MARTES WORKING GROUP

NEWSLETTER

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Martes Working Group Executive Committee

Martes Working Group Regional Representatives

FROM THE CHAIR

MWG research teams: a possible solution to data deficiency on species

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It was July on the River Kwai in Thailand. Rain had been falling for 2 days, and I was discussing wildlife with my guide on a floating bungalow. This is how I learned about the yellow-throated marten (*Martes flavigula*) inhabiting this riparian deciduous forest, which was adjacent to an old-growth teak forest. My guide was telling me that, although he spends most of his time in the bush, he did not know much about this species. He knew that martens were sometimes shot by locals, they stank, and they fed on fruits at night. It was unknown to most locals. I was thinking that it would be great to study yellow-throated martens in such beautiful surroundings. However, it is unlikely that this will happen anytime soon. For example, last year in Malaysia, I contacted the Malaysian Fish and Wildlife office, the University in Sabah, the Malaysian World Wildlife Fund office, and the Malaysian Nature Society to develop a research program in the Sandakan region where the yellow-throated marten was seen in a riparian second-growth forest. Nobody showed any sign of interest for this species.

The truth is that data deficiency on small carnivores is a worldwide problem (Schipper *et al*. 2008). Although a lack of studies is common in third world countries (*e.g.*, Johnson *et al*. 2009), it also happens in first world countries, and I have seen it in my own country (Proulx 2008, 2012). Martens and fishers are cute animals, but they are not as charismatic as mega-vertebrates like the pandas, tigers, lions, and wolves. In my experience, a large portion of the public still believes that "marten" and "fisher" are bird names; many have never heard of such mammals! Yet, we all know that conserving marten and fisher habitats means providing valuable habitat for many other species (*e.g.*, Thomas *et al*. 1988), and maintaining complex ecosystems (Roemer *et al*. 2009). Obviously, unless we promote the "goodness" of martens, fishers, and sables to the public, these small carnivores will remain unknown and under-funded species. In many areas, however, the loss of habitats and populations will happen before these species ever become known to the public.

We need real data to develop valuable conservation programs. In other words, we need field research and funding. Our *Martes* Working Group (MWG) is not wealthy enough to fund research on populations and habitats. Our membership is too small, and our annual contributions too low, to build any research fund. However, MWG members have the knowledge and the experience to conduct effective research on all aspects of the ecology of these species. Together, MWG members can develop research and conservation programs that may be attractive to government agencies and non-governmental organizations. Together, MWG members could develop multidisciplinary research teams and tackle a diversity of projects at the international level. The bottom-line is that MWG members must speak to each other, and team up to meet common objectives.

I believe that there is hope to improve the fate of *Martes* species by pooling our competencies and working together on the development of research and conservation programs around the world. All we need to do is to email each other and discuss possibilities. So if the idea of developing MWG research teams interests you, please contact me (gproulx@alphawildlife.ca). Together we can do something about data deficiency in the genus *Martes*.

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FROM THE TREASURER AND MEMBERSHIP DIRECTOR

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I need your help. The *Martes* Working Group needs your help. Our membership is declining and the trend warrants action for a successful future (Figure 1). In last year's newsletter, Gilbert Proulx ("From the Chair") touched on the cyclical nature of the membership: peaking at the symposium and dipping in between. It is time to crawl out of the trough.

The first step to reforming our ranks is for old members to move "Renew my *Martes* Working Group Membership" from their *task* list to their *done* list. I have had many people request an invoice for membership, but then not follow through with the transaction. I am happy to send a lost invoice again, but I am reticent to nag. I do not want to send out quarterly or monthly reminders any more than you want to receive them.

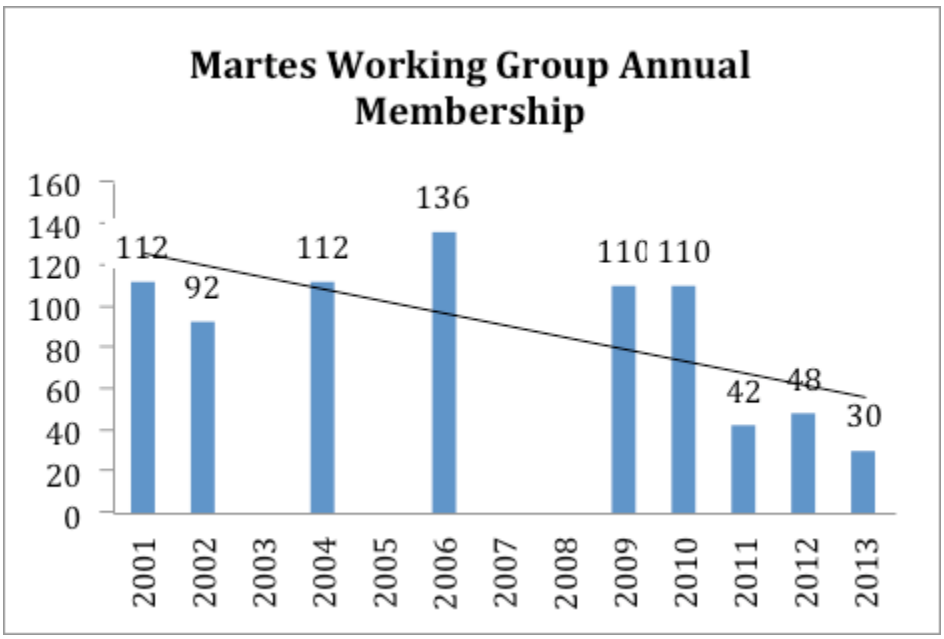

Figure 1. *Martes* Working Group membership from 2001 to 2013.

The second step is to recruit new individuals. As you peruse this year's newsletter and the interesting events submitted from *Martes* Working Group members from around the world, I would ask you to reflect on why YOU are a member of the group. Share your experiences with a colleague and get them interested in joining the rich collaborative opportunities with like-minded professionals afforded though membership and active participation. Remember, this group belongs to you. Only your active participation can guide the direction of the group and ensure it continues to provide the values and benefits you seek.

For those of you who maintained your regular membership, thank you! For the others looking to renew or join, send me an email and I will get you set up. Membership rates are one year for $18 USD, or save money – and having to remember to renew your membership – by joining for 2 years ($30 USD), or for 3 years ($40 USD).

FROM THE WEBMASTER

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In addition to this newsletter and the international symposia, your *Martes* Working Group (MWG) membership also helps support a website dedicated to facilitating communication and collaboration among *Martes* researchers.

The current URL for the MWG website is:
http://www.martes.laurentian.ca/Laurentian/Home/Departments/Biology/Faculty_and_Staff/Professors/robitaille/MWG?Laurentian_Lang=en-CA

The MWG website is intended to serve as an informational tool for current members, as well as a promotional tool for newcomers. The website currently includes:

- The MWG Mission Statement;
- Current and previous MWG membership directories;
- The current and previous MWG Newsletters;
- A bibliography of *Martes* research, including hyperlinks to the documents when available, and
- A catalog of publicly available images of *Martes* species from around the world, as well as hundreds of images from the International Symposia.

We are continually updating the MWG website and always looking for new ways to make it better! We can also use your help in making the website more useful. For example, our image library is still relatively small, especially with respect to the more exotic *Martes* species. In addition, we always appreciate new contributions to the bibliography, including citations, original documents in MS Word or PDF formats, and links to online documents. If you have any photos, citations, or documents that you would like to share, please send them to me at the email address above, and I will see that they are posted in a timely fashion.

Following popular demand, the MWG now offers a (moderated) platform to facilitate short-term exchanges among members, something that has been lacking at least since Portugal 2004. If you are an active member, you are welcome to access the site at http://tech.groups.yahoo.com/group/martesworkinggroup/.

Follow the instructions provided by Yahoo. The MWG webmaster is the moderator for this Discussion Group and will authorize your subscription to this Discussion group on a per-request basis.

As always, we appreciate new ideas from the MWG membership. What additional services would you like to see?

PUBLICATION OF THE 5TH *MARTES* BOOK

"Biology and Conservation of Martens, Sables, and Fishers: A New Synthesis"

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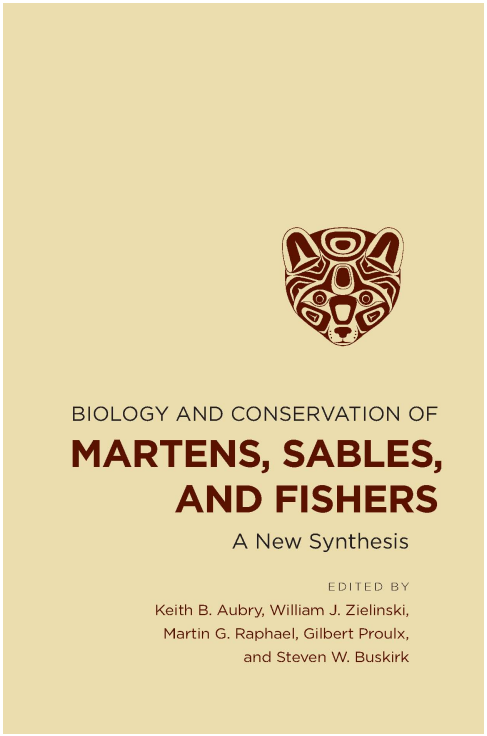

The book that we have been working on since we convened the 5th International *Martes* Symposium in Seattle, Washington 3 years ago, has now been published in hardcover by Cornell University Press. The new *Martes* book, entitled "Biology and Conservation of Martens, Sables, and Fishers: A New Synthesis," encompasses 580 pages, including 20 synthesis chapters, a comprehensive literature cited section, and an index. The 20 chapters in the book were developed to address the most timely and important topics for the genus *Martes* in today's world.

The book is divided into 5 sections:

- Evolution and Biogeography of the Genus *Martes* (4 chapters),
- Biology and Management of *Martes* Populations (4 chapters),
- Ecology and Management of Habitat for *Martes* Species (3 chapters),
- Advances in Research Techniques for *Martes* Species (4 chapters), and
- Conservation of *Martes* Populations (5 chapters).

Altogether, 62 *Martes* biologists from 12 countries contributed to the chapters in this book, and authors were instructed to be as taxonomically and geographically comprehensive as available information allowed. Thus, this book is truly an international synthesis of the current state of knowledge for the genus *Martes*.

The book is available for purchase online from Cornell University Press for $75 at the following URL:
http://www.cornellpress.cornell.edu/book/?GCOI=80140100360310&CFID=27262871&CFTOKEN=43e82cfc91f02de4-9611F872-C29B-B0E5-3923624918D0A12D&jsessionid=8430ae58f1a18c4f3d873d39185d40392e44

You can also go the Cornell University Press website and search for the book.

Cornell University Press is currently offering a 20% promotional discount off the purchase price for this book. We don't know how long they will be offering this discount, so we recommend that you purchase the book as soon as possible. When you go to the Shopping Cart online to pay for the book, you will receive a $15 discount by using the following Promotional Code: **CAU6**

In addition, the book is available from amazon.com (including a Kindle edition), Barnes & Noble, and other major booksellers.

FIRST ANNOUNCEMENT: 6TH *MARTES* WORKING GROUP SYMPOSIUM

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Dear Colleagues,

As you may know, the next *Martes* symposium will take place in 2014 at the Jagiellonian University, Krakow, Poland!

Theme

The theme of the 6th *Martes* Symposium is:

Ecology and Conservation of Martes Without Borders:
Common Denominators and Regional Differences Across Countries and Continents

Potential subjects include:

- Habitat
  - Similarities between *Martes* species of different countries and continents
  - Similarities between *Martes* and other genera
  - Ecological amplitude and regionalism between populations of a species
- *Martes* adaptations related to climatic differences and geographic regions
- Conservation programs:
  - Differences due to ecological characteristics
  - The socio-economic importance of *Martes* in different countries and continents, and its impact on conservation
  - Research priorities according to countries and continents.

Dates

As there is still time, please see the following provisional dates and kindly let us know which one best suits your plans. We offer for your consideration the following dates:

21 – 24 July 2014
28 – 31 July 2014
8 – 11 September 2014
15 – 18 September 2014

Unfortunately, the university is closed in August, and the academic year lasts between 1 October and 30 June. We have suggested these least "crowded" dates for your convenience.

Registration

Registration fees include admission to all sessions, coffee breaks, welcome cocktail social, and lunch every day. The provisional registration fee is approximately € 250 – € 290 ($325 – $375).

Place of venue

The venue for the 6th *Martes* Symposium will be the Jagiellonian University, Institute of Environmental Sciences (http://www.eko.uj.edu.pl/index.php/en/), in Krakow (http://www.krakow.pl/english), Poland.

Excursions

There will be possibility to take part in excursions or longer trips to Tatra National Park, Ojcow National Park, Wieliczka Salt Mine, and/or Bialowieza National Park. Depending on your arrival and departure it will be possible to participate in more than one excursion.

Please feel free to send comments on dates and other issues to Izabela Wierzbowska at i.wierzbowska@uj.edu.pl.

A CONFERENCE ON THE BIOLOGY AND CONSERVATION OF WILD MUSTELIDS

18 – 21 March 2013
Department of Zoology, University of Oxford, United Kingdom
Organized by the Wildlife Conservation Research Unit (WildCRU), in association with the IUCN/SSC Otter and Small Carnivore Specialist Groups

Organizing and Scientific Committee:
David Macdonald (WildCRU, Oxford University, UK) (Chairman)
Chris Newman (WildCRU, Oxford University, UK)
Lauren Harrington (WildCRU, Oxford University, UK)
Nicole Duplaix (IUCN/SSC Otter Specialist Group)
Jerry Belant (IUCN/SSC Small Carnivore Specialist Group)
Claudio Sillero (WildCRU, Oxford University, UK)
Dawn Burnham (WildCRU, Oxford University, UK)

Colleagues from around the world are invited to join the Wildlife Conservation Research Unit at the University of Oxford for this 3-day conference to discuss mustelid biology, conservation, and management.

The Mustelidae is the largest family in the order Carnivora and yet remains the least well understood. The diversity and extensive biogeography of this family provides a forum for developing a wealth of ecological paradigms, with implications for academics, conservationists, and veterinarians.

The conference, co-organized with the IUCN/SSC Otter and Small Carnivore Specialist Groups, will include plenary presentations by many of the world's leading authorities on mustelid biology and conservation (including the skunks), as well as stimulating oral and poster presentations from graduate students and researchers working in this field. Attending this meeting will also serve as an occasion to deepen friendships and further international understanding on mustelid issues. Social events are planned that will allow you the opportunity to network with international colleagues in the inspiring settings of this historic university city.

Please register your interest at mustelid.conference@zoo.ox.ac.uk to receive further details. A call for papers will be issued shortly.

FOREST CARNIVORE WORKING GROUP: NORTHEASTERN U.S. & SOUTHEASTERN CANADA

Paul Jensen
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Recently, there has been interest in forming a cooperative forest carnivore working group among those involved with the conservation and management of American marten, fisher, bobcat, and Canada lynx in the northeastern U.S. and southeastern Canada. Currently, we are in the initial phases of gauging interest and organizing this group.

We anticipate that the working group membership will be diverse, representing university researchers, State, Federal, and tribal natural resource agencies, and non-governmental organizations. The primary geographic area of interest will include the Northern Appalachians ecoregion and surrounding Northern Forest region, including New York, Vermont, New Hampshire, Maine, Ontario, Québec, New Brunswick, Nova Scotia, and Newfoundland and Labrador.

If you are interested in becoming part of this working group, please contact me (Paul Jensen, pgjensen@gw.dec.state.ny.us). Please provide your contact information, primary species of interest, current responsibilities (e.g., management, research, administration), and projects that you have worked on related to the above species.

Stay tuned…more information to come this winter! Thank you.

WESTERN NORTH AMERICA

Denning ecology and habitat use by fisher (*Martes pennanti*) in pine-dominated ecosystems of the Chilcotin Plateau

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The following is the abstract of a M.S. Thesis completed at Simon Fraser University, Burnaby, British Columbia, Canada, in 2009.

Abstract – I used radio-telemetry to monitor 24 fishers (*Martes pennanti*) in the Chilcotin area of British Columbia. Fishers used heart rot cavities in old lodgepole pine (*Pinus contorta*), Douglas-fir (*Pseudotsuga menziesii* var. *glauca*), and trembling aspen (*Populus tremuloides*) trees located primarily on south aspects for reproductive dens. Den trees in the Chilcotin were smaller in diameter than those documented elsewhere in western North America, but were locally large. Fisher used both arboreal and terrestrial rest sites in the Chilcotin, but terrestrial sites were preferred during periods of deep snow. Arboreal rest sites were usually on rust brooms in white spruce (*Picea glauca*), and terrestrial rest sites were typically associated with large-diameter coarse woody debris. Mean home range size for 10 females in my study was 30 km^2, and the male fisher I monitored had a home range of 166 km^2. Within home ranges, fisher preferred areas close to streams.

Third-year translocation of fishers into the northern Sierra Nevada and southern Cascades of California

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We released fishers (*Martes pennanti*) into the northern Sierra Nevada and southern Cascade mountain ranges in California for a third and final year. The translocation is a collaborative effort of the California Department of Fish and Game, U.S. Fish and Wildlife Service, Sierra Pacific Industries, and North Carolina State University.

In total, 24 female and 16 male fishers were released between late 2009 and December 2012. The third-year cohort of translocated fishers (8 females: 4 males) were released both in close proximity to home ranges of established fishers and in areas where we believed previous-year fishers (or their juveniles) had not settled.

Consistent with our previous 2 years of releases, fishers released within the established home ranges of other individuals moved further prior to establishing home ranges than did those released outside of established home ranges. Male fishers are more varied than females with respect to the amount they travel and the distance from release where they establish home ranges. These findings are consistent with our predictions about how new fishers relate to the already established home ranges of individuals of the same sex; however, further analyses are required before we can draw definitive conclusions.

Fishers that we released in the third-year cohort had high survival similar to animals released in years 1 and 2. Only 1 of 40 fishers we have released has died within the first 4 months following release. This female apparently died from conditions that existed prior to her translocation or capture, but those stresses could have contributed to expediting her death. Ultimately, translocation seems to have relatively little effect on survival of fishers in the months immediately post-release.

In total, we have documented mortalities in 10 of 40 released fishers (8 females and 2 males) across all years of the translocation. The causes of mortality are varied, but predation by bobcats (*Lynx rufus*) appears to be the leading cause of death in adult fishers. Other causes of mortality include vehicular trauma and drowning, while the cause of death for 3 fishers, thus far, cannot be determined. The majority (7 of 10) of mortalities have occurred during the period when males were actively searching for mates, or while females were lactating. Consequently, although we cannot document juvenile mortality, we must assume that the kits of mothers that die also perish. Juvenile fishers that were born on the Stirling Management Area and subsequently outfitted with a transmitter (see below) have also been tracked for nearly a year and we can document no mortalities among this cohort.

Translocated fishers successfully reproduced in all 3 years. In year 1, we documented denning behavior in 5 of 9 (55%) females, and observed 4 kits from 4 of the denning females (mean litter size = 1.0 ± 0.44). In year 2, 7 of 9 (77%) females denned, with observations of 14 kits (mean litter size = 2.0 ± 0.82). In year 3, 9 of 11 (81%) females denned, and we observed a minimum of 15 kits from the cameras we placed around dens. Females from previous releases (years 1 and 2) successfully produced kits in both years 2 and 3, and all females that have been tracked into their second year after release have denned (n = 8). Across all 3 years we can document a minimum of 34 kits, and the average minimum litter size is 1.50 kits (range 1-3).

Female reproduction (denning) in the first year following release is related to when females are released. Prior to the translocation we predicted that females released in February or March (the period when blastocysts are implanting) would have reduced reproductive success. We hypothesized that the stress of capture, translocation, and naiveté on a new landscape (causing a female to have fewer resources) would cause embryos to fail to implant, or having implanted, be lost prior to partition. Thus, we endeavored to release all fishers prior to January. We were unable to meet this goal in years 1 and 2, but did so in year 3. We have used these data to evaluate our initial predictions about the time of release on reproduction. These analyses show that females released prior to January denned at a high rate (>80%) compared to those released in

January or February (<50%). When we accounted for differences in age class (younger females have a lower chance of denning) we observed the same pattern. These results suggest that the timing of release has important impacts on reproduction in the first year. We are continuing to evaluate these data, and make comparison to other study sites, as well as modeling the effect of lowered reproduction in the first year of release on long-term success.

Monitoring and initial population estimation was done in the autumn of 2011. Over 2 weeks we had 1450 trap nights and captured 14 individuals from 17 captures. Seven of these captures were from animals with either active transmitters (*n*=5) or those that had been lost from the air in previous years (*n*=2). Seven were juveniles (4 males and 3 females), born on the Stirling Management Area from our founder animals, and represent evidence that a reasonable number of fishers born on the Stirling Management Area are surviving to independence from their mothers. Population estimates from this period, using capture-recapture methods, suggested that 18-40 animals existed in the areas that we trapped. We know there are areas that we did not trap that likely contain fishers and some areas located off our study area were later discovered to have fishers that came from our releases.

Trapping continued into the winter and through these efforts we trapped an additional 2 juvenile females and 3 adults from releases in years 1 and 2. By the end of trapping in January we could document at least 34 individuals alive on the Stirling Management Area (including newly released animals). Similar trapping efforts will be conducted again in the fall of 2012, but we shall increase our efforts both spatially (covering a larger percent of our study area) and temporally.

Anticoagulant rodenticides on our public and community lands: spatial distribution of exposure and poisoning of a rare forest carnivore

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The following is the abstract of a paper published in PLoS ONE 7(7): e40163. (2012) (DOI:10.1371/journal.pone.0040163)

Abstract – Anticoagulant rodenticide (AR) poisoning has emerged as a significant concern for conservation and management of non-target wildlife. The purpose for these toxicants is to suppress pest populations in agricultural or urban settings. The potential of direct and indirect exposures and illicit use of ARs on public and community forest lands have recently raised concern for fishers (*Martes pennanti*), a candidate for listing under the federal Endangered Species Act in the Pacific states. In an investigation of threats to fisher population persistence in the 2 isolated California populations, we investigate the magnitude of this previously undocumented threat to fishers, we tested 58 carcasses for the presence and quantification of ARs, conducted spatial analysis of exposed fishers in an effort to identify potential point sources of AR, and identified fishers that died directly due to AR poisoning. We found 46 of 58 (79%) fishers exposed to an AR with 96% of those individuals having been exposed to 1 or more second-generation AR compounds. No spatial clustering of AR exposure was detected, and the spatial distribution of exposure suggests that AR contamination is widespread within the fisher's range in California, which encompasses mostly public forest and park lands. Additionally, we diagnosed 4 fisher deaths, including a lactating female, that were directly attributed to AR toxicosis, and documented the first neonatal or milk transfer of an AR to an altricial fisher kit. These ARs, some of which are acutely toxic, pose both a direct mortality and fitness risk to fishers, and a significant indirect risk to these isolated populations. Future research should be directed towards investigating risks to prey populations that fishers are dependent on, exposure in other rare forest carnivores, and potential AR point sources, such as illegal marijuana cultivation in the range of fishers on California public lands.

Presumably forest management activities can affect fishers: how might we assess such impacts?

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The following is the abstract of a presentation given at the West Coast Fisher Symposium held in Sacramento, California, USA, in 2012.

Abstract - Fishers (*Martes pennanti*) are associated with moderately dense to very dense forested habitats throughout their range and are dependent on structural elements readily available in mature and old-growth forests. Fishers require trees cavities for reproduction and often use such trees for resting. Structural elements are present in varying amounts in late-seral forest stands and generally rare or absent in early seral stands. How much is enough? Can regeneration forest management practices retain such structure in sufficient abundance to meet the needs of fishers and maintain healthy populations?

In northern California, fishers are consistently present and reproducing in landscapes with little or no late seral forest, however, little is known about the quality of such habitat in terms of population dynamics. Are they sources, sinks, or neutral in terms of population demography? We know very little about habitat fitness for fishers. Therefore, it is very difficult to assess impacts on fishers from forest management activities with a high degree of confidence at this time. It seems obvious that forest management activities will affect fishers, but the level of effect will depend on the types of activities and the scale and timing of projects.

As a surrogate to predicting changes in habitat fitness, we have developed an approach that relies on percentages of several vegetation conditions across the landscape measured at the scale of a female fisher home range. The vegetation conditions are based on forest structural stages, which have been classified into 4 basic classes representing fisher denning-resting habitat, total closed canopy forest, early seral sites with dense over-fisher cover, and amount of area with little or no over-fisher cover. We have employed this approach to address impacts of a 15-year forest management plan for the 364 km^2 (90,000 acre) Hoopa Reservation.

Location, location, location: does it really apply to habitat in relation to fisher survival?

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The following is the abstract of a poster presented at the West Coast Fisher Symposium held in Sacramento, California, USA, in 2012.

Abstract - Conservation planning for an imperiled species presupposes an understanding of the environmental characteristics that describe the conditions of greatest fitness for the species. Current fisher habitat suitability models are based on the assumption that occupancy or habitat use patterns are surrogates for demographic parameters.

On the Hoopa Valley Indian Reservation in northwestern California we are using known-fate data collected via radio telemetry to model habitat in relation to survival, providing key information for the conservation of this imperiled and culturally significant species. We have radio collared and sufficiently tracked 86 fishers (30M:56F) between 2004 and present. We have documented 38 mortalities (10M:28F). Of these, 24 (5M:19F) succumbed to predation, 5 (2M:3F) to disease, 2 males to indirect poisoning, 1 female to a research mishap, and 6 (1M:5F) to unknown causes. We lost contact with 25 fishers (11M:14F), and 23 (9M:14F) are currently on the air.

We are comparing male and female fisher survival rates using known-fate data over a 7-year period. We are also modeling habitat covariates in the analyses of non-juvenile female survival. Our assessment of habitat in relation to non-juvenile female survival will be the foundation for recommendations regarding habitat management at the home range and landscape scale, and the first step in modeling habitat fitness potential.

Space use and microhabitat structure selection by American marten in Minnesota

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The following summary of research in progress was revised from an abstract of a poster presented at the 92nd Annual Meeting of the American Society of Mammalogists, held in Reno, Nevada, USA, in 2012.

Track counts and harvest data indicate that the American marten (*Martes americana*) population may be declining in Minnesota. Rest sites and reproductive dens provide marten with protection from predators and severe weather during periods of inactivity. Previous studies have shown that selection of these microhabitat sites depends on local availability of suitable structures. Current knowledge of home range size, rest sites, and reproductive dens has been heavily weighted towards western mountainous and eastern regions.

We deployed radiocollars on 131 American marten in northeastern Minnesota to determine space and habitat requirements. Annual home ranges and core-areas were estimated for 56 marten (37 males, 19 females) with ≥25 locations/year using minimum convex polygon (MCP) and fixed-kernel methods. Males had larger home ranges and core areas than females (Paired *t*-test: 95% Kernel, $t = 2.53$, $P = 0.0073$; 95% MCP, $t = 4.05$, $P = 0.001$; 60% kernel, $t = 4.90$, $P < 0.0001$; Table 1). Fixed-kernel home ranges were significantly larger than MCP home ranges (Paired *t*-test, $t = 9.60$, $P < 0.0001$). Small sample size influenced MCP home range size more than kernel estimates.

We used radiotelemetry to locate 117 rest sites (26 males, 52 females) and 19 reproductive dens used by 10 females (natal dens = 10, maternal dens = 9). Rest site selection varied by season and sex. Marten selected aboveground rest sites more often during summer and ground-level structures more frequently during winter. A greater proportion of female rest sites were in tree cavities, log piles, and burrows in rocky soil compared to males, while males used tree branches and irregular branch growths caused by broom rust fungus more frequently than females. Female marten used both aboveground ($n = 9$) and ground-level ($n = 10$) structures as reproductive dens. Natal dens were predominantly in tree cavities ($n = 7$) while maternal dens were mostly in ground-level structures ($n = 7$).

Table 1. Home range and core-area size (km^2) of 56 American marten (37 males, 19 females) in northeastern Minnesota. Locations used for home range analysis were taken between January 2008 and January 2012.

Method	Sex	Mean (± SEM)	Median	Min. – Max.
95% MCP	Males	5.5 ± 0.6	4.4	1.5 – 14.4
	Females	3.2 ± 0.7	2.0	0.9 – 12.5
95% Kernel	Males	10.2 ± 0.8	9.1	3.9 – 27
	Females	5.1 ± 0.8	4.2	1.3 – 18
60% Kernel	Males	3.4 ± 0.3	3.1	1.2 – 9.9
	Females	1.6 ± 0.2	1.4	0.5 – 5.2

Canine distemper in an isolated population of fishers (*Martes pennanti*) from California

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The following is the abstract of an article to be published in the Journal of Wildlife Diseases (In Press), October 2012 Issue.

Abstract – Four fishers (*Martes pennanti*) from an insular population in the southern Sierra Nevada Mountains, California, USA died as a consequence of an infection with canine distemper virus (CDV) in 2009. Three fishers were found in close temporal and spatial relationship; the fourth fisher died 4 months later at a 70-km distance from the initial group. Gross lesions were restricted to hyperkeratosis of periocular skin and ulceration of footpads. All animals had necrotizing bronchitis and bronchiolitis with syncytia and intracytoplasmic inclusion bodies. Inclusion bodies were abundant in the epithelia of urinary bladder and epididymis but were infrequent in the renal pelvis and the female genital epithelia. No histopathologic or immunohistochemical evidence for virus spread to the central nervous system was found. One fisher had encephalitis caused by *Sarcocystis neurona* and another had severe head trauma as a consequence of predation. The H gene nucleotide sequence of the virus isolates from the first 3 fishers was identical and was 99.6% identical to the isolate from the fourth fisher. Phylogenetically, the isolates clustered with other North American isolates separate from classical European wildlife lineage strains. These data suggest that the European wildlife lineage might consist of 2 separate subgroups that are genetically distinct and endemic in different geographic regions. The source of infection as well as pertinent transmission routes remained unclear. This is the first report of CDV in fishers and underscores the significance of CDV as a pathogen of management concern.

Putting knowledge to work: the Fisher Habitat Extension Initiative

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The following note was originally published by FORREX (Forum for Research and Extension in Natural Resources) in the BC Journal of Ecosystems and Management 13(1) (2012).

Fishers (*Martes pennanti*) are carnivores of the weasel family that rely on many features of late-successional forests to survive and reproduce. Fishers are considered a species at risk in British Columbia (BC) under the Identified Wildlife Management Strategy of the Forest and Range Practices Act 2004, and are also considered a "species of special concern" (blue-listed) by British Columbia's Conservation Data Centre. Under BC's Forest and Range Practices Act 2004, forest licensees are required to maintain key habitat features for fishers within their tenures.

Many late-successional forests in BC are targeted for timber harvest and other forestry activities, which can have negative impacts on the ability of the forest landscape to support fishers. Recognizing that fishers use habitat resources at spatial scales ranging from elements (e.g., tree cavities, rust brooms) to landscapes, a number of options are available to forest practitioners to make forestry decisions that help conserve fisher habitat at each of these operational scales.

Recent research on fishers has identified many opportunities for forest licensees to incorporate decisions that may positively affect the conservation and supply of habitat for fishers during all phases of forest management (planning, harvesting, and regeneration/post-harvest treatments).

Objectives of the Fisher Habitat Extension Initiative

For the last 4 years, the British Columbia Fisher Habitat Working Group has been implementing an extension program called the Fisher Habitat Extension Initiative to support forest management decision makers with relevant information and tools.

The long-term goal of this initiative is to ensure that sufficient habitat is conserved, recruited, and enhanced at different spatial scales – element, patch, stand, and landscape – to sustain populations of fishers distributed throughout their historical range in BC.

This extension initiative aims to achieve this goal by:

- Identifying key forest management practitioners whose decisions affect fisher habitat in BC.
- Helping these target audiences learn about the habitat requirements of fishers.
- Building relevant knowledge and skills among forest management practitioners to facilitate incorporation of fisher habitat needs into their decision-making.
- Inspiring these groups to implement the new knowledge and skills they have learned.

Target Audience

The target audience of this extension initiative includes forest management practitioners active within fisher habitat range (historical, current, or potential) in BC, including: higher-level government and industry planners; planning foresters; government and industry biologists; timber cruising crews; layout personnel; operational foresters; silviculture foresters; machine operators; and forestry contractors.

Outreach and Extension Products and Activities to Date

Outreach and extension products and activities to date include presentations and workshops, decision tools and web products, and pilot field projects.

Fisher Habitat Workshops

These face-to-face events are opportunities for forestry practitioners to acquire relevant information on fisher habitat needs and work with workshop organizers to develop effective ways of incorporating this information into their operational practices. One regional workshop was delivered from October 4th to 5th, 2010 in Williams Lake. In the spring of 2012, a number of training workshops were delivered in Lillooet, Williams Lake, Dawson Creek, and other northern BC locations.

Fisher Wildlife Habitat Decision Aid

This is a user-friendly decision support tool integrating the best available scientific and expert knowledge that forestry practitioners need to consider when managing for fisher habitat requirements. The Fisher Wildlife Habitat Decision Aid is available at http://www.forrex.org/publications/jem/ISS52/vol10_no3_art5.pdf

Fisher Habitat and Forest Management Web Module

This online product is designed to be used at operational levels and for training purposes. It is loaded with information and resources (e.g., maps, summary tables with quantitative management targets, pictures, and presentations) that facilitate the identification, conservation, recruitment, and enhancement of fisher habitat, and is specific for different biogeoclimatic zones of BC. This tool is available at the Fisher Habitat and Forest Management Web Module website: http://fisher.forrex.org

Outreach Presentations in International and Regional Forums

Presentations on this initiative have been made at the 5th International *Martes* Symposium (Seattle, September 2009) and at the West Coast Fisher Symposium (Sacramento, January

31 and February 1, 2012), providing great opportunities to share our experience and also to learn from the fisher conservation work that other colleagues are implementing in western North America.

Pilot Field Projects
Our team is currently working in collaboration with forest licensees within the fisher range in BC in the development of several pilot projects that will test silvicultural prescriptions for fisher habitat in the field and will serve as demonstration projects for forest practitioners.

Affecting Change
The following forestry stakeholders have already expressed their interest in incorporating the above-mentioned information and extension products in their forest management planning and forestry operations within fisher range in BC: Louisiana-Pacific Canada Ltd., West Fraser Mills, Tolko, BC Timber Sales, and the Quesnel and Williams Lake District Offices of the BC Ministry of Forests and Range.

The next steps of this extension initiative include the development and implementation of field silviculture trials in collaboration with our target audience and partners in the forestry sector. In the near future, this extension initiative is also aiming to engage key stakeholders of the oil and gas sector to further improve current fisher habitat management practices in collaboration with partners in this industry.

Acknowledgements
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- Artemis Wildlife Consultants
- BC Hydro – Fish & Wildlife Compensation Program
- British Columbia Ministry of Environment
- Davis Environmental Ltd.
- FORREX Forum for Research and Extension in Natural Resources
- Habitat Conservation Trust Foundation
- Louisiana-Pacific Canada Ltd.

Website
Fisher Habitat and Forest Management Web Module website:
http://fisher.forrex.org

Reproduction, recruitment, and dispersal of fishers (*Martes pennanti*) in a managed, Douglas-fir dominated forest in northwestern California

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The following is the abstract of a paper in press in Journal of Mammalogy.

Abstract - Many demographic parameters of imperiled fishers (*Martes pennanti*) in the Pacific Northwest remain poorly understood but are necessary to develop conservation strategies; herein we report on fisher reproduction, recruitment, and dispersal on the Hoopa Valley Indian Reservation, California to help fill key knowledge gaps. Forty radiocollared, breeding-age females exhibited denning behavior on 80 of 92 (87%) opportunities between 2005 and 2011. Twenty-eight female fishers weaned offspring in 55 of 85 (65%) adequately monitored denning opportunities. Two-year-old female fishers were less likely than older females to den and wean kits. We counted 52, and extracted and marked 51, kits comprising 28 litters of 19 females between 2005 and 2008. Average litter size was 1.9 kits (27F, 24M, 1 unknown) 4-12 weeks post birth. Mean distances between natal dens and centroids of newly established ranges for 7 juvenile females was 4.0 km (range = 0.8-18.0); this distance for one male was 1.3 km. The recruitment rate of juveniles that successfully established a home range/adult female was 0.19 (0.16 for females, 0.02 for males). Our results suggest that managers should work toward increasing female survival rates and consider translocations to increase and expand existing fisher populations.

Density of fishers and the efficacy of relative abundance indices and small-scale occupancy estimation to detect a population decline on the Hoopa Valley Indian Reservation, California

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The following is the abstract of a paper published in Wildlife Society Bulletin 35:69-75 (2011). (DOI: 10.1002/wsb.19)

Abstract - We used a mark–resight design to calculate density estimates of fisher (*Martes pennanti*), a candidate for listing under the United States Endangered Species Act, on the Hoopa Valley Indian Reservation in northwestern California, USA in order to determine population status in 1998 and 2005. Our density estimation results and simultaneous population-monitoring data provided a *post hoc* opportunity to evaluate the relative efficacy of 3 classical indexing techniques (catch-per-unit-effort, frequency of detection at camera stations, and frequency of detection at track-plate stations) and small-scale occupancy estimation to accurately detect population change. We calculated densities (and 95% CI) of 52 (43–64) and 14 (13–16) fishers/100 km^2 in 1998 and 2005, respectively. We detected a decline in the relative abundance of fishers between 1998 and 2005 using catch-per-unit-effort indices ($\chi^2 \geq 10.18$, $P \leq 0.007$), but not in magnitude similar to our density estimates. We detected an increase ($\chi^2 = 4.23$, $P = 0.040$) and no difference ($\chi^2 = 1.38$, $P = 0.240$) in the relative abundance of fishers between surveys using frequency of detection indices at camera stations and at track-plate stations, respectively. Occupancy estimates did not differ between 1998 and 2005. We speculate changes in prey habitat, increases in predation, disease, or some combination of these potential causes, were responsible for the population decline. Our results reinforce the importance of careful thought given to the study goals and potential limitations of any technique. For populations deemed valuable (*e.g.*, at risk or sensitive), we suggest managers consider adopting more defensible, large-scale occupancy estimation or mark–recapture methods to monitor changes in population sizes.

Spatiotemporal variation in resource selection: insights from the American marten (*Martes americana*)

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The following is the abstract for a manuscript submitted to Ecological Applications (in review).

Abstract – Species occurrence is often statistically related to covariates in resource selection functions to characterize species-habitat relationships. Covariates consistently related to occurrence across broad spatial and temporal extents present clear implications for habitat management. However, because animals may exhibit behavioral and genetic adaptations to spatiotemporal variation in habitat conditions across their biogeographic range, effective management and conservation of habitat over broad extents also requires an understanding of these important local adaptations. This is generally achieved by identifying covariates related to species' occurrence over multiple studies conducted in all relevant environments and seasons. Through this process of metareplication, both local as well as range-wide habitat relations may be inferred. Importantly, observed differences in selection between studies conducted in different locations or seasons are not always driven by local adaptations, yet this is often assumed.

In this study, we evaluated the consistency of covariates related to American marten (*Martes americana*) habitat selection in 2 different ecosystems and seasons. We controlled analytical variation by evaluating the same model covariates in a consistent statistical framework based on resource selection functions. Our results indicate that the particular covariates associated with marten occurrence are sensitive to the extent over which they are calculated, which factors are limiting to marten life-history in a particular study area, lack of covariate variation, multicollinearity, and the spatiotemporal consistency of covariate-habitat relationships.

These findings suggest wildlife researchers and managers should not assume that differences in selection between studies are driven by local adaptation, but rather should consider the potential for these factors to influence resource selection functions. Further, we propose that management actions based on inferences gained from synthesis of independent studies should focus on the habitat attributes that satisfy the species' life-history needs, rather than the inconsistently associated covariates per se.

Factors affecting landscape occupancy by fishers in north-central British Columbia

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The following is the abstract of a paper published in the Journal of Wildlife Management 74(3): 405-410 (2010). (DOI: http://dx.doi.org/10.2193/2008-579)

Abstract – To better understand distribution and density of fishers (*Martes pennanti*) in industrial forests of north-central British Columbia, Canada, we examined factors affecting the probability of a potential home range being occupied by 10 radiotagged resident fishers in the Sub-Boreal Spruce biogeoclimatic zone between 1996 and 2000. Percentage of a home range in wetlands and recently logged (within past 12 years) best predicted likelihood of occupancy by each fisher. Probability of a home range area being occupied by a resident fisher decreased with increasing amounts of wetlands and recent logging present in the area. We estimated that a 5% increase in wetlands or recent logging decreased the relative probability of occupancy of a potential home range by 50%. The accelerated rate of timber harvest in forests affected by mountain pine beetle (*Dendroctonus ponderosae*) infestations may have substantial implications for the ability of the landscape of central British Columbia to support sustainable populations of fishers.

Big, sick, and rotting: why tree size, disease, and decay are important to fisher reproductive habitat

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The following is the abstract of a paper published in Forest Ecology and Management 265:230-240 (2012) (DOI: http://dx.doi.org/10.1016/j.foreco.2011.10.043)

Abstract – To gain a better understanding of the factors affecting selection of reproductive habitat by female fishers (*Martes pennanti*) in boreal mixed-wood forests, we identified structures, sites, and stands used by 12 radiotagged female fishers for reproduction between 2005 and 2009 near Dawson Creek, British Columbia, Canada. We deployed a used-unused design to evaluate the support by the data for a series of candidate models at each scale using information-theoretic inference. All dens occurred in internal cavities in large, diseased, and decaying trembling aspen (*Populus tremuloides*; mean DBH = 50 cm, SD = 11, *n* = 20) or balsam poplar trees (*Populus balsamifera* spp. *balsamifera*; mean DBH = 58 cm, SD = 11, *n* = 11). Female fishers appeared to select reproductive denning structures

based upon the difference between the diameter of the tree (cm) from the mean DBH of trees within the site and whether the tree showed signs of damage and visible signs of decay. At the site scale, selection was positively related to mean DBH of aspen and balsam poplar trees and vertical diversity index, and negatively related to density of hard logs (pieces/ha). Females elected stands for reproduction based upon mean DBH of trees >15 cm and the position of the stand within their non-denning home range. In the boreal mixed-wood forests of northeastern British Columbia, reproductive habitat for fishers was strongly linked to infection courts in large, diseased, and decaying aspen and balsam poplar trees. Our data suggests that tree size, damage, and decay play critical roles in the suitability of habitat for reproduction, and forest managers should consider retaining and promoting ecological processes that result in the recruitment of trees with these features if conservation of reproductive habitat for fishers is a concern.

Home ranges and spatial organization of fishers in central British Columbia

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The following is the abstract of a paper published in Canadian Field-Naturalist 123:126-132 (2009).

Abstract – We described the size and spatial arrangement of aggregate and seasonal home ranges for 17 radio-tagged resident fishers (*Martes pennanti*) that were >1.5 years old in two areas of central British Columbia during 1990-1993 and 1996-2000. We estimated home range size for each fisher from the 95% isopleth of the utilization distribution generated using a fixed kernel model with smoothing selected by least-squares cross-validation (95% FK). For comparison to previous studies, we also calculated the minimum convex polygon estimate of home range size (MCP) for each animal. The aggregate home ranges (95% FK) of female fishers ($\bar{x}$ = 37.9 km^2, SD = 18.5, range = 10.5 – 81.2, n = 11) were significantly smaller than those of males ($\bar{x}$ = 161.3 km^2, SD = 100.0, range = 46.0 – 225.2, n = 3; P = 0.019). We observed minor overlap among 95% FK home ranges of fishers of the same sex, but considerable overlap among home ranges of males and females. Home ranges (95% FK or MCP) that we observed in central British Columbia were larger than those reported elsewhere in North America, particularly for males. We suggest that the distribution of resources for fishers may occur at lower gross densities in central British Columbia than in other portions of the fisher's range and that suitable habitat in which fishers can establish home ranges is not found uniformly across the landscape.

EASTERN NORTH AMERICA

Impact of wind farm development on American marten in high-elevation spruce-fir habitat in New Hampshire

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Distribution patterns and habitat use models predict that American marten (*Martes americana*) prefer high-elevation mixed and coniferous stands in northern New Hampshire where deep snow exists (Kelly 2005). Further, seasonal use patterns indicate marten require forests with either greater canopy cover (Buskirk and Ruggiero 1994, Hodgman *et al*. 1997, Fuller and Harrison 2005) and/or enhanced structural complexity during winter months.

Much of the current and proposed wind farm development in the northeastern United States occurs along high-elevation ridgelines where measureable disturbance could destabilize the fragile forest community. Succession is slower compared to lower-elevation habitats (Sprugel 1976), and associated fragmentation might reduce marten occupancy (Harrison 2011). In New Hampshire, wind farm development is identified as the greatest immediate threat in high-elevation spruce (*Picea rubens*)-fir (*Abies balsamea*) habitat (WAP 2005). Additionally, climate change models predict these forests to either disappear (Iverson and Prasad 2001) or become reduced in the long-term (Tang and Beckage 2010).

The objectives of this study are to assess the potential impacts of wind development (the Granite Reliable Power WindPark, a.k.a. GRP WindPark; 33 turbines) on marten in high-elevation (>2700 feet) (823 m) spruce-fir habitat in northern New Hampshire. Specific objectives include measurement of seasonal home ranges, movements, and habitat use, as well as development of a cost-effective method to index abundance and distribution. The 50-km^2 study area is located in Coos County, New Hampshire, specifically within the townships of Millsfield, Dixville, Odell, and Ervings Location (Fig. 1). Mt. Kelsey, Owlhead Mountain and the surrounding lowlands delineate the study area.

Background and Methods

A total of 34 marten have been captured since 29 October 2010, and 7 are currently (October 2012) monitored via remote dataloggers and ground telemetry. The use of spruce-fir on Kelsey and Owlhead Mountains is continuously monitored by 3 ATS 4500S receiver/dataloggers, which detect and store radio signals of marked marten within a prescribed area of ~8 km^2 from 3 locations (Fig. 2). Telemetered animals have been located weekly to obtain ~50 locations per year, ~25 each in leaf-off (1 November – 30 April) and leaf-on seasons (1 May – 31 October), to measure home range size, movements, and fidelity, and to provide comparisons with remote datalogger data.

To test the hypotheses that wind farm construction and/or season affects marten use of spruce-fir, the study was divided temporally into construction and seasonal periods. Specifically, we predicted that the use of spruce-fir will decrease due to disturbance and fragmentation associated with wind farm construction; alternatively, we predicted that use of spruce-fir can be explained by seasonal patterns, with greater use occurring during the leaf-off period.

Pre-construction monitoring began on 5 December 2010, construction commenced on 12 February 2011, and towers became operational on 12 November 2011. Five separate construction periods were defined initially, and 5 identical time periods were used to create comparative study periods for the following year (Table 1). The seasonal period was defined by local seasonal changes with respect to leaf emergence and senescence (*i.e.*, leaf-on = 15 May – 15 October and leaf-off = 16 October – 14 May) (Table 1).

Analysis of construction and seasonal periods in 2010 – 2012 included 10 marten (8M:2F) monitored for ≥3 construction periods for ≥30 days per period, and ≥2 seasons for ≥50 days per season (Table 1). A power analysis was performed to determine the number of days needed for each period; all marten exceeded the minimum requirement of days. The range of detection frequency per marten per period was 0 – >37,425 (Table 1). Further, the number of marten monitored per period was chosen to provide a relatively equal sample size across periods. All analyses were restricted to marten with home ranges containing spruce-fir based on standard evaluation of home range from VHF telemetry (minimum 25 locations/period).

Statistical analyses

We used generalized linear mixed effect models (GLMM) (software R version 2.14.0, R Cran Package "lme4"; Bates *et al*. 2012) to determine if construction and/or season impacted the frequency (presence/absence) and intensity (detections/day) of spruce-fir use by marten. Three competing models ("construct", "season", and "day") were tested for both logistic and Poisson models, and 2 fixed effects ("construction", "season"), and 2 random effects ("marten", "day") were included in the models. The "day" model was included as a random model to measure its influence on the response. The model with the best fit was determined by using Akaike Information Criterion (AIC) scores.

Results

The "construct" logistic model performed slightly better than the "season" logistic model. The random effect "marten" did vary and was retained in all models (Table 2). The "day" model performed poorly, and was not included as a random intercept. All periods – except for the "Tower Construction" period – had different detection odds compared to the "Construction Lull" period (dummy variable) (Table 2). Specifically, the odds of marten being detected in spruce-fir were less during "Pre-Construction" (z = -6.12; P >0.0001) and "Road Construction" periods (z = -3.09; P >0.001), greater during "Road Clearing" (z = 3.25; P >0.001), "Operational 1" (z = 11.96; P >0.0001), "Operational 2" (z = 7.64; P >0.0001), "Operational 3" (z = 7.82; P >0.0001), and "Operational 4" periods (z = 7.48; P >0.0001), and similar during the "Tower Construction" period (Table 2).

The "season" logistic model was also interpreted because the AICc scores were similar to the "construct" model (Table 2). All seasons had different detection odds compared to the "Leaf-off 1" season (dummy variable). The odds of marten being detected in spruce-fir were less during the "Leaf-on 1" season (z = -7.16; P >0.0001), and greater during the "Leaf-off 2" (z = 14.66; P >0.0001), and "Leaf-on 2" seasons (z = 8.54; P >0.001) (Table 2).

The "construct" Poisson model performed well compared to all other models, and the random effect "marten" was retained in all models (Table 3). The "day" model performed poorly, and was not included as a random intercept. Similar to the best performing logistic model, all periods – except for the "Tower Construction" period – had different detection rates compared to the "Construction Lull" period (dummy variable) (Table 3). Specifically, the detection rates for marten in spruce-fir were less during "Pre-Construction" (z = -31.73; P >0.0001) and "Road Construction" periods (z = -61.73; P >0.0001), greater during "Road Clearing" (z = 21.03; P >0.0001), "Operational 1" (z = 97.71; P >0.0001), "Operational 2" (z = 59.16; P >0.0001), "Operational 3" (z = 89.15; P >0.0001), and "Operational 4" periods (z = 7.92; P >0.0001), and similar during the "Tower Construction" period (Table 3).

The second best performing Poisson model ("season") had higher AICc values, yet results will be reported to compare models. All seasons had significantly different detection rates compared to the "Leaf-off 1" season (dummy variable). The detection rates for marten in spruce-fir were less during the "Leaf-on 1" season (z = -67.31; P >0.0001), and higher during the "Leaf-off 2" (z = 134.67; P >0.0001) and "Leaf-on 2" seasons (z = 21.27; P >0.001) (Table 3).

Discussion

This analysis indicates that both season and construction probably influenced the use of spruce-fir by marten. Interestingly, the detection rate was lowest during the "Road Construction" and "Leaf-on 1" periods, which corresponded with the most marten monitored during all periods. These periods were characterized by disruptive construction activity (e.g., heavy machinery and blasting). In the periods ("Operational 1, 2, and 3 periods") and seasons ("Leaf-off 2" and "Leaf-on 1") following construction, marten were more likely to be detected in spruce-fir. Overall, marten were more likely to be detected and had higher detections rates during leaf-off seasons.

Because the "Operational" periods correspond to the construction phases of the previous year, comparisons can be made between these periods (Table 1). Likewise, the same comparisons can be made between seasons (Table 1). Marten were more likely to be detected during the "Operational 4" period and had higher detection rates compared to "Road Construction," the corresponding period in the previous year, supporting the conclusion that construction contributed to lower use of spruce-fir.

We expected the use of spruce-fir to decline post-construction due to habitat loss, fragmentation, and disturbance associated with wind turbines. Although use of spruce-fir declined during the construction periods, the greatest use of spruce-fir occurred in the first 2 Operational periods. Although construction periods were a better predictor for both models, the results are confounding, and the seasonal hypothesis (i.e., marten will use

spruce-fir more often in the leaf-off periods) describes the trends of the data more accurately than the construction hypothesis. Overall, the data conform to known seasonal habitat use patterns in that marten select stands with greater canopy cover during winter (Steventon and Major 1982, Fuller and Harrison 2005). Further, the elevations that marten were detected in followed the same seasonal trends.

Other factors presumably confound location data during both seasonal or construction periods. For example, territorial shifts and fluctuating resources have the potential to increase or reduce use of spruce-fir. Marten shift home ranges when space becomes available (Katnik *et al*. 1994, Phillips *et al*. 1998), and preferentially use specific habitats (*e.g.*, regenerating clearcuts) to access seasonal forage (*e.g.*, soft mast) (Soutiere 1979, Steventon and Major 1982, Martin 1994).

Marten were located via ground telemetry in spruce-fir more often during leaf-off seasons. This data supports the trends found in the datalogger data. Remote dataloggers have proven effective for monitoring habitat use, and provide fine-scale data not afforded by traditional telemetry monitoring methods (ground/aerial telemetry). Further analyses of this data will be to test for patterns in time of use, and whether marten were moving or resting in spruce-fir habitat.

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Table 1. Summary of period dates, period lengths (days), range of detections, total of detections, and sample size of marten monitored each period.

Construction Periods	Length (days)	Range	Total	Marten (*n*)
Pre-Construction (5 Dec. 2010 – 11 Feb. 2011) *	69	67-2098	3876	7
Road Clearing (12 Feb. 2011 – 31 Mar. 2011)	48	99-5178	7791	6
Construction Lull (1 Apr. 2011 – 19 May 2011)	49	138-2450	5491	6
Road Construction (20 May 2011 – 31 Aug. 2011)	104	0-661	1936	9
Tower Construction (1 Sep. 2011 – 11 Nov. 2011)	72	1-4362	9540	7
Operational 1 (12 Nov. 2011 – 11 Feb. 2012)	92	262-21166	48714	7
Operational 2 (12 Feb. 2012– 31 Mar. 2012)	48	303-5160	13943	6
Operational 3 (1 Apr. 2012 – 19 May 2012)	49	14-10018	18153	5
Operational 4 (20 May 2012 – 31 Aug. 2012) **	104	57-4398	7649	4
Operational 5 (1 Sep. 2012 – 11 Nov. 2012) **	72	5-147	159	4
Seasonal Periods	**Length (days)**	**Range**	**Total**	**Marten (*n*)**
Leaf-off 1 (5 Dec. 2010 – 15 May 2011) *	162	605-9667	16894	7
Leaf-on 1 (16 May 2011 – 15 Oct. 2011)	153	0-3016	6132	9
Leaf-off 2 (16 Oct. 2011 – 15 May 2012)	212	263-37425	85018	7
Leaf-on 2 (16 May 2012 – 15 Oct. 2012)**	115	62-4816	9208	5

* Dataloggers began monitoring on 5 December 2010.

** Actual number of marten for these periods is unknown and dependent on current marten remaining through following monitoring periods.

Table 2. Results of a GLMM logistic regression analysis of detection data collected by 3 remote receiving stations in spruce-fir in northern New Hampshire. Results indicate the "construct" model to be slightly better at predicting the response (presence of marten in SF).

Model	K	AICc	Delta_AICc	AICcWt	Cum. Wt.	LL
construct	10	2987.81	0	0.99	0.99	-1483.87
local	5	2998.22	10.41	0.01	1	-1494.1
day	2	4184.8	1196.99	0	1	-2090.4

Parameter (construct)	Estimate	Std. Error	*z*-value	Exp. Estimates
(Intercept)	-0.57	0.55	-1.04	
Operational 1	2.95	0.25	11.96***	19.19
Operational 2	2.14	0.28	7.64***	8.46
Operational 3	2.53	0.32	7.82***	12.51
Operational 4	1.91	0.26	7.48***	6.74
Pre-Construction	-0.58	0.19	-3.09**	0.44
Road Clearing	0.69	0.21	3.25**	1.99
Road Construction	-1.08	0.18	-6.12***	0.66
Tower Construction	0.31	0.20	1.57	1.36
Parameter (season)	Estimate	Std. Error	*z*-value	Exp. Estimates
(Intercept)	-0.56	0.53	-1.06	
Leaf-off 2	2.49	0.17	14.67***	12.03
Leaf-on 1	-0.85	0.12	-7.16***	0.43
Leaf-on 2	1.89	0.22	8.54***	6.64

** P <0.001
*** P <0.0001

Table 3. Results of a GLMM Poisson regression analysis of detection data collected by 3 remote receiving stations in spruce-fir in northern New Hampshire. Results indicate the "construct" model to be slightly better at predicting the response (marten detection/day in SF).

Model	K	AICc	Delta_AICc	AICcWt	Cum. Wt.	LL
construct	10	148349.2	0	1	1	-74164.57
local	5	162448.6	14099.4	0	1	-81219.29
day	2	162616.1	14266.87	0	1	-81306.03

Parameter (construct)	Estimate	Std. Error	*z*-value	Exp. Estimates
(Intercept)	2.25	0.40	5.57***	
Operational 1	1.49	0.02	97.71***	4.42
Operational 2	0.99	0.02	59.16***	2.70
Operational 3	1.47	0.02	89.15***	4.33
Operational 4	0.15	0.02	7.92***	1.16
Pre-Construction	-0.67	0.02	-31.73***	0.51
Road Clearing	0.37	0.02	21.03***	1.45
Road Construction	-1.79	0.03	-67.36***	0.17
Tower Construction	0.03	0.02	1.74	1.03
Parameter (season)	Estimate	Std. Error	*z*-value	Exp. Estimates
(Intercept)	2.2166	0.34	5.57***	
Leaf-off 2	1.3196	0.01	134.67***	3.74
Leaf-on 1	-1.033	0.06	-67.31***	0.36
Leaf-on 2	0.3021	0.01	21.27***	1.35

** P <0.001
*** P <0.0001

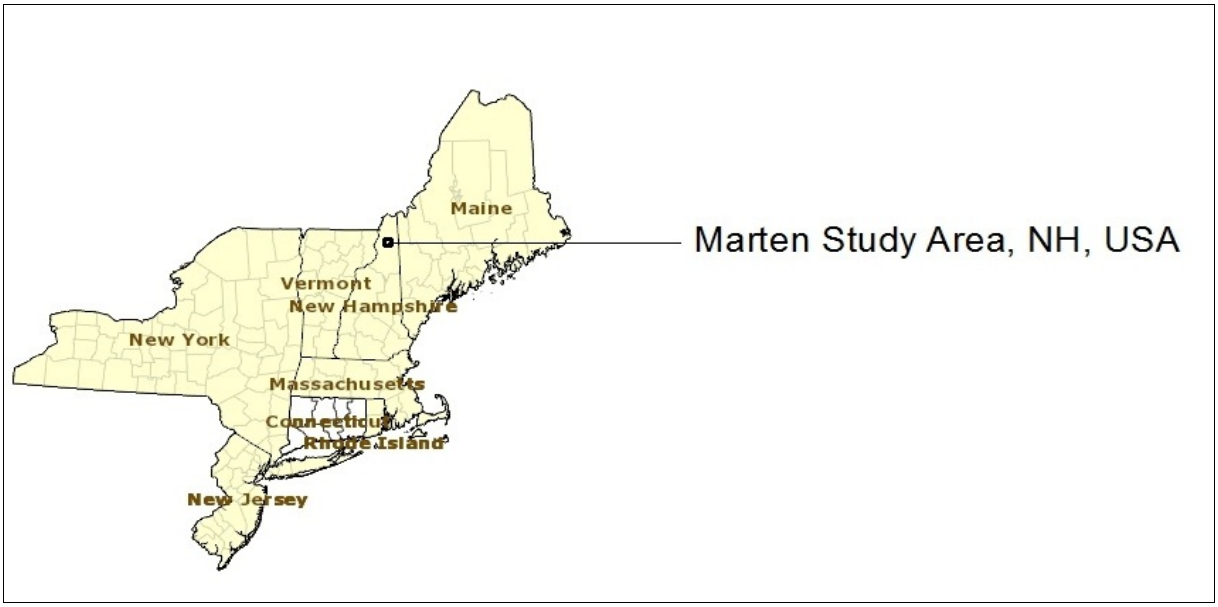

Figure 1. Kelsey Mountain Study Area (~50 km^2) in northern New Hampshire.

Figure 2. Downloading data from a station on Kelsey Mountain. Dataloggers are fixed with dipole, omni-directional antennas and monitor ~8 km^2 area.

EUROPE

Do macroscale patterns in carnivore diet apply at mesoscales? A test with pine marten (*Martes martes*) in Scotland

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The following is the abstract for a manuscript submitted to Mammal Review (in review).

1. The accumulation of dietary data collected at local spatial scales from wide-ranging carnivores has enabled a recent proliferation of biogeographic analyses of carnivore diet across global scales. Such analyses are useful for elucidating how environmental gradients drive the localized foraging adaptations of carnivores worldwide. However, environmental drivers at macroscales are not necessarily the same as those acting at mesoscales, and investigation of how this is reflected in regional dietary patterns is therefore warranted.

2. We used independent data on the diet of pine martens *Martes martes* to test whether predictions from recent biogeographic syntheses of marten diet at macroscales applied at a mesoscale (within Scotland).

3. Against predictions, we found latitude, longitude, and elevation had no effect on diet diversity, and that diet composition demonstrated a stronger longitudinal than latitudinal trend (in which small mammals were increasingly consumed in the west, and birds and fruit in the east).

4. In line with predictions, duration of snow cover had a strong influence on marten diet diversity, indicating a more varied diet as snow cover persisted. Both snow cover duration and diet diversity were associated with consumption of small mammals. Together, these patterns indicated that as duration of snow cover increased from west to east, marten access to voles became limited and they were forced to diversify their diet.

5. Our findings suggest that while the diet of martens at regional scales is driven by the same climatic factor as at global spatial scales (snow cover duration), climate patterns at mesoscales occurred along different geographical gradients than at macroscales (i.e. longitude rather than latitude). We suggest that proximity to, and orientation with, orographic features and prevailing atmospheric pressure systems may better explain mesoscale patterns in climate, and therefore carnivore diet, than geographic location alone.

Martens in the matrix: the importance of nonforested habitats for forest carnivores in fragmented landscapes

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The following is the abstract of a paper published in the Journal of Mammalogy 93(2): 464-474. (2012) (DOI: http://dx.doi.org/10.1644/11-MAMM-A-149.1)

The intervening landscape between patches of forest (*i.e.*, matrix) has enormous potential to mitigate the negative effects of forest fragmentation. However, to release this potential requires understanding of how individual species perceive matrix. Here we investigated use of matrix by pine martens (*Martes martes*) in a region with low forest cover (Scotland). We radiotracked 11 martens to determine their habitat preferences, then combined our data with those published from 5 additional Scottish landscapes to examine how home-range size (*i.e.*, population density) and diet of martens varied with forest edge density (*i.e.*, fragmentation). Our tracking showed that although mature forest was the most preferred habitat, certain matrix habitats (scrub and tussock grassland) also were consistently selected. These 2 habitats provided martens with fundamental resources that are of limited availability within intensively managed plantation forests: den sites and primary prey (*Microtus agrestis*). Our synthesis of data across landscapes indicated martens benefit from supplemental resources in matrix habitats; consumption of small mammals increased with fragmentation and coincided with an initial increase in marten population densities. However, population densities of martens decreased once fragmentation passed a threshold level. Our results demonstrate that habitat complementation at the landscape-scale is essential for some forest-associated species. Resource supplementation from matrix habitats may be particularly important in regions with a long history of low-forest cover or where forest cover is now dominated by afforested plantations, which may lack essential resources.

The seasonal diet of British pine marten determined from genetically identified scats

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The following is the abstract of a paper published in the Journal of Zoology (Early View) (2012). (DOI: 10.1111/j.1469-7998.2012.00951.x)

Knowledge of a carnivore's foraging behavior is central to understanding its ecology. Scat content analysis provides a non-invasive way to collect such information but its validity depends on attributing scats to the correct species, which can prove problematic where similarly sized species occur sympatrically. Here we provide the first description of the diet of European pine marten *Martes martes* in Scotland based on genetically identified scats (*n* = 2449). Concurrent small mammal live trapping also allowed us to determine preferential selection of small mammal species. We found the marten diet was almost entirely formed by 3 principal foods: *Microtus agrestis* (39%), berries (*Sorbus aucuparia* and *Vaccinium myrtillus*: 30%) and small birds (24%). The seasonal dominance of these foods in the diet suggested a facultative foraging strategy, with a short period in which the diet was more generalized. A discrepancy in the occurrence of *Microtus* in the diet (77% of small mammals consumed) and marten home ranges (12% of small mammals trapped) indicated a frequency-independent preference for this prey, one that differentiated British marten from marten in continental Europe. *Microtus* were the marten's staple prey and taken with relative consistency throughout the year, even at times when rodent populations were at their least abundant. Martens supplemented their diet with small birds and fruits as these foods became abundant in summer. The diet became generalized at this time, reflected by a threefold increase in diet niche breadth. *Microtus* consumption was significantly reduced in autumn, however, when their populations peak in abundance. The autumn diet was instead dominated by fruit, an abrupt dietary switch suggesting a frequency-dependent preference for fruit irrespective of the abundance of alternative prey.

Comparison of mitochondrial DNA variability of continental and island stone marten (*Martes foina*) populations from Croatia

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The following abstract is from the 11th Croatian Biological Congress (2012): 162-163.

The majority of plant and animal island populations have lower genetic variability than continental populations of the same species. Variability of island populations is influenced by founder effect, mutations, population size, distance from the mainland, and migrations. Stone marten (*Martes foina*) is an autochthonous species in Croatia, inhabiting the entire continental part, but it can also be found on islands. The species is adapted to humans, so it can be found not only in forests, meadows, and karst, but also in agriculture, industrial, and urban areas. The goal of this research was to compare mitochondrial DNA variability of stone marten from central Croatia and the island of Hvar. We have analyzed 26 samples from central Croatia and 20 samples from Hvar. Among the 592 base pair long sequence, we found 49 polymorphic sites comprising 12 haplotypes. Eight haplotypes were found in central Croatia, 2 on Hvar, and 2 in both continental and island populations. All measures of

genetic diversity were higher for the continental population (gene diversity H = 0,800, nucleotide diversity Π = 0.033, mean number of pairwise differences π = 19.323) than for the island population (H = 0.614, Π = 0.007, π = 3.905). We conclude that stone marten from Croatia have very high mitochondrial DNA diversity, but the diversity of the island population is lower than the continental due to the limited population size and reduced migration possibility.

Fox and martens – are they really opportunistic feeders? A case of beetles and other arthropods occurrence in carnivores' diet

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The following is the abstract of a paper published in the Baltic Journal of Coleopterology 10(2): 129-139 (2010).

The main goal of the investigation was to assess and compare insects' abundance in diet of fox (*Vulpes vulpes*) and martens (*Martes martes*, *Martes foina*). The research was carried out in 3 national parks and in the city of Kraków, all located in the southern Poland. The collection of carnivores' faeces took place between 2002 and 2007. The total number of samples was 517 for foxes and 747 for martens. 59 insect species were recognized in 19% of samples. Forward selection of canonical correspondence analysis revealed factors that were carnivore species, place of collection which both described 89% of variance of insect species environment relations. Martens as a variable seemed to be the most influential on the composition and relative abundance of all insect assemblages (Monte Carlo test F = 3.94, P <0.001). Moreover, the place of collection was an important factor (Monte Carlo test F = 3.03, P = 0.002 and F = 2.18, P = 0.002, respectively for Kraków and the Tatra Mountains). Martens fed most often on nest insect species, whereas foxes chose large beetles. The diagram of canonical correspondence analysis confirmed that distribution of specific groups of arthropods depended on carnivore feeder as well as occupied habitat.

Human-wildlife conflicts with carnivoran species in the city of Krakow (Poland)

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The following is the abstract of a chapter published in Piotr Indykiewicz, Leszek Jerzak, Jörg Böhner, and Brendan Kavanagh, editors. 2011. Urban Fauna: Studies of Animal Biology, Ecology, and Conservation in European Cities, pp. 553-559. UTP Bydgoszcz, Poland.

Abstract – Human-wildlife conflicts were studied looking at carnivore species in Krakow, one of Poland's biggest metropolitan cities. Between September 2007 and January 2010, 202 records of conflicts with 6 species were collected, which included stone marten *Martes foina*, red fox *Vulpes vulpes*, Eurasian otter *Lutra lutra*, European badger *Meles meles*, raccoon dog *Nyctereules procyonoides*, and stoat *Mustela ermine*. Three categories of conflict were identified: property intrusion, damage, and car collision. The majority of the records referred to red fox and stone marten. Both species were recorded in administrative districts of Krakow; red fox in 18 and stone marten in 16. Stone marten mainly caused property damage (entering attics in buildings and car engines), whereas red foxes were more commonly associated with property intrusion. Individuals of all 6 species were found as road kills.

RUSSIA

About the study of the ecology of Baikal Sable using stable isotopes of strontium in 1956-1960

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Recently, the Journal of Mammalogy (Vol. 93 No. 2, April 2012) published a series of 10 articles on the use of radioactive isotopes in the ecology of mammals. Background information from M. Ben-David and E.A. Flaherty (2012a) showed that this is a promising direction for further study of ecology and biology of mammals. However, from the introductory text it is clear that these studies have been carried out only in the last decade, the most active of the new millennium. Indeed, an analysis of the references shows that the earliest works were published in 1989 (Schell *et. al*. 1989) and 1996 (Best and Schell 1996). The remaining references are distributed by publication date as follows: 3 for 2001-2005, 4 in 2006-2010, and 10 for the years 2011-2012.

The 10 articles that comprise the feature section of the Journal of Mammalogy reported studies using stable isotopes of different elements (mainly nitrogen, carbon, sulfur, and strontium) for investigating various aspects of mammalian ecology. The first of these 10 research papers (Ben-David and Flaherty 2012b) provides some initial guidance on the problem. This paper acknowledges those who paved the way in this area of mammalian ecology and describes how their investigations developed. What does an analysis of the references mentioned in this article show?

The distribution of cited works by decades is as follows: 1 for 1970s, 6 in 1980s, 22 for 1990s, 76 in 2000s, and 13 in 2010s. The first ecological studies of radioactive isotopes in

mammals began in the 1970s and 1980s, and 5 of 7 cited papers were in line with this direction. They were dedicated to the study of dietary habits, mostly in marine mammals.

I would like to direct your attention to these facts for the following reasons. My father, Dr. Genrikh Monakhov, was a member of a 7-person expedition conducted in the winter 1956-1957 by the East-Siberian division of Research Institute of Hunting (now VNIIOZ, All-Russian Research Institute of Hunting and Fur-Farming). The main task of this difficult venture in the Baikal taiga was to build a platform for ecological studies of spatial movement of sable using the application of radioactive isotopes. Experiments were carried out under the guidance of Prof. N.V. Timofeev-Ressovsky, and Dr. V.V. Timofeev, his brother, the famous sable researcher. The sulfur 35S and strontium 90Sr isotopes were used for labeling; these are introduced to sables orally.

Further work continued in the 1959-1960 winter season. Materials collected during these 2 winters were analyzed for several years. Their observations lead to 1 published article (Monakhov and Timofeev 1965). The main conclusion of their work was that labeling with radioisotopes can be successfully applied in the study of spatial navigation in sables. Sable movements of up to 20 km have been recorded from places with activated bait. Six months after marking at the site, only 1 of 26 labeled animals was caught; the others left the experimental plot. This pioneering work discovered previously unknown features of the ecology and behavior of sable.

Now the East-Siberian division of VNIIOZ no longer exists; it was abolished in the early 1990s. The studies were conducted in the interfluve of the Lena and Tongoda Rivers (coordinates between 107°18`E/54°35`N and 107°53`E/54°24`N). Now this territory is included in the State Baikal-Lena Reserve, organized in 1986.

In the above-mentioned issue of the Journal of Mammalogy, there is an article (Pauli *et al*. 2012) dedicated to similar studies of North American *Martes americana* that took place in 2006-2008. Thus we can note that in Russia the study of another representative of the genus *Martes* with the use stable isotopes was carried out 50 years before.

It should be noted that in the late 1950s in the USSR precise techniques of radio-labeling animals (mostly rodents) were not yet available. Many details were perceived through personal experience (Ternovskaya and Vorsin 1959, Shura-Bura *et al*. 1960, 1962, Sudeikin *et al*. 1962). Of course, the book by Comar (1955), a pioneering manual for observing the movements of organisms, elements, and compounds, includes about 15 references to research on radioactivity in Russia in 1947-1953. In 1957, the translation of this book was published in Soviet Union (Comar, 1957). In its preface, Prof. A.A. Nichiporovich noted that guidance on the application of labeled atoms in agriculture, medicine, and biology had already been published in the USSR in the early 1950s.

The use of stable isotopes for labeling mammals actively began to develop in the 1970s and 1980s not only in the United States (Ben-David and Flaherty 2012b), but also in the USSR (Litvin 1967, Kulikova and Timofeev-Ressovsky 1965, Bazhenov 1980, Bazhenov *et al*. 1983, 1984). Some monographs summarizing the results obtained using this method were

issued at the end of the 1980s (Bolshakov and Bazhenov 1988, Bazhenov 1989). Bolshakov and Bazhenov (1988) found that the first experiments on radioactive tagging of insects were conducted by D.W. Jenkins (1954), Yu. G. Ternovskaya and A.N. Vorsin (1959) in rodents. However, G.I. Monakhov and V.V.Timofeev (1965) were the first for carnivores, with their work on sable.

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Martes and other mustelids in the Southern and Middle Urals

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Over the past decades, the numbers of many game mammals in Russia have changed. This is due to a change of priorities in the fur market, which has emphasized mainly those species that can easily be exploited. The Urals region is no exception. As noted previously (Korytin 2011; Monakhov 2010, 2011a, 2011b), the numbers of *Martes* species (pine marten *Martes martes* and sable *Martes zibellina*, which are sympatric in the Urals), and other mustelids have significantly changed in the last 20-25 years. Identifying the reasons for these trends is one of the tasks of joint project, *Methodology of monitoring and prognostication of game animals resources in Sverdlovsk region under new economic conditions* (No. 10-04-96063 RFBR-Ural), which is now being performed.

The following has been established in the course of the project. Over the last 20-25 years there have been changes in game animal communities: their numbers have changed, due to industrial development, or because their habitats are being converted by succession. Certain species (sable and ungulates) are locally hunted noticeably more intensively than in the past. For these reasons, further study of the populations of these species is needed in order to develop and implement methods of population management of the hunted mammals (Monakhov and Domnich 2010; Monakhov 2011b, 2012c).

In 2011, the numbers of 23 important species of game animals in the 47 municipalities in the Sverdlovsk region were identified for the past 8 years. A comparison of game animal resources in terms of mean annual number was used to estimate significant trends in their regional, zonal, and district abundances over a 20-year period (Monakhov 2011a, 2012b, 2012d). Significant increases in number were observed for some species, including marten, sable, mink, otter, beaver, wild boar, roe deer, fox, bear, and muskrat. However, other

species, such as ermine, weasel, Siberian weasel, and mountain hare, showed a significant reduction in abundance.

Korytin (2011) also found such changes in the number of Middle Urals carnivores. He attributed these changes to man-made causes. In 1980 – 1990, the numbers of marten, sable, and fox were limited by hunting. When these harvest factors were removed in the 2000s, the population of these species increased strongly.

Global (20-year) abundance trends can be verified by comparing the local numbers for the last 5-7 years. This reveals whether the ongoing nature of the identified trends or changes have attained a "plateau" phase. We base the calculations on the biological productivity of hunting habitats, which will form the basis of methods for determining regional standards for mustelid exploitation (Monakhov 2012d).

The environmental effect of changes in abundance of predatory species due to anthropogenic and natural factors can be quite varied. We believe that the decline in abundance of species such as the Siberian weasel and ermine (Monakhov 2011a, 2012b) may be attributed to the reduction of their characteristic habitats (overgrown fields and meadows) by deciduous and coniferous young forest, and to an increase in the numbers of other predators. The increase in forest cover through succession on uncultivated agricultural land offers the prospect of growth in habitats for forest species in the near future.

Recent studies (Borisov and Lomanov, 2006; Safonov *et. al*. 2006; Monakhov 2010, 2011a, 2012b; Korytin 2011, Sinitsyn 2012) have shown that the growth in sable number has continued in recent years. In a roundtable discussion at the Kirov conference *Modern Problems of Nature Management, Hunting and Fur Farming*, held in June 2012, leading ecologists and sable researchers documented that sable harvest in Russia reached 700,000 – 750,000 animals in the winter 2011 – 2012 game season. The species resources in the country are estimated at 2.0 – 2.2 million animals. In different parts of the area, this relationship has a variety of causes. In the eastern part (especially in Yakutia), the number of unoccupied habitats continued to increase under intensive exploitation. In the western part, the increase has been attributed to reduced hunting pressure because of socio-economic factors. In connection with the numbers trend, from the point of rationalizing exploitation, it is appropriate to propose increasing quotas for sable and marten (Monakhov, 2011b).

Methodological approaches to perfecting a system of economic development with respect to the new economic conditions but derived from the possible productivity of regional game lands using elements of population management based on population natality have been published (Monakhov and Domnich 2010, Monakhov 2012c). In addition, there is also the need to manage the numbers of some mammals that have a negative impact on the components of the environment and the economy. Beavers are multiplying in number and expanding their ranges, leading to flooding in economically important lands, and felling trees along roads and power lines. Bears in Siberian districts have absolutely no fear of people, getting into towns and suburban cooperatives, as well as roadside dumps, scaring

the people, and often attacking them. Much information is available about the increasing number of wolves, whose negative impact and the damage is known. Unfortunately, the biggest drawback of the abolition of hunting leases is the loss of statistical reporting on indicators such as the number of game animals and the size of their annual use, *i.e.*, those data that made it possible to evaluate the activity of the farms and the efficiency of the natural resources entrusted to it.

Resource management of game animals should be based on knowledge of the dynamics of population structure: age, sex, environmental, spatial, and genetic. Therefore, in 2012, work began on the project No. 12-P-45-2002 at section 30 "*Wildlife: current status and problems of development*" of the Presidium of RAS called *Mustelids of Middle and South Urals: Present Status and the Relationship between Species*.

Research plans for this project are related to the study of species diversity, abundance, and spatial distribution of martens in the most typical habitats of various landscape and geographical zones of the Southern and Middle Urals. The studies will examine the current status of mustelids and the major factors that determine their abundance and distribution in the region, as well as the peculiarities of the population structure and the relationships between species.

Research on the relationships of the genus *Martes* were initiated by our group in 2004, the project RFBR-Ural 04-04-96006 *The Dynamics of Populations and Habitat Forming Species (Carnivora, Mustelidae) in the Urals*, and continued in the framework of the project 07-04-96105 *Modern Taxonomic and Phenogenetic Status of the Ural Martes in Genus System*. We studied the quantitative relationships of *Martes* species in the zone of spatial superposition, the configuration of boundaries within the Sverdlovsk region, and verified their intraspecific status and interspecific consensus.

This year, special attention was paid to the search for possible areas of remaining habitat of European mink (*Mustela lutreola*). This species is now causing the great concern for the state of its resources. Recently, late 2011, there was a discussion on the IUCN Small Carnivore Specialist Group website concerning the status of *M. lutreola* and additional measures for its protection. The result of the discussion was the decision to designate *M. lutreola* to a new, more restrictive category of rarity – Critically Endangered (Aulagnier *et al*. 2011). The European mink had been assigned the Endangered status for quite a long time, from 1994 to 2011. However, the steady decline in the numbers and habitats, not only in the west of Asia, but also in the east and west of Europe, forces us to take additional measures for the protection of resources of the European mink, in the opinion of many researchers.

In 2012, we identified key areas and river basins of the Middle Urals, and have already begun reconnaissance work, with the detection of inhabited areas as our ultimate goal. This year we are also studying the patterns of manifestation of intersexual differences in sable in natural and fur-farm populations (Monakhov 2012a). This work is partially supported by RFBR (project 10-04-96063) and by Presidium of RAS (project 12-P-45-2002).

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Sable in the western spurs of the Verkhoyansk Ridge

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The following is the abstract of a paper published in the Journal of Siberian Federal University, Biology 2(4): 133-141 (2011)

Population structure, fecundity, and participation in breeding of female sables (*Martes zibellina* L.) of different ages, feeding trends, and fat condition were studied under cold climate conditions in the spurs of the Verkhoyansk mountain ridge. We observed a relatively simple age structure, rapid alternation of generations in the population, increased mortality of mature-age females, abundance of junior age cohorts in the sable stock, and larger mean value fecundity. Sables with low fat reserves made up over two thirds of the population. A change in their fat condition depended on the consumption level of animal food items. In some years seeds of the mountain pine were more important as a foodstuff. Females of reproductive age had the least fat reserves, which may be regarded as one of the reasons of their increased death rate.

Ecology of sable (*Martes zibellina* L.) in western Yakutia

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The following is the abstract of a paper published in the Tomsk State University Journal of Biology 1(17): 73–84 (2012)

The population grouping of sable in Western Yakutia has resulted from the natural movement of autochthonic sables from the northwest of Yakutia and the Krasnoyarsk region, and also from descendants of the Baikal region sables, alien to the Lena River area. During the last decade the population of the west-Yakut grouping reached a ceiling in connection with increased migration activity and inflow of sables from adjacent territories. Its growth has stopped under the influence of an intensive harvest, and there has been a reduction tendency. The age-sex composition was different from the big share of under-yearling species (68.8 ± 1.8%). Adult sables occupied 31.2 ± 1.8%, including males (20.7 ± 1.6%) and females (10.5 ± 1.2%). The overwhelming majority was made up of small animals in the second year of life (64.1 ± 3.3). More senior age groups are not numerous: animals 3–5 years old comprised 5.7%, animals 6–8 years old comprised 2.9%, and animals 9–10 years or older comprised 1.3%, of the number of under-yearling individuals. An especially big reduction is in females of reproductive age. Among young sables, their parity with males is 1:1; with adults it is 1:2. The breeding nucleus is formed by sables of

1–5 years, representing 90.8% of the adult stock. Approximately one third (31.4%) of adult females took part in reproduction. Among one-year-old females, 13.6% of individuals bred; among females two and more years in age, 64.0% of individuals bred. Potential breeding power of females equaled 3.14 ± 0.26, and was above than in alien (2.78 ± 0.15), but is less than in native populations (3.43 ± 0.21), reflecting the geographical variability of breeding power. Animal forages form the basis of winter food (84.8%). Vegetative forages were eaten in a small amount, which is typical of light coniferous taiga with impoverished phytocenoses. According to the quantity of well-fed individuals (32.9 ± 1.8%), and the index of their fatness (1.51 ± 0.09 g/kg), the grouping took an average place between alien (60.1 ± 2.3% and 1.64 ± 0.3) and autochthonic (28.1 ± 1.7% and 1.04 ± 0.15 g/kg) populations. According to morphological signs (weight and length of the body and coloring of the fur), it is closest to the autochthonic form which has developed in similar nature and climatic conditions. It appears from this that the west-Yakut sable has generated under the prevailing influence of native populations and is closer to the Yenisei subspecies.

The accelerated alternation of generations in the breeding nucleus, its close dependence on replenishment younger animals, caused by a cold climate and the impoverished forage reserve, make an important demographic feature of the west-Yakut grouping of a sable that is necessary to consider when forecasting of its number and trade operations.

ASIA

Craniometry of *Martes* species in Russian Far East and Japan

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With respect to the genus *Martes*, the Far East is a remarkable place. Here, as nowhere else, the ranges of 3 species of this genus, the sable *Martes zibellina*, the yellow-throated marten *M. flavigula*, and the Japanese marten *M. melampus*, converge. For the latter 2 species there is a noticeable lack of data on morphometry, and on craniometry, in particular.

For *M. flavigula*, Heptner *et al*. (1967) provided condylobasal length (CBL) data for 8 males (mean 109 mm) and 7 females (mean 100.6 mm). For samples from Southeast Asia, Anderson (1970) measured CBL for 48 males (average = 99.24 mm, range 87.87 – 108.9 mm) and 46 females (average = 90.08 mm, range 81.02 – 101.2 mm), (averages calculated by V. Monakhov).

M. melampus craniometry data are very rare. Primary (Kuroda, 1922, 1939; Kuroda, Mori, 1923) and contemporary (Masuda 2009, Murakami 2009) descriptions of Japanese marten (and Japanese sable, *Martes zibellina brachyura*) morphometric traits are available. However, only Anderson (1970) provided CBL data for *M. melampus*: 8 males (range 82.52

– 85.00 mm) and 6 females (range 74.55 – 77.00 mm). Craniometry data are not available for *M. zibellina brachyura* living on the Hokkaido Island.

We studied the cranial collections from (mainly) Russian museums and research institutes for 3 species of the genus *Martes*: 48 skulls (31 males and 17 females) of *M. melampus* (Dokkyo Medical University), 35 skulls (16 males and 19 females) for *M. flavigula* (ZMMU, Moscow), and 24 skulls (19 males and 5 females) for *M. zibellina brachyura* (Shiretoko Museum, Sharicho, and Hokkaido University Museum, Sapporo) (Table 1). Each skull was measured using a digital caliper with the accuracy of up to 0.1 mm. Seventeen measurements were taken (Table 2). We only measured the skulls of adults over 1 year old.

We compared these measurements to our (Monakhov 2006) data for 9 East Asian populations of sable (Table 1). The total sample of craniometrical materials was 1850 specimens (983 males and 867 females). The majority of the museum collections are concentrated in ZMMU (Moscow), Zoological Institute RAS (St. Petersburg), All-Russian Institute of Hunting and Fur-Farming (VNIIOZ: Kirov, Khabarovsk, Irkutsk), and Kamchatsky Division of Institute of Geography RAS (Petropavlovsk-Kamchatsky).

Size comparisons show that Amur Basin yellow-throated marten are larger than animals from Southeast Asia. With the new data, we can determine the medium-specific indicator, the condylobasal length, which has already become *de facto* standard in studies on the morphology of mammals. Using data from Anderson (1970), and our own data, we have calculated the CBL of *M. flavigula* males (101.81 mm, $n = 64$), and females (93.60, $n = 65$).

A detailed description of the craniometry of *M. melampus* is given for the first time, as for the Japanese subspecies of sable *M. zibellina brachyura*. The Japanese marten is considerably larger than the Japanese sable (Table 2, statistical significance $p < 0.05$, confirmed for 29 of the 34 pairwise comparisons). However, for males, the width of auditory bulla of the Japanese sable was greater than in the Japanese marten (Table 2, $p < 0.05$).

We used both CBL and principal components analysis (PCA) to conduct interspecific comparisons of skull sizes in sables. The first principal component describes 81.5% (males) and 81.9% (females) of the variance of craniometric traits, and its value is legitimate to use as an integral dimensional characteristic of samples. Dimensional relationships of compared sable samples are provided in Figure 1. The *M. melampus* species data are also included for comparative purposes.

The compared samples may be classified into 4 groups, or clusters (Figure 2). Members of the "very small" cluster (Gorun, Tugur, Sikhote-Alin, and Hokkaido) have a CBL less than 80 mm in males and less than 73 mm in females. Members of the "small" cluster (Bureya, Barguzin, Sakhalin, and Shantar) have a CBL from 80 to 82 mm in males and between 73 and 75 mm in females. Members of the "medium" cluster (Iturup only) have a CBL from 82 to 84 mm in males and between 75 and 76.5 mm in females. Members of the "large" cluster (Kamchatka and *M. melampus*) have a CBL greater than 84 mm in males and greater than

76.5 mm in females. These results are similar to those that have been obtained with the principal components analysis method.

The *M. melampus* data require some special remarks. According to our data, Japanese marten males are the largest in the subgenus *Martes*. Their size is comparable only to some populations of *M. zibellina* in the west and east of the species' range (Monakhov 2006), and *M. martes* in western Europe (Anderson 1970, Reig 1989, Lopez 2006, Monakhov 2009).

R. Powell (1993) believed that the stone marten (*M. foina*) is the largest species in the subgenus *Martes*, with the American marten (*M. americana*) the smallest. According to our measurements, the smallest species are the stone marten and the American marten (CBL ♂ less than 82 mm). *M. melampus* demonstrates a very large size. Dimensions in sable (males) varied from a minimum (<78 mm) in the southeastern part of the area (Sikhote-Alin Mountains, lower Amur Basin) to a maximum (> 87 mm) in the South-West Altai and Kamchatka (Monakhov 2006).

Thus, according to craniometry, we can conclude that the Japanese sable *M. zibellina brachyura* shows the closest relationship to geographically neighboring continental populations of the lower Amur Basin. Non-continental sable populations diverged toward increasing skull size. *M. melampus* has a larger skull than *M. zibellina brachyura*; this is consistent with the data on the external morphometrics of those species in Japan (Masuda 2009, Murakami 2009).

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Table 1. *Martes* craniometrical material sources and sample sizes.

Species and population	Long. / Lat.	Name	Males	Females
Martes melampus		MEL	31	17
Martes zibellina				
Hokkaido Island	143/43	HOK	19	5
Barguzin Mountains	109/54	BAR	97	102
Bureja River	132/51	BUR	229	190
Gorin River	136/51	GOR	17	16
Tugur, Torom, and Uda Rivers	135/53	TUG	7	6
Sikhote-Alin Mountains	135/46	SIH	201	161
Shantar Island	137/55	SHA	10	9
Iturup Island	148/45	ITU	7	6
Kamchatka Peninsula	158/55	KAM	284	249
Sakhalin Island	143/50	SAH	65	87
Martes flavigula			16	19
Total (1850)			983	867

Table 2. Mean values of craniometric traits for 3 *Martes* sp. in Russian Far East and Japan (X±SE, mm).

	M. flavigula		*M. melampus*		*M. z. brachyura*	
	Males	Females	Males	Females	Males	Females
Measures	(*n* = 16)	(*n* = 19)	(*n* = 31)	(*n* = 17)	(*n* = 19)	(*n* = 5)
(1) Basal length	99.21	92.34	79.12	71.35	73.17	66.04
	±0.70	±0.75	±0.29	±0.47	±0.35	±0.34
(2) Condylobasal length (CBL)	109.54	102.13	85.02	76.82	79.74	71.34
	±0.79	±0.81	±0.29	±0.49	±0.51	±0.46
(3) Profile length	111.04	103.09	91.04	80.77	81.51	72.32
	±0.80	±0.82	±0.32	±0.48	±0.65	±0.60
(4) Braincase length	72.36	67.70	57.66	50.94	52.73	47.62
	±0.57	±0.58	±0.27	±0.40	±0.60	±0.47
(5) Facial length	48.89	44.78	39.50	35.76	33.85	29.32
	± 0.46	±0.41	±0.15	±0.28	±0.64	±0.62
(6) Teeth row length	39.20	36.27	33.49	30.37	30.53	26.92
	±0.29	±0.29	±0.14	±0.22	±0.27	±0.34
(7) Molar row length	29.21	27.50	25.57	23.21	23.90	20.80
	±0.23	±0.19	±0.13	±0.21	±0.18	±0.23
(8) Length of auditory bulla	23.93	22.86	18.59	17.36	18.55	17.50
	±0.24	±0.21	±0.13	±0.16	±0.19	±0.38
(9) Braincase width	48.04	45.09	36.66	33.94	33.21	30.12
	±0.39	±0.33	±0.16	±0.21	±0.30	±0.71
(10) Greatest width of skull	48.20	46.18	37.03	35.29	34.17	32.08
	±0.37	±0.37	±0.19	±0.30	±0.30	±0.65
(11) Width of occipital condyles	27.53	24.37	20.37	18.95	18.72	17.50
	±0.30	±0.19	±0.11	±0.13	±0.19	±0.44
(12) Choanal width	13.84	12.94	9.62	8.69	8.31	7.56
	±0.18	±0.16	±0.09	±0.11	±0.18	±0.20
(13) Facial width between zygomatic foramina	28.01	25.97	23.05	20.92	19.33	17.56
	±0.29	±0.24	±0.10	±0.17	±0.19	±0.12
(14) Width of upper incisors row	12.40	11.15	9.14	8.43	7.87	6.80
	±0.15	±0.16	±0.07	±0.10	±0.11	±0.17
(15) Width of auditory bulla	13.31	12.42	9.96	9.60	10.55	9.58
	±0.17	±0.09	±0.08	±0.12	±0.11	±0.24
(16) Height in the area of auditory bullae	41.63	38.06	34.25	30.13	31.37	29.06
	±0.51	±0.27	±0.23	±0.27	±0.28	±0.84
(17) Height in the area of interorbital narrowing	35.18	31.21	26.06	22.50	23.21	20.80
	±0.43	±0.29	±0.14	±0.22	±0.25	±0.40

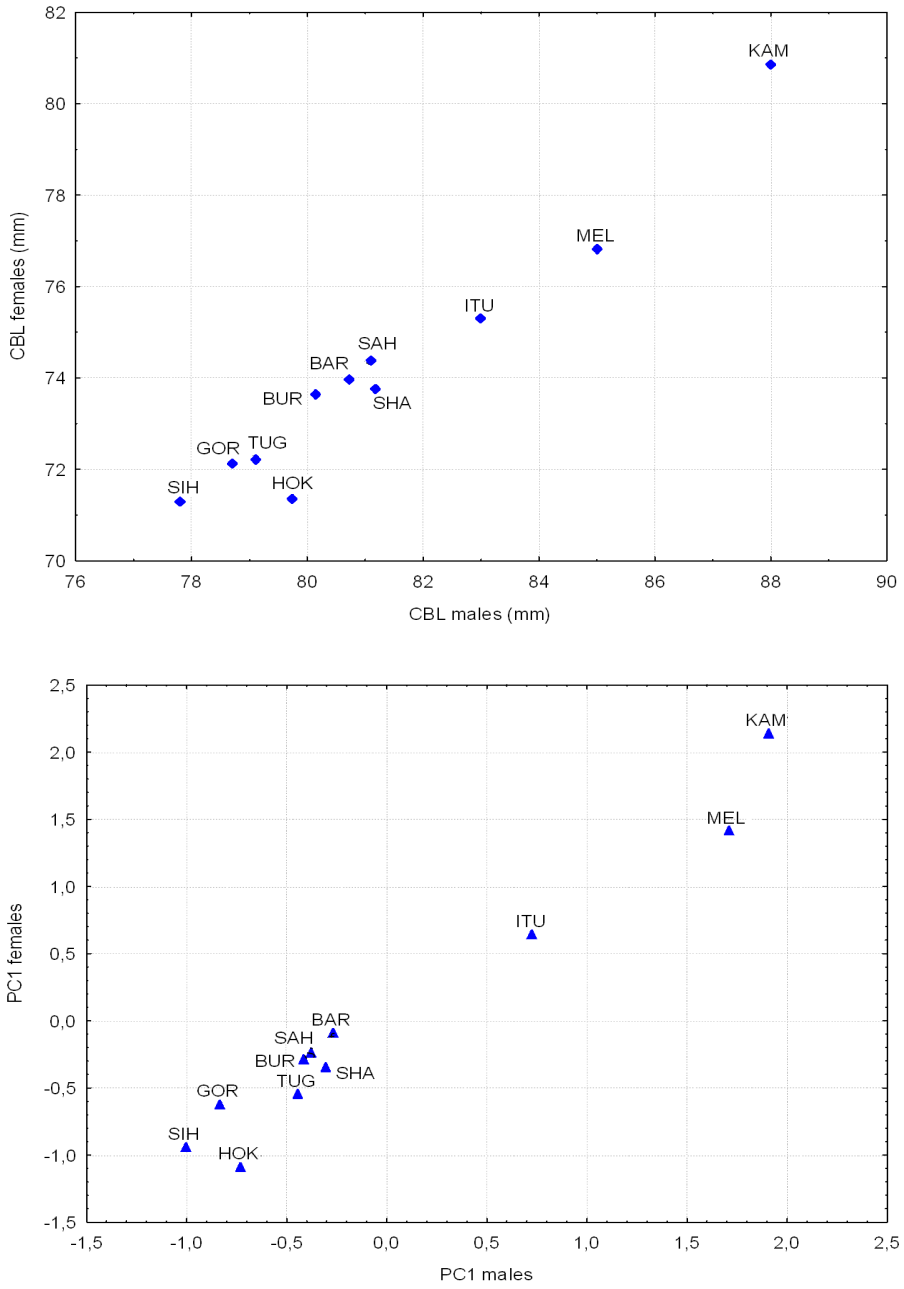

Figure 1. Craniometrical relationships between male and female sables (*M. zibellina*) and Japanese martens (*M. melampus*) for CBL (top) and PC1 score (bottom).

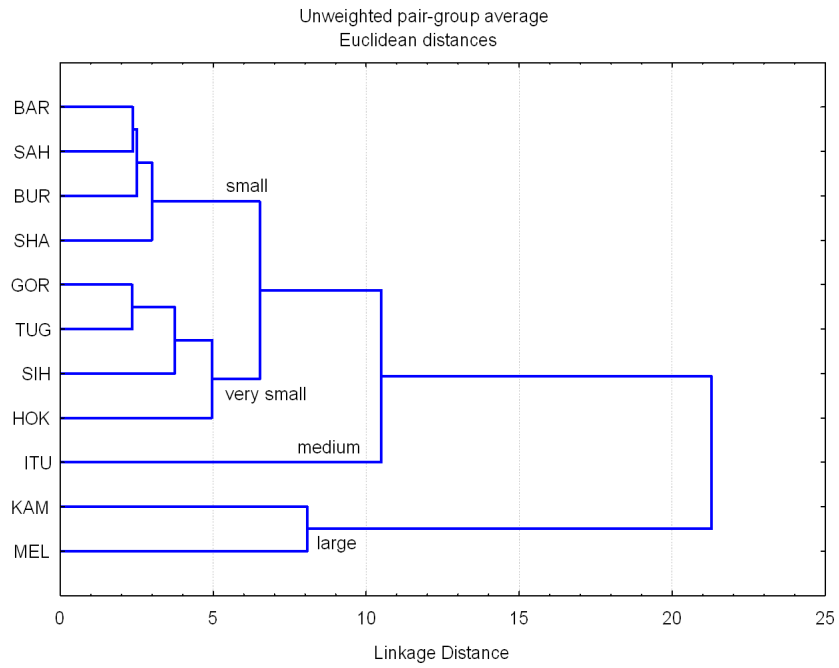

Figure 2. UPGMA classification tree for sable (*M. zibellina*) and Japanese marten (*M. melampus*) craniometrical features.

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