18. Wildlife Terrestrial Habitat: Endemic Mammals

Goal: Maintain the abundance and distribution of habitats, especially old-growth forests, to sustain viable populations. Also, maintain habitat capability sufficient to produce wildlife populations that support the use of wildlife resources for sport, subsistence, and recreational activities. Maintain ecosystems capable of supporting the full range of native and desired non-native species and ecological processes. Maintain a mix of representative habitats at different spatial and temporal scales (USDA Forest Service 2008).

Objectives: Provide sufficient habitat to preclude the need for listing species under the Endangered Species Act, or from becoming listed as sensitive due to National Forest habitat conditions. Manage young-growth to improve habitat for wildlife and commercial timber products. Include a young-growth management program to maintain, prolong, and/or improve understory forage production and to increase future old-growth characteristics in young-growth timber stands for wildlife (USDA Forest Service 2008).

Background: The National Forest Management Act requires that the Forest Service provide for the diversity of plants and animals, based upon the suitability and capability of each National Forest, as a part of meeting overall multiple use objectives (16 USC 1604(g)(3)(B)). This direction requires that fish and wildlife habitat be managed to maintain viable populations of existing native and desired non-native vertebrate species. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others (36 CFR 219.3).

Due to its historic isolation, ecological complexity, and narrow distribution between the Pacific Ocean and coastal mountain ranges, the North Pacific Coast is considered a hot spot for endemism (Demboski et al. 1999; Cook and MacDonald 2001; Cook et al. 2006). The Endangered Species Act defines endemic as "a species native and confined to a certain region; having comparatively restricted distribution." Southeast Alaska has an especially high degree of endemism in its small mammal fauna, principally because of the combination of its archipelago geography and its highly dynamic glacial history (Demboski et al. 1998). Roughly 23 percent of the mammal taxa in Southeast Alaska (species and subspecies) are endemic to the region. Recent molecular genetic analyses have enabled a more accurate look at the level of genetic divergence among island and the mainland populations than previously possible. These analyses have refuted the classification of some taxa previously believed to be endemic and identified other taxa as endemic (see Dawson et al. [2007] for a current list of species and associated ranges).

Much of our understanding of endemism in Southeast Alaska is based on sampling conducted in the 1990s, much of which was conducted by the Museum of Southwestern Biology, University of New Mexico (UNM) and in collaboration with the Tongass (Cook et al. 2006). A little over 100 of the more than 2,000 named islands in Southeast Alaska were surveyed during this time. Thus, there continues to be a gap in knowledge about the natural history and ecology of wildlife subspecies indigenous to Southeast Alaska and conclusive geographic ranges of many endemics could not be produced (Hanley et al. 2005).

The Prince of Wales Island complex appears to be an endemic hotspot based on evidence that it was an area of refugia during the last glacial event (Cook et al. 2001). This has implications for management because there is notable overlap between this area, past timber harvest, and the potential for future timber harvest (Cook et al. 2006). The island archipelago setting of the Tongass and the naturally fragmented landscapes of Southeast Alaska create challenges for management as natural interactions between subpopulations and individuals is problematic, especially for species that cannot move between islands. This is illustrated by the lower genetic variability documented in island populations of northern flying squirrel (*Glaucomys sabrinus*) compared to those on the mainland (Bidlack and Cook 2001, 2002).

Other recent research on the demography, systematics, phylogeography, and post-glacial expansion of Southeast Alaska endemics has focused on the red backed vole (*Myodes rutilus* and *M. gapperi*) (Runck 2001; Cook et al. 2004; Smith and Nichols 2004; Runck and Cook 2005; Smith et al. 2005), long-tailed vole (*Microtus longicaudus*) (Conroy and Cook 2000), Keen's mouse (*Peromyscus keeni*) (Lucid and Cook 2004; Smith et al. 2005), dusky shrew (*Sorex monticolus*) (Demboski and Cook 2001), cinereus shrew (*Sorex cinereus*) (Demboski and Cook 2003), ermine (*Mustela erminea*) (Fleming and Cook 2002), marten (*Martes* spp.) (Stone and Cook 2002; Stone et al. 2002), wolverine (*Gulo gulo*) (not endemic, but isolated populations with limited dispersal capability occur in Southeast Alaska [Tomasik and Cook 2005]), and black bear (*Ursus americanus*) (Stone and Cook 2000; Peacock et al. 2007).

Major factors identified by these studies include reduced genetic diversity, limited dispersal capabilities, and the existence of highly divergent or relatively restricted western or Pacific coastal lineages of some species. This last factor was due to the existence of eastern and western forest refugia in North America during past glacial advances, all resulting in populations that are especially vulnerable to environmental stochastisity and anthropogenic disturbances.

Due to their isolation, island archipelagos themselves are more sensitive to the effects of introduced exotics, emerging pathogens and disease (e.g., canine distemper), and natural events, than other managed landscapes. Therefore, there is a higher probability of extinction on islands due to the restricted ranges of species, patterns of extinction are dynamic (i.e., in higher latitude archipelagos geographic ranges of mammals and recolonization abilities fluctuate with glacial advances and retreats), and the effects of management activities are magnified. In fact, more than 81 percent of mammalian extinctions in the last 500 years have been insular, endemic mammals (Ceballos and Brown 1995; as cited in Dawson et al. 2007). Notably, while the distribution of mammalian species in Southeast Alaska is a function of the size of the island on which they occur and distance to the mainland, the distribution of endemic mammals is not (Conroy et al. 1999; Dawson et al. 2007). Thus, designing conservation measures based on island size or location will not effectively maintain the endemic diversity found in this region. Because of the uniqueness of this type of geographic setting and the vulnerability of species within it, some researchers have proposed structuring conservation efforts and land management planning along the North Pacific Coast around the issue of endemism (Cook and MacDonald 2001; Cook et al. 2001).

Wildlife Question: *What is the geographic distribution and habitat relationship of mammalian endemic species on the Tongass?*

Evaluation Criteria

The geographic distribution and habitat relationship of mammalian endemic species on the Tongass is be determined by reviewing new information. Recent research helps assess the distribution and habitat relationship of endemic mammal species.

Monitoring Results

The University of New Mexico (UNM) and the Tongass collaborated to inventory mammals and their distribution on the Tongass through the ISLES (Island Surveys to Locate Endemic Species) project between 2009 and 2013. This work was a continuation of mammal inventory work that started in 1991. The final report on their research was received in FY2014.

Work with the University of Wyoming (UW) to identify the understory vegetation most important to small mammal (including endemic species) diversity and abundance in young-growth forests on Prince of Wales Island occurred from 2010 through 2012, with a final report being received in FY2014.

Island Surveys to Locate Endemic Species

Small mammals were collected using traplines of snap and pitfall traps. In some cases, live-traps were used (for animals to be karyotyped) and rat traps were employed when targeting larger species (like ermine and flying squirrels). UNM also salvaged mammal carcasses from cooperating trappers and hunters. All specimens collected were identified using DNA techniques, vouchered, and the information was entered into ARCTOS (an online database of museum specimen data http://arctos.database.museum/home.cfm) (Cook and MacDonald 2012). The specimens and associated information are geo-referenced for use in a geographic information system (GIS).

Highlights of their efforts include:

- A total of 2,056 small mammals were captured from 2009 through 2013.
- Over 500 black bear (*Ursus americana*) specimens from previous research were processed, data based and archived.
- More than 2300 small mammals and salvaged furbearer specimens can be accessed in the ARCTOS database.
- Eight endemic mammalian lineages have been identified within the Alexander Archipelago; 24 of 107 mammal taxa were recognized as endemic based on morphological characteristics.
- Preliminary Niche Modeling efforts (species distribution model) suggest habitat capability will change throughout the region under climate warming scenarios, particularly on the southern outer islands (Prince of Wales group).
- Multiple education presentations given during a Scientist in Residency program in Sitka during the fall of 2013.
- Numerous journal articles, books or book chapters, graduate research work, and scientific presentations (symposia and general public audiences).
- Participation in a National Science Foundation funded Research Coordination Network called Advancing Integration of Museums into Undergraduate Programs (AIM-UP). This led to a web-based educational module for use in college courses: http://www.aim-up.org/educational-modules/educational-module-1-island-biogeography.

For a complete list of the publications, see the final report (Cook and MacDonald 2013). Additional information about the ISLES project, including links to publications, can be found at http://msb.unm.edu/divisions/mammals/research/projects/isles.html.

The final report also contains five recommendations for future work on Tongass biodiversity:

- Comprehensive management plan aimed at preserving the endemic biota and natural ecosystems of the Alexander Archipelago,
- Rigorous, integrated inventories of all islands over 500 hectares,
- Monitoring efforts to provide information and sampling to assess environmental change,
- Build partnerships to investigate and monitor the region, and
- Thoroughly regulate introduced species.

Small Mammal and Carnivore Response to Tongass Young-growth Treatments

This study assesses vegetation and structural features of young-growth that influence small mammal abundance. This is relevant to marten, which rely on small mammals as prey. Study objectives include determining:

- Which TWYGS treatments enhance the abundance of small mammals,
- The habitat variables the populations respond to, and
- The response of marten and ermine to small mammal abundance.

Four habitat types were studied: young-growth (control group), thinned young-growth, old-growth, and clearcut. Mark-recapture methods were used to estimate small mammal and marten abundance. Small mammals were live trapped and marten and ermine were trapped using hair-snares. DNA was extracted from the hair samples and used to identify individual marten. Trapped small mammals were weighed, measured, sexed, aged, assessed for reproductive status, and marked with a passive integrated transponder tag for permanent identification. Blood samples were taken from small mammals and, in combination with plant samples, stable isotope analyses was used to identify small mammal diets. Small mammal feces were also collected opportunistically for diet analyses. In addition, vegetation was sampled to assess food availability (Flaherty and Ben-David 2012).

Mice and shrew densities varied across the years and exhibited no relation to forestry treatments. Ermine captures were correlated with the density of Keen's mice in the same year. Marten captures were correlated with the density of mice the previous year.

Samples of mice and shrew tissues, along with diet items, were analyzed by the University of Wyoming Stable Isotope Facility. The isotope niches of Keen's mice and dusky shrews are distinct; however, the choice of trophic discrimination factors will influence the interpretation of their diets. Values of carbon and nitrogen for mice varied considerably between habitat types, contributing to their relatively broad isotopic niche. In contrast, the isotopic niche of shrews was constant and relatively narrow. The relatively wide isotopic niche of mice suggests either specialized foraging behavior of individuals within a generalist species or faithfulness to specific foraging habitats (Flaherty and Ben-David 2010). In the future, multi-source dual-isotope mixing models will be used to determine the range of possible contributions of each food source to small mammal diets in each of the 21 trapping grids used in this project. This will be used to explore how diet composition influences population and community dynamics (Ben-David et al. 2013).

Sixteen progress reports and a final report were produced during the course of the study. In addition, a manuscript entitled "Estimating Leaf Area Index in Southeast Alaska: A Comparison of Two Techniques" was published in *PLOS One* in November 2013. Three educational modules were also designed as part of the cooperative agreement. These modules follow the guidelines of the National Center for Case Study Teaching in Science and include a case study, answer key, and teaching notes. The three case studies are:

- Seeing the Forest for the Trees: Managing for Multiple Use in National Forests
- Fur Trapping and Management of Old-Growth Forests: Survival, Reproduction and Population Forecasts of Marten
- Big Thorne Timber Sale: Managers Stumped Searching for Common Ground

Evaluation of Results

Assessing biotic change begins with modern inventory studies and long-term monitoring programs that can be used to develop more rigorous databases. Ideally, these databases will be based on permanently archived museum specimens that have been collected over many years and contain representatives from environmental gradients throughout a given region. The Tongass continues to work towards filling these information gaps as funding becomes available. In addition, work will continue to identify habitat relationships and the effects of young-growth and young-growth treatments on small mammals and their predators. This work will inform our management of young-growth as well as our monitoring of management effects on wildlife habitat and forages in the understory.

Often the benefit of geographically extensive and site intensive collections is not immediately apparent, but over time, the value of specimen archives increases as these materials present a prime opportunity to view past environmental conditions. Specimens also provide the physical evidence for species identification and associated data on reproduction, habitat, pathogens and parasites, among others.

Action Plan

Island Surveys to Locate Endemic Species

Field data collection for ISLES ended with the FY2013 field seasons. The final report from UNM was received in FY2014. This included a list of the reports, professional publications and book chapters based on ISLES and on specimens collected as part of ISLES. However, due to personnel shortages, a thorough review of the final report and associated literature was not undertaken and will occur in FY2015.

Small Mammal and Carnivore Response to Young-growth Treatments

Field sampling is complete and analysis of data continues. Near-term plans are as follows:

- Data analysis of habitat and vegetation characteristics of all sampling stands, including tree height, diameter at breast height (DBH), basal area, and plant and fungi biomass was completed. Data summaries will be included in a Random Forest modeling framework to assess the effects of landscape and local scale factors on population dynamics of mice and shrews.
- Resubmit a proposal to the National Science Foundation Mathematical Biology for the project "Modeling 2 prey-2 predator cycles in a heterogeneous landscape" in 2015. Modeling work continues. The Tongass will receive any additional papers on the subject.
- Carolyn Eckrich will complete data analyses and her dissertation. She is expected to defend her dissertation in fall 2015 and the Tongass will be provided a copy of the final work.

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