



# What's new in conservation biology?

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The conservation paradigm in British Columbia is slowly shifting from a single-species approach to a more multi-species, ecosystem-based approach. This evolution in management is occurring partly to optimize the return from investments in conservation, and to adapt to large-scale issues (e.g., mountain pine beetle epidemic, climate change). The new Conservation Framework ([www.env.gov.bc.ca/conservationframework/](http://www.env.gov.bc.ca/conservationframework/)) developed by the BC Ministry of Environment speaks to this new reality. Even more proactive efforts at both the species and ecosystem levels are being called for with recent information about the status of biodiversity in BC ([www.biodiversitybc.org/](http://www.biodiversitybc.org/)).

The BC Ministry of Forests and Range, via the Forest Investment Account–Forest Science Program (FIA–FSP) is funding research projects that are generating the much-needed scientific knowledge to support conservation and management decisions. This article summarizes several FIA–FSP research projects that help solve challenges for natural resource managers.

## Conservation genetics and ecology of the threatened Coastal Giant Salamander in managed forests of British Columbia: Setting priorities for an integrative species recovery plan

The Coastal Giant Salamander is on the provincial Red List and is designated as Threatened in Canada. While viable populations occur in the

Pacific coastal states of the US, this highly vulnerable salamander occurs in Canada in an area less than 100 km<sup>2</sup> in the Chilliwack River Valley. The continued survival of the Coastal Giant Salamander in BC is dependent upon ecologically sensitive forestry practices.

**John Richardson** and **Rachael Dudaniec** (University of British Columbia) used

genetic tools to understand the movement of Coastal Giant Salamanders (*Dicamptodon tenebrosus*) across the landscape, and, consequently, to find out how much gene flow (i.e., mixing of genes) is occurring between streams within the Chilliwack Valley. Patterns of gene flow are directly affected by habitat characteristics, which also may be influenced by forestry practices and/or natural features of the landscape, such as elevation or the presence of lakes or large rivers. The health and persistence of Coastal Giant Salamanders rely on adequate dispersal of reproducing individuals to add new genetic material, to decrease the effects of inbreeding, and to enable colonization of new streams. Therefore, understanding what affects and creates genetic structure is vital for implementing management strategies at the landscape scale.

Richardson and Dudaniec feel that amphibians are important and sensitive indicators of ecosystem health and are an ideal study group for examining the impacts of human-habitat disturbance and fragmentation. Preliminary results point to effects of elevation and forest age (i.e., time since harvest) on both salamander genetic structure and individual density across 15 streams of the Chilliwack Valley. Habitat characteristics vary greatly between streams containing salamander larvae, while species distribution is patchy and species abundance varies. Streams also appear to vary in the number of contributing parents to the larval population, with genetic relatedness among larvae differing markedly between streams.

“In a broader context, the use of landscape genetics provides a new and important angle for conservation problems, and it is intended that this research will further validate its use and applicability within threatened species management,” the researchers said. “In combination with ecological data and life-history information about a species, genetic analyses have unmatched potential for revealing cryptic behaviours and patterns that drive key factors in population dynamics and persistence.”

For more information about this Coastal Giant Salamander research, contact [john.richardson@ubc.ca](mailto:john.richardson@ubc.ca) or [rachael.dudaniec@gmail.com](mailto:rachael.dudaniec@gmail.com)

The Coastal Giant Salamander is on the provincial Red List and is designated as Threatened in Canada.



Rachael Dudaniec photo



## FIA–FSP Forest Science Corner

### Quantifying forest stand and landscape attributes that influence mountain caribou habitat fragmentation and predation rates

**Bruce McLellan** (BC Ministry of Forests and Range) and **Rob Serrouya** (University of Alberta) conducted research quantifying the forest stand and landscape attributes that influence mountain caribou (*Rangifer tarandus*) habitat fragmentation and predation rates. Mountain caribou are classified as Endangered (COSEWIC) under the *Species at Risk Act* and live at low densities over very large areas that contain sufficient old-growth forest. In winter, they feed almost exclusively on an arboreal lichen that is most abundant on old trees. The cumulative impacts of environmental changes have contributed to the caribou's decline and likely its eventual extinction in its southernmost range. Changes in mountain caribou habitat, through conversion of old-growth forests into younger forests and fragmented habitats, have encouraged the increase of deer, elk, and moose and their suite of predators (wolves, cougar, and bears) in areas where they were all previously less abundant. Additionally, winter recreation, including heliskiing and snowmobiling, have negatively impacted caribou distribution.

McLellan and Serrouya's research has shown that the scales at which predator/prey systems operate are much larger than the scale over which caribou live and forage. Protecting caribou foraging habitat alone will not be enough. The area that broadly surrounds caribou foraging habitat also has to be managed in a combination of three ways: 1) reduce the shrubs that benefit moose and deer (shrubs follow forest harvesting), 2) reduce the moose and deer, and/or 3) reduce the predators of moose/deer and caribou.

McLellan has been working on this project for many years and, in preparing for retirement, is now passing the torch to Serrouya. The response of predator/prey dynamics to habitat changes are Serrouya's particular area of interest. "We know a lot about the decline of woodland caribou; they are proximately

limited by predators. But climate and habitat changes are the ultimate causes as these factors favour deer and moose, which benefit predators that feed on them, thus bringing more predators into caribou habitat to kill caribou. We know less about how to recover caribou. How much do deer and moose and their predators have to be reduced, and over what spatial extent? Can we recover the habitat so that we no longer have to manage predator/prey systems through hunting and predator control? This is the kind of information we will provide to decision makers," said Serrouya.

McLellan and Serrouya and others have published several journal papers from FIA–FSP-funded projects and several more are in the queue. Extension of this knowledge to operational people on the land has been very successful. "This work is linked directly into management on a daily basis," said McLellan. "The licensees and other professional foresters have been great to work with. The practitioners are well aware of our work and use the information." Locations of radio-collared caribou captured between north of Wells Gray Park to the TransCanada Highway between Salmon Arm and Golden have been the basis for delineating where old forest will be left uncut for caribou.

For more information, please contact **bruce.mclellan@gov.bc.ca** or **rserrouya@telus.net**

Marbled Murrelets (*Brachyramphus marmoratus*) are Red-listed in British Columbia, listed as Threatened in Canada, and have been the focus of attention for forest managers, practitioners, and conservationists for many years. Researchers **Alan Burger** and **Peter Arcese** are investigating different aspects of reproductive success in Marbled Murrelets.

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Wildlife Informatics photo

Group of caribou located during a population survey.



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### Nest-site re-use and management of nest habitat attributes of Marbled Murrelets in coastal forests

**Alan Burger** (University of Victoria) has been studying Marbled Murrelets' re-use of nesting sites and examining how best to manage nesting habitat attributes in BC's coastal forests. His current research is important for conserving and managing Marbled Murrelets in BC because he is addressing, for the first time, those fine-scale factors at the tree level that affect the availability of potential nest platforms.

"Based on other studies of murrelet nests, we define a platform as a limb or deformity in the canopy wider than 15 cm," said Burger. "Most platforms are mossy pads on the branches in which the murrelet might make a nest cup. Platforms, along with large trees and gaps in the forest canopy, are an essential requirement for this threatened species to nest in the coastal forests. We collated data on almost 30,000 trees at 1,412 sites in 170 watersheds across coastal BC. Our research identifies the tree size and species that are most important in providing platforms in each region, and we also identify key environmental features affecting the growth of mossy pads that make up most of the nest platforms."

In most regions, trees have to be larger than 60 cm in diameter to provide potential nest platforms. This threshold is higher on the central coast (over 80 cm) and on east Vancouver Island (over 96 cm). It is unknown why the central coast needs larger trees, but on east Vancouver Island this is likely due to the drier climate affecting the rate at which trees grow and the epiphytic moss that accumulates in the canopy branches. Other predictors of platforms include tree height, tree species, and, to a lesser extent, elevation, slope, and latitude. Sitka spruce, Douglas-fir, and yellow cedar are more likely to provide platforms than other tree species.



Alan E. Burger photo

A tree with murrelet nesting platforms.

The widespread western redcedar is less likely to provide platforms, while firs and hemlocks show region-specific capabilities to provide platforms.

Interestingly, some of the key findings suggest that nest trees are seldom or never re-used on southwest Vancouver Island where habitat is still plentiful. About one-third of nest trees are re-used in later seasons on the Sunshine Coast where habitat has been greatly reduced, but re-use is still less frequent than in California where suitable habitat is sparse.

"Our research helps practitioners identify the size and type of trees, and the environmental conditions that will most likely provide nesting habitat for Marbled Murrelets in each region," said Burger. "This is important because the government and the forest industry select areas of old-growth habitat to be maintained for murrelet nesting across the BC coast. Our work also identifies the types of trees that should be left standing when variable retention logging is being applied in murrelet habitat. Our results also help to predict the age and stand conditions at which regenerating second growth might mature sufficiently to provide nesting habitat for this old-growth-dependent species."

For further information, please contact [aburger@uvic.ca](mailto:aburger@uvic.ca) or go to <http://web.uvic.ca/~mam/>

### Reconstructing historic diets and population dynamics of the Marbled Murrelet

**Peter Arcese** (University of British Columbia) is taking a new approach to looking at factors that contribute to, or hinder, the reproductive success of Marbled Murrelets in a marine environment: the influence of diet quality on Marbled Murrelet reproduction. Most habitat planning for Marbled Murrelets has focused on the availability and quality of forest for nesting. Arcese is looking at larger-scale patterns, beginning with climate changes that are impacting oceans, which in turn impact food availability, which in turn impacts reproductive success in Marbled Murrelets. His research investigated whether historic declines in the diet and marine habitat quality limit population growth rate of Marbled Murrelets. He measured stable isotopes of nitrogen and carbon in blood and feathers, collected from Marbled Murrelets between 1890 and 1997 in the Georgia Basin, and has analyzed trends.

Arcese's research strongly suggests that reductions in the biomass of forage fish over the last 100 years have caused parallel declines in the diet quality of Marbled Murrelets just prior to breeding, and that these declines are limiting the population growth



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rate of Marbled Murrelets in this region. Arcese suggests that if diet quality does limit reproductive success in Marbled Murrelets, then perhaps managers should refocus their recovery plans on rebuilding fish stocks as well as maintaining sufficient desirable forest nesting habitat.

Arcese’s research will facilitate decisions about the optimal allocation of resources in the protection and restoration of: 1) mature forest habitats where Marbled Murrelets nest and 2) marine environments where the Marbled Murrelet spends most of its life. This information will help planners develop sustainable forest management plans in coastal forest regions.

For more information, please contact **Peter.Arcese@ubc.ca**

### Use of adaptive management to mitigate risk of predation for woodland caribou in north-central British Columbia

**Scott McNay** (Wildlife Infometrics) is using an adaptive management approach to mitigate risk of predation for woodland caribou in north-central BC. Much research has already been conducted on the causes of the demise of woodland caribou. These causes include increases in the amount and distribution of early seral predator/prey systems (i.e., deer, elk, moose, wolves, and cougars), roads and linear corridors, and winter recreational impacts. Now, work is happening on a more local, grassroots approach whereby research biologists are directing local trappers to geographic areas where predation risk is greatest for caribou.

For this project, McNay and his collaborators analyzed data from moose hunters and local wolf trappers, and used a combination of Habitat Supply Modelling and adaptive management techniques to assess the efficacy of recent wolf-predation mitigation activities (i.e., varying harvest schemes on wolves and moose) in an adaptive management framework.

“Our project is really a grassroots research effort to stimulate recovery of woodland caribou populations in at least a couple of places in BC,” explained McNay. The trapping methods being used are actually a restoration of an older lifestyle; a “tried and true” practical approach first adopted by Aboriginal people and original settlers. If proven successful, broader application will present opportunities for the trapping community in BC to become part of the solution to recover woodland caribou. Preliminary results suggest that wolf removal is coincidental with an increase in caribou survival. However, at

this point, it is early in the study so results are not conclusive. McNay hopes that others will establish similar efforts elsewhere in the province and that these practical projects will make a difference for caribou populations.

McNay’s philosophy and basic conservation ethic is “let’s keep good what is already good.” Caribou populations in the north are basically in good shape (compared to those of the south), but they are still at risk from factors that will cause population decline. Caribou, grizzly bears, and wolverine represent part of an old seral predator/prey system that is a stark contrast to the system that develops in early seral forests. McNay suggests that we need to work with those differences, understand them, and manage them in ways that will allow for sustainable populations of caribou. McNay’s research is intended to maintain woodland caribou populations until critical portions of their habitat are restored to old seral conditions. Once these specific habitats are restored, there should be no need for further mitigation of predation.

For more information, please contact **scott.mcnay@wildlifeinfometrics.com**

### Fisher habitat ecology in pine-dominated habitats of the Chilcotin

**Larry Davis** (Davis Environmental Ltd) is coordinating a 3-year FIA–FSP-funded project studying the fisher (*Martes pennanti*) habitat ecology in the pine-dominated habitats of the Chilcotin. In collaboration with several partners, Davis is addressing key knowledge gaps on the habitat-use and denning ecology of this Blue-listed species in BC. In particular, this project has developed recommendations for stand-level targets and configurations of stand-level structures in pine-dominated areas of the Central Interior (regarding reproductive denning, rest sites, and foraging habitat) as well as recommendations at the home range and landscape levels. This information is being used to produce best-management guidelines that are designed to maintain fisher habitat in pine-dominated landscapes. Beyond the area of study of this project, Davis is actively involved in an ongoing, province-wide, multi-agency extension program on fisher habitat.

For more information, please contact Davis at **rldavis@shaw.ca**

Immobilized grey wolf fitted with a GPS tracking device.



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Wildlife Infometrics photo



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### Developing and validating habitat-based management models for species at risk in northeastern BC

Another FIA–FSP project with a habitat perspective is being led by **Fred Bunnell** and **Pierre Vernier** (University of British Columbia), who are aiming to develop and validate habitat-based management models for five warbler species at risk in northeastern BC: the Bay-breasted Warbler (*Dendroica castanea*), Black-throated Green Warbler (*Dendroica virens*), Canada Warbler (*Wilsonia canadensis*), Cape May Warbler (*Dendroica tigrina*), and Connecticut Warbler (*Oporornis agilis*). This particular project addresses two important issues relevant to managing forest resources: 1) the need for current and credible information on the status of these species at risk and their habitat associations and 2) the development and ongoing refinement of management-based habitat models that can be used to provide insight on the effects of management practices over large spatial and temporal scales.

In collaboration with industry and government partners, Bunnell and Vernier have developed a web-based biodiversity monitoring/DSS (Decision-support System) that can be used by forest managers, researchers, and policy makers to access:

- 1) up-to-date information on the status and trends of warblers,
- 2) tools for designing and evaluating alternative monitoring protocols,
- 3) habitat models that can be linked to forest inventory data and simulation tools, and
- 4) links to other relevant resources for conservation planning and management.

For more information, please contact **fred.bunnell@ubc.ca** or **Pierre.vernier@ubc.ca** Further

information and contact details can be found on the project's evolving website (<http://biod.forestry.ubc.ca/warblers>).

### Badger habitat use and movements in forested ecosystems

**Karl Larsen** (Thompson Rivers University), **Roger Packham** (BC Ministry of Environment), and **Richard Klafki** (MSc candidate, Thompson Rivers University) are also using a habitat approach to study the habitat use and movements of badgers (*Taxidea taxus*) in forested ecosystems.

One of BC's most endangered mammals, with estimates placing the total provincial population at fewer than 340, the BC subspecies of badgers (*ssp. jeffersonii*) has been placed on the Red List within the province, and is listed as Endangered by COSEWIC at the federal level. Two main factors are contributing to the continued decline of badgers in BC: 1) an historical and current decline in habitat and 2) road mortality caused by major transportation corridors running through valley bottoms where badgers exist. Within this context, the purpose of this project is to provide resource managers and forest planners with recommendations for maintaining critical forest habitat for these animals, as well as examining and separating the effects of forest-habitat alterations from road mortality.

Historically labelled a grassland species, the research to date has revealed a much wider range of habitat associations for this animal, particularly forested lands or forest/grassland complexes, including agricultural areas, grasslands, golf courses, gravel pits, open forests, subalpine meadows, recently harvested cutblocks, and other human-modified landscapes that maintain early seral habitats. Roadkill has also been confirmed as a major source of mortality in this study. The results of this project include important forest and range management recommendations that are a major contribution to developing a Wildlife Habitat Decision Aid (co-ordinated by FORREX and soon to be published in the *BC Journal of Ecosystems and Management*). Furthermore, this project is creating very valuable monitoring information on movement patterns and roadkill of badgers, and is already generating road management and planning recommendations to address the main cause of mortality of this species.

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Three-month-old badger kits.



Richard Klafki photo



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### Early seral forest stands and their relationship to wildlife populations and ecosystem stability

**Karl Larsen** (Thompson Rivers University) is also involved in a project developed with **Eric Stromgren** (PhD candidate, University of Victoria) that is looking at early seral forest stands and their relationship to wildlife populations and ecosystem stability. The overarching goal of this study is to facilitate a science-based planning process (or ecosystem-based management) for the future harvest of mature timber in BC's Central Interior by providing greater insight into how the young-to-mature stand representation influences the wildlife component of ecosystems. One of the aspects being studied in this project is the requirement that stands be allowed to regenerate to 3-m height before adjacent stands can be logged—a common criterion across much of Canada, yet supported by little ecological data.

The study occurs in the Interior Douglas-fir (IDF) ecosystem of BC, and is using two squirrel species (the red squirrel, *Tamiasciurus hudsonicus*, and the northwestern chipmunk, *Tamias amoenus*) as indicators of forest condition and ecological maturity. Preliminary analysis of data indicates that juvenile red squirrels begin to explore juvenile lodgepole pine stands when the stands reach 3 to 4 m in height, while chipmunk populations seemed to persist across all of the age classes in the project (i.e., up to 20 years, or 8-m tall). Further track tunnel and live trapping efforts, and collection of radio-telemetry, stand-structure, and understorey-vegetation data during 2009 will assist in describing the study stands and identifying critical habitat features used by these two focal species.

For more information, contact [klarsen@tru.ca](mailto:klarsen@tru.ca) or [estromgren@tru.ca](mailto:estromgren@tru.ca)

### Creation of habitat for small mammal prey and their predators on clearcuts: Coarse woody debris in piles and windrows

Also funded by FIA–FSP, a project led by **Thomas Sullivan** (University of British Columbia) in collaboration with the Okanagan Innovative Forest Practices Association, is studying the creation of habitat for small mammal prey and their predators—particularly marten (*Martes americana*)—on clearcuts, and is also looking into the role of coarse woody debris (CWD) in piles and windrows. Installation of CWD treatments was completed and monitoring activities initiated in the 2007–08 fiscal year. The second year, 2008–09, of this 5-year study was designed to provide habitat

for marten in newly harvested clearcuts and in their subsequent managed stands through time.

Preliminary results show different responses among treatments for the different small mammal species. However, CWD piles and windrows have shown higher overall small mammal abundance than the dispersed CWD and forest treatments. Results of snow tracking showed a variety of mammalian species observed at, or near, the CWD treatments. Snow-track transects in early, mid-, and late winter in subsequent years will determine the relative habitat-use patterns, over successional time, of marten and other mammalian species.

For more information, contact [tomsu@interchange.ubc.ca](mailto:tomsu@interchange.ubc.ca)

### Future vegetation structure and vertebrate distributions based on changes in moisture balance and temperature

Within the realm of adaptation to climate change, **Fred Bunnell** (University of British Columbia) is also co-ordinating an FIA–FSP-funded project analyzing future vegetation structure and vertebrate distributions based on changes in moisture balance and temperature. According to Bunnell, climate change has already changed the way vertebrates (including us) live in BC, affecting the productivity of all natural systems and the ecosystem services we rely on. These changes will continue and likely become stronger.

The first step in adaptation is to assess relative vulnerability of species and ecosystems. This particular project incorporates influences of evapotranspiration and moisture stress to assess relative vulnerability of both species and ecosystems, and projects the patterns for the future using climate models. Some of the key findings to date of this project are about to be published in Paper 11 of the *Smithsonian Scholarly Publication Series*, entitled “Avian Response to Climate Change in British Columbia—Towards a General Model” and co-authored by F. Bunnell, **M.I. Preston**, and **A.C.M. Farr**.

This project has produced a preliminary model that projects the vulnerability of wetlands to drying and looks into adaptation strategies to sustain the many services provided by wetlands in a climate change context. “Although a very helpful system in BC, the Biogeoclimatic Ecosystem Classification is becoming an historical artifact as species shift distributions and recombine in ways not described by the current system,” said Bunnell.

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