the potential for microbes to enhance nutrient cycling or compete (mixotrophs) with autotrophs for resources. However, the relative contributions of trophic interactions versus local environmental factors in promoting species coexistence are poorly understood with many studies of food web assembly only considering two trophic levels. Here we examine correlations in diversity among zooplankton, phytoplankton and bacteria in the pelagic zone of 31 lakes in British Columbia. We sampled species diversity of zooplankton and phytoplankton through morphological identification while bacterial diversity was estimated through 16s rDNA derived DGGE bands. Correlations in diversity that are independent of physical factors may suggest a role for food web assembly in promoting diversity, while correlations with similar abiotic variables indicate shared responses to the environment. The strength of these relationships has implications for the role of abiotic processes versus food web interactions as factors regulating diversity across trophic levels.

Evolution of novel brooding modes in spirorbin polychaetes.
T. A. Macdonald
1.) University of Alberta & Bamfield Marine Sciences Centre

The Spirorbinae, tiny marine tubeworms, have a fascinating diversity of brooding modes. These form the basis for their taxonomic division into six tribes: Four tribes with in-tube incubation (possessing different brood attachments); and two tribes with a novel brood chamber: The operculum, a modified tentacle. I investigate the evolutionary transitions among brooding modes, and possible explanations for observed phylogenetic patterns. Phylogenetic reconstruction using molecular (28s and 18s rDNA) and morphological data supports a monophyletic Spirorbinae, and monophyly, or paraphyletic grouping, of all six tribes, and reveals surprising relationships. Opercular brooding appears to be ancestral, and tube-incubating tribes are likely derived independently from opercular-brooding ancestors. These findings challenge previously held assumptions about the evolution of Spirorbinae, and the advantages of opercular brooding. We must therefore rethink the evolutionary context in which we place comparative studies of reproductive traits associated with miniaturized body forms in the Spirorbinae.

The role of edge type and predator identity in mediating edge effects on nest predation risk in the marbled murrelet.
J. M. Malt and D. B. Lank
1.) Simon Fraser University 2.) Simon Fraser University

Promoting sustainable Marbled Murrelet (Brachyramphus marmoratus) populations in harvested landscapes requires a comprehensive understanding of how habitat fragmentation affects their breeding success. The proliferation of industrial edges that accompany habitat fragmentation warrant special attention, as breeding success may be reduced in edge habitats due to higher usage by nest predators. Understanding the influence of edge type on the strength and direction of edge effects is important for effective murrelet management, as their apparent preference for nesting near natural edges may no longer be adaptive at industrial edges in fragmented landscapes. We tested this hypothesis by comparing predation rates of artificial nests (eggs and nestlings) between forest edge and interior sites at recent clear-cut, regenerating stand, and natural edges. Nest cameras documented that all suspected murrelet predator guilds visited our nests, including corvids, raptors, and mammals. Avian predations were biased towards eggs, and resulted in a negative edge effect at clear-cut edges, but a positive edge effect at regenerating stand and natural edges. In contrast, mammalian predations were biased towards nestlings, and resulted in consistent negative edge effects regardless of edge type. These results suggest that it is important for managers to consider both edge habitat structure and predator community composition when assessing relative nest predation risk of contrasting habitats for the Marbled Murrelet.

Parallel evolution by correlated response? Lateral plate reduction in threespine stickleback.
K. Marchinko and D. Schluter
1.) University of British Columbia 2.) University of British Columbia

Recent work has revealed the molecular mechanisms governing one of the most dramatic examples of parallel evolution in nature: the repeated loss of lateral plate armor in freshwater populations of threespine stickleback. Yet, the ecological mechanisms armor loss remain unclear. Using a reciprocal transplant, we examined Huets' (1947) hypothesis that selection due to changes in salinity drive the reduction of lateral plate armour in freshwater and maintenance of lateral plate armor in the sea. We measured two fitness related traits, hatching success and juvenile growth rate, in reduced (low and partial) and complete lateral plate morphs from two populations when raised in either freshwater or seawater. In contrast to Heuts, there was little difference among morphs in hatching success. However, salinity strongly influenced juvenile growth: reduced lateral plate morphs grew substantially faster than completely plated morphs in freshwater, but there was little difference in seawater. Clearly, changes in salinity alone do not explain the predominance of completely plated morphs in marine populations and we suggest that the parallel loss of lateral plates in freshwater may have arisen through a correlated response to selection for faster growth.

Begging signals and parental responsiveness in fledgling American dippers.
H. Middleton, D. Green and E. Krebs
1.) Simon Fraser University 2.) Simon Fraser University 3.) Enivronment Canada, Canadian Wildlife Service

Begging signals and patterns of food allocation during the post-fledging period in passerine birds are poorly understood. The costly nature of begging signals reinforces signal honesty. Signals typically reflect chick hunger, condition and are distorted by sibling competition. Parents use begging signals when allocating care. Studies during the nestling period find that parents typically preferentially allocate food to the nestling giving the most conspicuous signal. We explore the information content of begging signals and the response of parents to begging in fledging American Dippers (Cinclus mexicanus). Dippers are obligate aquatic passerines with a short post-fledging period that occupy a two-dimensional river territory permitting ease of fledgling observations. We explore whether begging signals communicate hunger, condition or sibling competition. We found that fledgling begging signals do not reflect hunger but may reflect condition and sibling competition. We assess whether parental provisioning rules during the nestling period persist into the post-fledging period. When provisioning pairs of fledglings, parents followed the general nestling patterns of feeding the loudest and closest begging fledgling. When we tested whether parents were responsive to beg intensity in the fledglings we found that the return time of parents was not explained by begging intensity.

Rapid population divergence of sockeye salmon in a volcanic lake.
S. A. Pavey, T. R. Hamon and F. Breden
1.) Simon Fraser University 2.) National Park Service 3.) Simon Fraser University

Ecological speciation is the evolution of reproductive isolation resulting from divergent natural selective regimes, and is a key component of adaptive radiation thought to be responsible for much of the biotic diversity of life. This study on sockeye salmon combines genetic, paleolimnetic, geologic, and ecological evidence to describe a case of local adaptation and reproductive isolation in a recently colonized volcanic lake. The parapatric anadromous populations spawn in ecologically different habitats in a lake that resides in a volcanic caldera. Preliminary data suggest the caldera was colonized by a single source and evolved significant reproductive isolation ($F_{st} = 0.011$ $p<0.001$) in less than 100 generations and these populations may be in the incipient stages of ecological speciation.

Nest-site selection patterns by yellow warblers in an altered riparian landscape.
S. Quinlan and D. Green
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We studied Yellow warbler nest-site selection patterns in riparian forest patches on a human-altered floodplain, British Columbia. Vegetation structure was quantified at four scales for nest patches and random locations, and compared between successful and unsuccessful nests. Discriminant analyses identified nine variables at all four scales measured that differed between nest and random points. Of these, four habitat characteristics at three scales were associated with nest success. Nests built in more dense willow stands and with less canopy cover had higher success rates. Territories in more fragmented riparian vegetation with more discrete patches tended to have less successful nests. These results suggest that individuals use habitat cues at multiple scales to select nest sites. Selected habitat characteristics that also predicted success may represent adaptive habitat choices in this population.

The presence of neighbours causes western black widow spiders to modify their web building tactics.
M. Salomon
1.) Simon Fraser University

Web-weaving spiders are territorial animals that are fully reliant on their webs for foraging, protection and reproduction, which is why behavioural decisions relating to web building have a direct bearing on individual fitness. For spiders, two factors are predicted to be of primary importance in determining web-building behaviour: an individual's current energetic state, or feeding status, which influences the construction costs, and the distribution of other co-occurring individuals, with whom it may have to interact. In this study, I examined whether Latrodectus hesperus, a tangle-web weaver, exhibited plasticity in its web-building behaviour in response to the presence of conspecifics and heterospecifics in the same microhabitat, and whether this behaviour was expressed in a state-dependent manner. The results of this laboratory experiment indicate that L. hesperus increases its web building investment in the presence of other microhabitat occupants, and that there is a positive relationship between foraging investment and feeding status. I suggest that these alternative behavioural tactics represent an optimal foraging strategy employed to deal with some of the constraints associated with web building and cohabitation.

Why do exotic species cause problems in some systems but not others? Evaluating the impacts of species introductions and stocking measures on kokanee (Oncorhynchus nerka) populations in a large, oligotrophic lake.
E. Schoen, D. Beauchamp, N. Overman and C. Sergeant
1.) University of Washington 2.) University of Washington 3.) University of Washington 4.) University of Washington

Introduced species alter communities directly through interactions such as competition and predation, and indirectly through feedback from the food web. In aquatic systems, the trophic impacts of introduced species can vary widely among host communities, making outcomes difficult to predict. A top predator, lake trout (Salvelinus namaycush), and a voracious planktivore, opossum shrimp (Mysis relicta), have been introduced to many montane lakes in western North America, often resulting in the reduction or extirpation of fish populations. However, in certain lakes, these species appear to produce few or no deleterious effects. We studied trophic interactions in Lake Chelan, Washington, where kokanee (Oncorhynchus nerka) populations have increased despite the establishment of lake trout and opossum shrimp. A bioenergetic assessment suggests that stocking of hatchery kokanee alone cannot explain the success of naturally spawning kokanee in the lake. Spatial patterns of opossum shrimp abundance and lake trout diets were examined to determine whether lake trout might cause localized depletion of opossum shrimp densities to the benefit of other planktivores, such as kokanee. A better understanding of the variable ecological roles of lake trout and opossum shrimp can aid the conservation of native salmonids in systems where introductions have already taken place, and can help to identify particularly vulnerable systems to protect from future introductions.

Global warming and cloud forest orchids
R. L. Sewell Nesteruk and K. Masters
1.) University of Washington 2.) University of Washington

Cloud forests are exceptional for their high levels of endemism. However, the local manifestations of global climate change present challenges to species survival that are also exceptional. High levels of endemic species, isolation from potential colonists and the exceedingly specialized obligate microclimates of many montane moist forest plants portend a potentially devastating loss of biodiversity if warming trends change precipitation profiles. To determine whether precipitation changes may be affecting epiphytic orchids in cloud forests, we followed survival and reproduction of orchids grown under two moisture regimes in Monteverde, Costa Rica.

Gray Whales and Marine Protected Areas: A multi-trophic level approach to assessing functional ecological association.
C. Short and D. Duffus
1.) University of Victoria / Province of British Columbia 2.) University of Vicitoria

The time and space domain of large baleen whales make them an unlikely candidate for conservation via protected areas. If, however, network function and connectivity can be brought into play, the likelihood of successful protection for large whales rises. Our objective for this research is to examine the ecological linkages between six marine protected areas that encompass summer foraging sites of gray whales (Eschrichtius robustus) on the west coast of Vancouver Island, Canada. To make those linkages we investigated three levels of the whale's food chain. The spatial / temporal distribution of chlorophyll a, mysid (Holmesimysis sculpta) dispersal capacity and gray whale foraging movements were used to elucidate ecological connectivity between protected areas. Boundary delineation for these MPAs was examined in reference to bathymetry and gray whale foraging locations. The results of the research indicate ubiquity at the foundation of the food chain. There is a strong molecular indication of discontinuity in the middle of the food chain, given the life history strategies of the whale's principle prey item. At the top of the food chain the whales move with alacrity between sites in a fairly typical patch foraging manner. Slight alterations to existing park boundaries will increase the proportion of foraging gray whales inside park boundaries. Our most useful conclusion is that care should be taken using only one layer in a food chain for designation of protected areas because it will miss significant aspects of whales' ecology and is insufficient for planning management strategies for MPA's and cetaceans.

Food web components of species-area curves: tests with phytotelm insect communities.
D. Srivastava, M. Trzcinski, B. Gilbert and B. Richardson
1.) University of British Columbia 2.) University of Calgary & Parks Canada 3.) University of British Columbia 4.) Luquillo LTER

Species-area curves ignore the trophic complexities of real food webs. Theory suggests that organisms on different trophic levels or in different functional groups should respond differently to area. We test these hypotheses using data from 290 bromeliads in three countries, and also with larger-scale data from phytotelmata around the world. Our results are broadly consistent with theory, but only at the smaller spatial scale. This may reflect differential effects of area on species turnover.

Phylogenetic relationship among deep-sea wood-boring clams from the NE Pacific (Xylophagainae, Bivalvia, Mollusca).
M. Stoeckle and V. Tunnicliffe
1.) University of Victoria 2.) University of Victoria

Six new morphological taxa of deep-sea wood-boring clams have been discovered in the NE-Pacific, increasing the total number of taxa from one (Xylophaga washingtona [Bartsch]) to seven (species descriptions in preparation, J. Voight). This diversity is surprising, given the common notion of a homogenous and stable environment, non-conducive for speciation due to lack of separation mechanisms. I used the 18S rRNA gene sequence to elucidate the genetic relatedness among the newly discovered taxa and test a) whether the newly discovered taxa are more closely related to each other than to taxa from outside the NE-Pacific and b) whether the morphological taxon classification can be corroborated by genetic data from the 18S gene. In phylogenetic trees, members of a clade are more closely related to each other than to members of another clade. The phylogenetic tree (neighbour-joining, Saitou 1987) based on the alignment of 45 individual sequences from 14 taxa shows the presence of non-NE-Pacific taxa among the newly discovered NE-Pacific taxa. Consequently, the newly discovered taxa are not more closely related to each other than to taxa from elsewhere. The 18S genetic data also revealed 100% sequence identity among the morphological taxa F, G and M. The morphological taxon classifications cannot be confirmed by the 18S rRNA gene without data from additional molecules.

Population genetic structure in the recently-glaciated range of the bat star (Patiria miniata) and implications on the history and dispersal of this species.
J. Sunday, C. Keever and M. Hart
1.) Simon Fraser University 2.) Simon Fraser University 3.) Simon Fraser University

On the Pacific coast of north America, bat stars (Patiria miniata) have a disjunct distribution; present in California, British Columbia and Alaska but absent from Oregon and Washington. With a history of glacial cover in the northern extent of this range, northern P. miniata are thought to represent either survival in northern glacial refugia or more recent colonization from a large southern refugium. Preliminary mitochondrial DNA and nuclear microsatellite evidence reveals some surprising genetic structuring within the northern range of this species, and suggests that both survival in a northern refugium and south-to-north colonization have influenced population structure in this species. Implications on historical and existing dispersal patterns of this species are discussed.

Contrasting the lifecycles of two invasive spider species.
S. Vibert and M. Salomon
1.) Simon Fraser University 2.) Simon Fraser University

The hobo spider (Tegenaria agrestis) and giant house spider (Tegenaria duellica) were incidentally introduced into Western North America in the early 1900s. Since then, their distribution has expanded eastward and southward. Understanding their phenology is important in monitoring their spread. We followed sympatric populations of both species for two consecutive years to determine their lifecycle. Our analyses have focused on seasonal differences between the two species with respect to age class distribution and mating and egg-laying periods. Our study site is a natural habitat located near the points of introduction for both species, whereas previous studies have focused on synanthropic populations located throughout their geographic range. We compared the published data from these studies to ours and found that a synanthropic life style might lead to a shift in the phenology of the spiders. Furthermore, we found that T. duellica dominates from spring to summer whereas T. agrestis is predominant in the fall and early winter, suggesting a temporal partitioning of the habitat, possibly linked to differential winter survival between the species.

GPS bias correction and mountain goat habitat analysis.
A. G. Wells and D. O. Wallin
1.) Western Washington University 2.) Western Washington University

Traditionally, difficulties monitoring mountain goats (Oreamnos americanus) year round biased understanding of their habitat requirements towards summer ranges. GPS wildlife telemetry collars offered an opportunity to overcome this obstacle. Satellite acquisition problems associated with this technology however, created a new observational bias towards areas of favorable signal reception. To account for this bias, we used logistic regression with Akaike's Information Criteria (AIC) to develop a model that

predicted GPS position acquisition rates across the range of collared goats in the Washington Cascades. We sampled GPS success at 543 sites using Vectronic-Aerospace GPS collars. At each site, we left a collar for 24 hours and logging a position every 30 minutes. Sample sites selected approximated the full range of vegetation and topography expected in the study area based on predictor variables derived from the Interagency Vegetation Mapping Project (IVMP) and a 10 m digital elevation model (DEM). We used this model to weight an analysis of two years worth of data from 39 GPS collared mountain goats in the western Washington Cascades, again using logistic regression with AIC, to develop habitat maps based on elevation. Our data set included over 86,826 animal locations and we employed a use-availability habitat selection design. With GPS and GIS we generated a bias correction model and habitat maps to assist with future management activities and ecological studies of Washington's endemic mountain goat populations.

Rapid habitat change and apparent life history evolution of sticklebacks in the Chignik Lake system, Alaska.
P. A. H. Westley
1.) University of Washington

How organisms respond to rapid habitat perturbations is a fascinating area of ecological and evolutionary inquiry. Although as scientists we are often trained to explicitly consider change when examining systems, we have likewise been trained to think of evolutionary processes necessarily occurring over long time scales (e.g. speciation). However, organisms can evolve rapidly to changes in habitat across many temporal scales. Case in point: rapid habitat evolution in Black Lake, Alaska, has apparently resulted in correspondingly fast response by the fish communities of the system, particularly 3-spine stickleback. Using a unique long term data base collected by the UW Alaska Salmon Program I test the hypothesis that migratory patterns in sticklebacks have changed in approximately 50 years. Specifically, I test the hypothesis that between lake spawning migrations and subsequent juvenile migrations are a phenomenon new in the past few decades. Preliminary results indicate that life history, specifically migratory patterns in the system, has changed dramatically in the past few decades. These changes in stickleback life history are a poignant reminder that systems and organisms are not static and what we observe and measure today may be radically different than conditions and life histories we would have witnessed a short time ago.

Peanut butter can bias habitat modeling: A spatial analysis using northern flying squirrels.
M. Wheatley and K. Larsen
1.) University of Victoria 2.) Thompson Rivers University

Small mammal habitat use is inferred either from live-capture data or from radio telemetry, with notable differences among the methods that can affect the inferential abilities of resulting models. Unlike telemetry, live-trapping employs the use of bait, typically peanut butter. This presents potential for proximate changes in animal density seen in many food addition studies (the pantry effect), and conceivably biases habitat use as inferred via trapping, particularly at small spatial extents. To assess this, I acquired both trapping and radio-telemetry data of northern flying squirrels in Alberta, Canada to determine whether differing habitat model inputs could be generated contingent on sampling methods. I found baited trap areas did not represent used habitat at small spatial extents; trapping areas were used rarely if at all post-capture, and animals on average (n = 34) were spatially biased from 100 - 200+ m (upwards of 700m) away from used habitat to access baited traps. Flying squirrels used black spruce habitat relatively extensively (33% of sampled squirrels), but this was not identified via stratified trap effort. Thus, conditional on sampling method, two different habitat use patterns were identified from the same group of squirrels, and consequently two different sets of habitat model input were acquired. This suggests using data from baited live-traps for any habitat-selection analysis could produce misleading inferences regarding fine-scale habitat use. The severity of this inaccuracy will necessarily vary with the relative habitat heterogeneity of the sampling area, and with the inter-patch movement abilities of the study animal.

Assessing the relative influence of local ecological interactions and regional species pools on local species richness.
S. A. Wood and R. Russell
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A primary question in ecology considers the relative importance of local and regional determinants of community structure. Local scale interactions between species such as competition and predation are undoubtedly key at some local scales; likewise, more regional historico-evolutionary processes such as speciation also have a hand in the sculpting of communities. Plots of local species richness versus regional species pools have been used to address this question, yet after an active quarter century of research on the relative influence of local interactions versus regional species pools, consensus remains elusive. We propose a conceptual framework that incorporates spatial scale and ecological interaction strength to reconcile current disparities. We then test this framework using a survey of marine rocky intertidal algal and invertebrate communities from the Northeast Pacific. These data show that the power of regional species pools to predict local richness disintegrates a) at small spatial scales coincident with the scale of biological interactions, b) when studying ecologically interactive groups of species, and c) in generally more abiotically stressful habitats.

Regional heterogeneity and gene flow maintain variance in a quantitative trait within populations of lodgepole pine.
S. Yeaman and A. Jarvis
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Genetic variation is of fundamental importance to biological evolution, yet we still know very little about how it is maintained in nature. Because many species inhabit heterogeneous environments and have pronounced local adaptations, gene flow between differently adapted populations may be a persistent source of genetic variation within populations. If this migration-selection balance is biologically important, then there should be strong correlations between genetic variance within populations and the amount of heterogeneity in the environment surrounding them. Here, we use data from a long-term study of 142 populations of lodgepole pine (Pinus contorta) to compare levels of genetic variation in growth response to measures of climatic heterogeneity in the surrounding region. We find that regional heterogeneity explains at least 20% of the variation in genetic variance, suggesting that gene flow and heterogeneous selection may play an important role in maintaining the high levels of genetic variation found within natural populations.

Poster Presentations

Sea louse mediated salinity preferences in juvenile Pacific salmon.
B. M. Connors and L. M. Dill
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Parasites are ubiquitous in nature and can influence the ecology of their hosts in numerous ways. One parasite of considerable economic importance and growing ecological significance is the parasitic caligid copepod Lepeophtherius salmonis, the sea louse. Recent research suggests that salmon farms can be a significant source of sea lice infection in wild salmonids, and sea lice transmission from farmed to wild juvenile salmon has been implicated in the collapse of pink salmon (Oncorhynchus gorbuscha) cohorts in the Broughton Archipelago of British Columbia. Heavily infected salmonids in Europe have been documented exhibiting a preference for freshwater and similar observations have been made in wild juvenile Pacific salmon in British Columbia. Despite the fact that perturbations to salinity preferences may have a number of ecological implications for the migration patterns, foraging success and habitat preference of Pacific salmon, to date there has been no investigation in to sea louse altered salinity preferences in Pacific salmonids. My proposed research will combine behavioural and physiological assays to: (1) examine the role L. salmonis infection plays in mediating salinity preferences in juvenile pink and chum (O. keta) salmon, (2) provide insight into the mechanism behind sea louse mediated salinity preferences, and (3) investigate the potential for these preferences to influence Pacific salmon ecology. This work will serve as a model for understanding parasite mediated behaviour in marine teleosts has applied importance in addressing the myriad of questions surrounding the impacts of salmon aquaculture on out-migrating wild juvenile salmon populations.

An assessment of radial growth in Pinus contorta Dougl. relative to changing climate patterns in British Columbia: Genetic response to annual climate variations, 1973-2005.
S. Curtis-McLane and S. Aitken
1.) University of British Columbia 2.) University of British Columbia

The unprecedented rate of climate change that occurred during the twentieth century is projected to continue throughout and beyond the fossil fuel era, provoking concerns regarding how plant species are and will continue to respond to new climatic conditions. This study will evaluate ring width indices for Pinus contorta spp. latifolia (lodgepole pine) throughout its range in British Columbia in order to examine correlations between growth and climate trends over the last three decades. Genetic responses of lodgepole pine to changing climate variables will be analyzed based on radial increment data for 6 populations replicated in 15 environmentally disparate common gardens throughout the province. Observed annual and total radial growth values will be compared to expected values for local populations at each site, and correlations will be drawn between annual growth and a variety of growth-related climate variables. It is expected that radial growth increments in all populations will be larger than growth predictions based on climate normals from 1940 to 1970, due to increases in springtime temperature and precipitation. However, populations planted in climate envelopes that have historically been colder than their native climate envelopes are expected to have greater growth increases than those planted to the south, due to warmer temperatures helping to make growing conditions more similar to those of the population's native range. These analyses will be used to make predictions regarding a potential shift in the range distribution of lodgepole pine under future climate change scenarios.

Proxy development for a method of reconstructing mountain pine beetle (Dendroctonus ponderosae Hopk.) outbreak in central British Columbia.
S. Goring
1.) Simon Fraser University

Organic matter including insect parts, diatom frustules and pollen is often trapped in anoxic lake sediments, providing insight into conditions prevailing at the time of deposition and preservation. Modern proxies are used to interpret historic or prehistoric environmental conditions from fossil assemblages by comparing them to modern assemblages of known origin. Currently no prehistoric record exists for mountain pine beetle (Dendroctonus ponderosae Hopk.) outbreak in central British Columbia; however palynology provides the most likely candidate for a reliable indicator of the prehistoric recurrence of outbreak. Proxies will be developed using pollen deposition models and changes in the ecological characteristics of lodgepole pine (Pinus contorta var latifolia) forests following outbreak. These proxies will then be differentiated conceptually from other ecosystem types and stand replacement events. Finally, a method for checking the validity of the proxies is presented referring both to field work and subsequent statistical analysis.

Adaptive plasticity in parasitoid behaviour.
L. Henry, B. Roitberg and D. Gillespie
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Aphidius ervi Haliday (Hymenoptera: Aphidiidae) is a generalist parasitoid that utilizes over 15 known host species. Studies have shown that A. ervi expresses plasticity in several life history traits including developmental time and adult size. In the present study we investigated co-variance of plastic morphology (size at pupation) and behaviour using parasitoids reared on two aphid species of dissimilar sizes resulting in morphologically disparate parasitoid adults. Our objectives were to determine if natal host influences the success rate and host size preference of females when choosing between instars of each host species, given that the optimal host instar for larval development between the two aphid species is approximately two-fold difference in size. We also demonstrate a possible mechanism behind host size selection behaviour in generalist parasitoids by relating adult parasitoid size to a host instar selection regime. Furthermore, we discuss how host selection behavioural is tightly linked to reproductive fitness within parasitoid systems and how covariance of plastic morphological and behavioural traits could have evolved as an adaptive process in patchy heterogeneous host environments.

Modeling larval survival of a checkerspot butterfly, Euphydryas anicia, and the effect of soil moisture on its host plants, Castilleja miniata and C. rhexifolia, in the North Cascades National Park.
S. Imholt and J. McLaughlin
1.) Western Washington University 2.) Western Washington University

Climate change can impact butterfly populations by disrupting the timing of host plant phenology and shortening the growing season. I studied the effects of soil moisture and stream proximity on the phenology of common red and alpine paintbrush, Castilleja miniata and C. rhexifolia, host plants of the Anicia checkerspot, Euphydryas anicia, at two subalpine sites in the North Cascades National Park. I considered 14 models that include the following variable combinations to predict growing season length: 1) growing season length is random; 2) calendar date; 3) proximity to stream; 4) soil moisture; 5) proximity to stream and soil moisture; 6) date and soil moisture; and 7) date, soil moisture, and proximity to stream. I determined the performance of each model using Akaike's Information Criterion. Preliminary data analysis suggests that a linear relationship with date is the best predictor of phenology. Further analysis is required to determine the best model set to predict growing season length in dry and moist areas near and far from streams. Growing season length will be forecasted in various climatic scenarios and used to estimate survival of E. anicia larvae. By comparing the predicted growing season length to the time of larval development I expect to find that climate scenarios in which the growing season is substantially shortened (a dry summer with low snow pack) will result in higher larval mortality due to the early onset of senescence. These results will suggest the extent that E. anicia distributions are likely to shrink as climate change progresses.

Watershed scale factors affecting freshwater production of Pacific Salmon in Whatcom County.
L. Kaminski
1.) Western Washington University

Salmon spawn in many small lowland streams in the Pacific Northwest, and studying salmonid usage of these streams is important to understanding population declines. To evaluate salmon production in small tributaries and independent drainages in Whatcom County streams, many groups, including community non-profits, Western Washington University students, and the City of Bellingham, have monitored salmon out-migration with smolt traps. In addition, habitat has been evaluated based on stream and riparian condition by various agencies. In the present study, I will compile existing data sets on salmonid out-migration and habitat condition, and, with additional data on land cover and land use at the watershed scale, identify patterns in fish production in small Whatcom County streams. These analyses will identify relationships between fish production and characteristics at both the stream and watershed scale.

Population Genetics of Pacific Dogwood.
K. Keir and S. Aitken
1.) University of British Columbia 2.) University of British Columbia

Pacific dogwood (Cornus nuttallii) is a beautiful deciduous tree found in forests along the Pacific Coast from southwestern British Columbia to southern California and disjunctly in Northern Idaho. At present, there is very little known about the population genetics of C. nuttallii. I propose to fill some of these knowledge gaps and in doing so, aid in the development of an effective conservation strategy, if necessary, to maintain healthy populations of this tree. Foliage and seeds will be collected from 25 populations throughout this species' native range. Using microsatellite and chloroplast DNA (cpDNA) markers, I hope to determine the genetic diversity, population structure and mating system for these populations of trees. Nine microsatellite loci have been characterized in Pacific dogwood (Cornus nuttallii L.) using microsatellite primers and sequence data for a closely related species of dogwood, flowering dogwood (Cornus florida L.). Relative to C. florida, allelic diversity was relatively low in Pacific dogwood individuals at these loci. We found one to eight alleles per locus with a mean of 2.44. I plan to investigate the effect of location, level of anthracnose infection, insect pollination and animal dispersal will have on these genetic parameters. Furthermore, I plan to use maternally inherited cpDNA to determine the post-glacial migration strategy of this species. This data can be useful in setting guidelines for seed collections, species restoration and determining the effects climate change will have on these genetic parameters. Here I outline my proposed research.

Instream structures as barriers to upstream passage by freshwater sculpins (Cottus spp.) in Puget Lowand streams of Whatcom and Skagit counties.
M. LeMoine and L. Bodensteiner
1.) Western Washington University 2.) Western Washington University

Barriers to prickly sculpin (Cottus asper) and coastrange sculpin (Cottus aleuticus) passage were investigated in 12 Puget Lowland streams in Whatcom and Skagit Counties, Washington. I sampled selected reaches within each stream for sculpins, characterized the habitats in which I found them, and identified upstream limits of distribution. Where sculpins were absent from upstream reaches, I identified potential obstructions to movement and measured the features of each potential barrier in a fashion similar to that for salmonid species. Of the 12 Puget Lowland streams sampled, 7 complete barriers, 3 partial barriers, and 2 streams with no barriers were identified in the field. Complete barriers shared a common attribute; a hydraulic disconnect with the stream substrate. Partial barriers had extreme stream slope changes over short longitudinal distance, and streams with continuous sculpin distribution had neither of these characteristics. In all cases, salmon were able to pass these structures, suggesting freshwater sculpins may be a more appropriate model fish for recognizing barriers to upstream fish passage.

The early marine survival of juvenile pink salmon: The effects of sea lice on predation risk.
P. A. Mages and L. M. Dill
1.) Simon Fraser University 2.) Simon Fraser University

In British Columbia, evidence indicates that the numbers of sea lice found on wild juvenile salmon are higher in areas near fish farms. Salmon face the highest predation level as juveniles from birds (e.g. herons, mergansers, and kingfishers) and fish (e.g. coho salmon smolts, trout, and rockfish). If being parasitized makes juvenile salmon more vulnerable to predation, then increased

parasite loads on out-migrating salmon would decrease their chance of survival, and thus further reduce already low numbers of wild salmon. There are a number of ways sea lice may affect the vulnerability of juvenile salmon to predation. Parasites put increased energetic demands on the host which has many direct implications for the host's health. For instance, a reduced energy state may impair the host's physical abilities to escape predators. In addition hosts may compensate for the increase in energy demands by increasing their foraging time. More time spent foraging may result in an increase in predation risk because vigilance decreases while foraging. I propose three questions to assess the impact of sea lice on the vulnerability of juvenile pink salmon to predation. Question 1: Are parasitized juvenile pink salmon more vulnerable to predation than unparasitized fish? Predation experiments using natural fish predators are planned for spring field season. Question 2: Do infestations by sea lice affect escape swimming speed? Preliminary results are presented here. Question 3: Do parasitized juvenile salmon balance increased energetic demands by increasing foraging time and does this result in increased predation risk?

Benthic ecology and gray whale foraging in Clayoquot Sound

A. G. Patterson and D. A. Duffus
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Gray whales, Eschrichtius robustus, have high energy requirements and an efficient foraging strategy. As a result, they can significantly impact the prey populations that they target. During the summer, gray whales feed on benthic and hyper-benthic prey in Clayoquot Sound, British Columbia. There has been a decrease in the number of gray whales foraging on benthic amphipods here over the last twelve years. We propose that there has been a decline in amphipod populations, which may have been caused by the exploitation of this resource by gray whales. Benthic samples were collected from two bays in Clayoquot Sound through the summer and fall of 2004 and 2005. Amphipods were counted, measured and weighed. Findings were compared to the results of sampling conducted in the mid-1990's. Results indicated that population structure and average length have remained relatively constant over the last 10 years, while overall biomass and density have declined in both bays. At current levels the amphipod populations in these bays are probably too small to meet the energy requirements of gray whales. Depletion of this resource may have caused reduced use of these bays by gray whales.

Response functions of lodgepole pine to temperature and CO2: Implications for genetic resource management for future climates.

P. Smets, R. Guy, T. Wang, A. Yanchuk and S. Aitken
1.) University of British Columbia 2.) University of British Columbia 3.) University of British Columbia 4.) Canadian Ministry of Fisheries 5.) University of British Columbia

In the context of rapid global warming, active management of genetic resources may be needed to ensure adaptation to local climate in reforestation. Knowledge of the relative performance of populations with regard to temperature is needed, but future temperatures are beyond the range covered by existing field common garden experiments. A seedling experiment was set up to address this need. Seedlings of ten contrasting lodgepole pine (Pinus contorta var. latifolia) populations from British Columbia were subjected to five temperature regimes and two CO2 levels in controlled climate chambers for six months. Growth and gas exchange traits were measured and analysed. Growth chamber environments were less stressful than expected, partly explained by lack of drought and partly by lack of temperature extremes. The relative performance of populations was similar in chambers and the field, with the notable exception of one population. This population had excellent field growth, low growth in the chambers and a high water-use efficiency, an asset in the field but possibly counterproductive in the chambers where water was not limiting. Selected populations from the provincial breeding program grew better than the best unselected populations. Photosynthetic downscaling occurs in plants grown in elevated CO2 and high, but not low, temperatures. The net effect of CO2 enrichment on growth at high temperatures is still positive. To improve juvenile testing, the effects of drought and temperature extremes, both unique and recurring, need to be investigated.

A spatial analysis of cougar-human interactions on the west coast of Vancouver Island.
D. Thompson, D. Eastman, S. Boychuk and B. Hansen
1.) University of Victoria 2.) University of Victoria 3.) Clayoquot Sound UNESCO Biosphere Reserve 4.) Pacific Rim National Park Reserve

Over the past five years, cougar-human interactions appear to have increased in frequency and intensity in Pacific Rim National Park Reserve (PRNPR) and Clayoquot Sound UNESCO Biosphere Reserve (CSUBR) on the west coast of Vancouver Island. Resource managers are concerned with growing visitor numbers compromising the utility of cougar habitat while increasing the potential for negative interactions to occur. It is necessary to understand the factors influencing cougar distribution in areas of human use to ensure cougar conservation and human safety. However, traditional radio-telemetry methods to study this far-ranging and elusive species are not feasible in densely vegetated coastal environments. To overcome these issues, we will assess the use of cougar sighting data to delineate cougar-human interaction hotspots. Habitat attributes at hotspots will be compared to those at random sites to determine if particular landscape features increase the likelihood of cougar occurrence. Non-invasive detection methods will be employed to substantiate our hypotheses and assessed for their efficacy and long-term monitoring capabilities specific to coastal habitats.

Reproductive isolation in a contact zone between two divergent forms of winter wren (Troglodytes troglodytes).
D. P. Toews and D. E. Irwin
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Areas in which forms come into secondary contact after a long period of geographic separation provide a unique opportunity to study the evolution and maintenance of biodiversity. Differences in singing behavior and mtDNA between western and eastern populations of Winter wrens (Troglodytes troglodytes) in North America, one of the few currently recognized songbird species that has a holarctic distribution, have led to speculation that western North American winter wrens are a separate species than those of the rest of the world. Song and genetic analyses of individuals in the only known contact zone between these forms, found in the Rocky Mountains of western Canada, support this hypothesis and provides insight into the processes involved in the evolution of reproductive isolating barriers.

ClimateBC and its applications in forest genecology and resource management in BC.
T. Wang, A. Hamann, D. L. Spittlehouse and S. N. Aitken
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Maps of interpolated climate normals have recently become essential for genecology, forest resource management and other studies associated with climate change. Interpolating climate data in mountainous regions, however, is difficult. Poor climate models can be misleading. The climate model â~@~\ClimateBCâ~@~] we developed based on the PRISM climate data for British Columbia generates scale-free climate data. It significantly improved the prediction of climate variables over the original PRISM data. In addition, we have also developed 11 biologically relevant climate variables and integrated several global circulation models (GCMs) into our model. Applications of ClimateBC improved the modeling of ecosystems and promoted studies associated with climate change. The model has been used in forestry, agriculture, hydrology and meteorology.

210Pb-derived Sedimentation and Mixing Rates in Hood Canal, WA.
S. Wingert
1.) Western Washington University

Accurate sediment accumulation rates in estuaries are necessary to determine budgets and fluxes of chemicals, calculate residence times of particles, and date changes in chemical compositions recorded in the sedimentary column. Using MatLab, we report recent sediment accumulation and mixing rates calculated from excess 210Pb activity profiles at 3 sites in Hood Canal. 210-Pb derived sediment accumulation and mixing rates were calculated based on a one-dimensional, two-layer, steady state sedimentation model in which mixing occurs only in the surface mixing layer (SML). These data will be used in combination with biogeochemical tracers, such as organic matter, organic nitrogen, organic carbon, redox sensitive metals and stable sulfur isotopes to compile a historical view of sedimentation, nutrient input, changes in water column productivity and changing dissolved oxygen, all characteristics of coastal eutrophication.

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