

Alaska Department of Fish and Game
State Wildlife Grant

Grant Number: T-9 **Segment Number: 1**
Project Number: 1.0
Project Title: Phylogeography, taxonomy, and conservation genetics of Alaska's enigmatic hoary marmots
Project Duration: 1 July 2008 – 30 June 2014
Report Period: 1 July 2012 – 30 June 2013
Report Due Date: September 1, 2013
Location: Southwestern, south-central, and southeastern Alaska and northwestern British Columbia

Summary of Project Accomplishments *Please use plain language to sum up (in two or three sentences) the work accomplished on each job, or reasons for not implementing a job as planned during only this segment period. Quantify achievements as much as possible. Combining jobs is fine.*

Objective 1: Determine the number of species currently referred to *Marmota caligata*.

Job/Activity 1a: Collect and prepare voucher specimens from localities where divergent haplotypes occur in sympatry or near-sympatry to obtain larger sample sizes of fresh tissue and to characterize pelage phenotypes.

Accomplishments:

In summer 2014 Olson, students, and colleagues collected marmots from multiple localities in SE Alaska, Washington State, and British Columbia at or near zones of sympatry.

Job/Activity 1b: Use DNA sequence data from multiple unlinked loci to further test the results obtained from a subset of available material sequenced for mtDNA only, particularly with respect to the phylogenetic position of *M. vancouverensis*.

Accomplishments:

Multiple unlinked nuclear and mitochondrial DNA markers were sequenced and analyzed and suggest that mitochondrial similarities between *M. vancouverensis* and *M. caligata* are the result of relatively recent mtDNA introgression from the latter to the former. A manuscript currently in review at the *Journal of Mammalogy* describes these results.

In spring 2014, Olson's lab technician and a PhD student travelled to UCLA to learn a new method of next-generation DNA sequencing (NGS) that will enable the collection of orders of magnitude more DNA sequence data for investigating very recent evolutionary divergences, such as those among hoary, Vancouver Island, and Olympic marmots (which collectively comprise the hoary marmot complex). Results exceeded expectations, with over 900,000 nucleotides of DNA from across the nuclear genome sequenced in a subset of hoary marmot sequences.

Job/Activity 1c: Use mtDNA sequence data from museum specimens representing the entire range of *M. caligata* to see if phylogeography is concordant with recognized subspecies

Accomplishments:

All material has been obtained and sequencing is completed. This will form the basis of Nick Kerhoulas's 2nd PhD dissertation and is currently in manuscript form with plans to submit in Spring 2015.

Job/Activity 1d: Re-examine type material and a majority of available specimens of *M. caligata* to determine if original diagnostic morphological characters are constant within *M. caligata* and its constituent subspecies given a much larger available sample.

Accomplishments:

Specimens at several museums have been examined by PI Olson or his PhD student Nick Kerhoulas. These will form the basis of a publication reviewing the traditional characters used to diagnose the three currently recognized species in the hoary marmot complex.

Objective 2: Determine the persistence and taxonomic validity of the Montague Island marmot.

Job/Activity 2a: Conduct limited aerial and extensive ground surveys on Montague Island to ascertain whether marmots have persisted.

Accomplishments:

No progress on this in 2014 due to scheduling conflicts and weather. This may require an extension of the grant.

Job/Activity 2b: Live-trap marmots (if possible) and collect blood and ear biopsies prior to on-site release for archiving at the University of Alaska Museum and inclusion in the molecular studies above.

Accomplishments:

See above.

Job/Activity 2c: Collect feces and any marmot remains found during ground surveys as voucher material and possible sources of DNA.

Accomplishments:

See above.

Job/Activity 2d: Obtain skin or dried tissue samples from existing museum specimens of MI marmots for inclusion in the mtDNA study above.

Accomplishments:

Done; results currently in review at the *Journal of Mammalogy*.

Objective 3: Determine the taxonomic validity of the Glacier Bay marmot.

Job/Activity 3a: Re-visit the type locality and conduct limited collecting (3-5 individuals) to obtain material for multi-locus molecular study above and to characterize pelage phenotype.

Accomplishments:

Scheduling and weather did not permit this in 2014. This may require an extension of the grant.

Job/Activity 3b: Collect additional specimens in other accessible areas around Glacier Bay in order to characterize phenotype and the degree of mtDNA haplotype sympatry as well as to study gene flow between GB marmots and adjacent populations.

Accomplishments:

See above, pending permission from NPS (initial conversations have not been promising). This may require an extension of the grant.

Job/Activity 3c: Obtain skin or dried tissue samples from existing museum specimens of GB marmots for inclusion in the mtDNA study above.

Accomplishments:

Done; results currently in review at the *Journal of Mammalogy*.

Objective 4: Identify, to the extent possible, the geographic and chronologic origin of the hoary marmots on Sud Island.

Job/Activity 4a: Collect specimens from the southwestern region of the Kenai Peninsula and the eastern slope of the Aleutian Range

Accomplishments:

Colleagues on the Alaska Peninsula have provided additional specimens from the Aleutian Range that we are currently analyzing in the lab.

Job/Activity 4b: Develop and characterize 10-15 microsatellite markers for use in statistical tests of gene flow between the Sud Island marmots and adjacent mainland populations.

Accomplishments:

Done. These data are currently being analyzed and the resulting manuscript is scheduled for submission in summer 2014.

Using NGS (see above), Olson and colleagues at the University of Michigan and University of Wyoming generated a dataset of over 4,000 single-nucleotide polymorphisms (SNPs) to test the hypothesis that hoary marmots were introduced to Sud Island in the past century. Results definitely reject this hypothesis and strongly suggest that hoary marmots have been present on Sud Island since well before the arrival of Euroamericans to Alaska.

Significant Deviations:

3a: Due to scheduling conflicts and weather, visiting the type locality of the Glacier Bay hoary marmot was not possible. However, this is a top priority for summer 2015.

Publications:

Kerhuolas, NJ, AM Gunderson, LE Olson. Complex history of isolation and gene flow in hoary, Olympic, and critically endangered Vancouver Island marmots in northwestern North America. *Journal of Mammalogy*. *Submitted*.

Lanier, HC, AM Gunderson, M Weksler, VB Fedorov, LE Olson. Comparative phylogeography highlights the double-edged sword of climate change faced by arctic- and alpine-adapted species. *PLoS ONE*. *Submitted*.

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