# FEDERAL AID ANNUAL RESEARCH PERFORMANCE REPORT

ALASKA DEPARTMENT OF FISH AND GAME
DIVISION OF WILDLIFE CONSERVATION
PO Box 115526
Juneau, AK 99811-5526

**Alaska Department of Fish and Game**
**Wildlife Restoration Grant**

**GRANT NUMBER:** AKW-20 **SEGMENT NUMBER:** 4

**PROJECT NUMBER:** 7.01

**PROJECT TITLE:** Develop and evaluate indices for assessing marten population status and trend in Interior Alaska

**PROJECT DURATION:** 1 July 2010–30 June 2018

**REPORT DUE DATE:** 1 September 2017

**PARTNER:** None

**PRINCIPAL INVESTIGATORS:** Kerry L. Nicholson, Craig L. Gardner (retired), ADF&G, Alyssa Crawford (Biometrician)

**COOPERATORS:** Knut Kielland (University of Alaska Fairbanks); Joe Cook (Museum of Southwestern Biology)

**WORK LOCATION:** Game Management Units 12, 19D, 20, 25B, and 25C

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## I. SUMMARY OF WORK COMPLETED THIS SEGMENT ON JOBS IDENTIFIED IN ANNUAL WORK PLAN

**OBJECTIVE 1:** Evaluate if fecundity based on pregnancy rates and blastocyst counts can be used as indicators of marten population status and composition for subsequent trapping season(s).

**JOB/ACTIVITY 1A:** Collect carcasses from the same trappers from the same areas and evaluate the young of the year: to adult female (YOY:AdF) ratios relative to the previous year's blastocyst counts and pregnancy rate. If there are no relationships, these data will indicate that either our methods of assessing pregnancy (presence of blastocysts) or counting blastocysts are not adequate or that YOY survival was lower than expected during the period between birth and the onset of trapping season.

Federal funds were used to pay salaries associated with collecting and necropsying marten carcasses. Trapper interest in the project has increased across the Interior. During all years, for each carcass, we determined gender:age class (adult or young of year [YOY] based on skull characteristics); pregnancy by the presence of blastocysts in the uterine horns; and collected muscle, hair, and claw samples to determine seasonal diets using stable isotope analyses.

During FY17 we necropsied 1,618 marten carcasses collected from 26 trappers across the Interior (Figure 1).

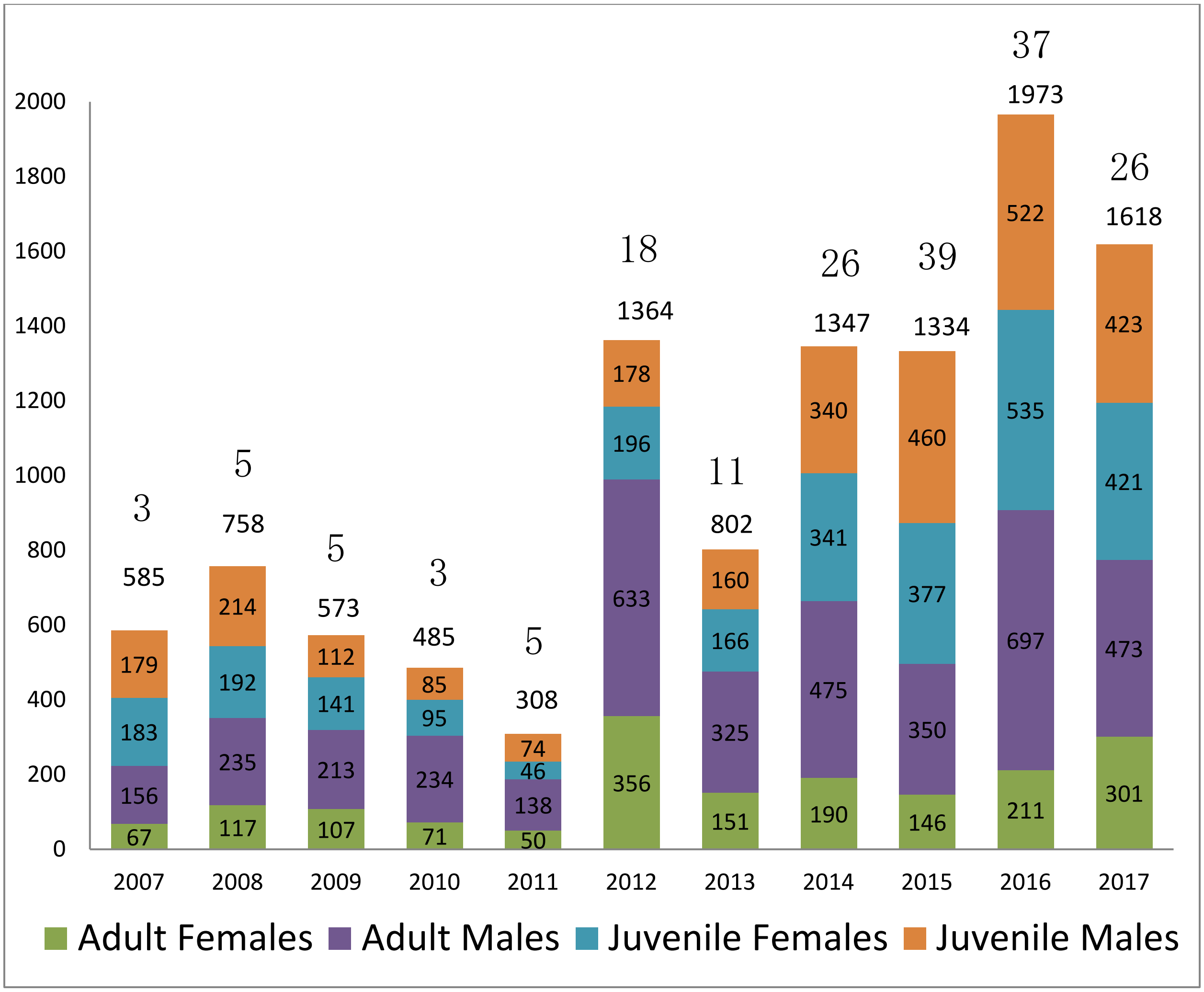


Figure 1. Number of marten harvested per trapping season from across Interior Alaska 2007-2017. Number of trappers participating indicated above column.

We also extracted a lower fourth premolar from adults for more exact age determination using cementum annuli. For FY17 we collected 440 adult teeth for aging (167 females and 273 males).

Preliminary analyses of data collected in FY17 closely agreed with previous years' findings that the best forecast variable for predicting a given year’s marten harvest is pregnancy rate in the previous year. It also revealed that forecasting models of marten harvest using previous year’s harvest were not precise enough for management due to the multiple factors affecting marten abundance and harvest. We have hypothesized reasons why forecasting the next season does not always work and propose an in-season harvest check to determine the marten abundance and population composition status. However, there can be disconnects between pregnancy and juvenile presence in the harvest due to both poor (fewer than expected) and excellent juvenile survival during spring and summer. Lacking an inexpensive and easy method of collecting juvenile survival or prey abundance, we have attempted to develop an in-season check of harvest done by trappers using percentage of adult males or adults in the harvest. Since adult males are vulnerable to harvest throughout the season and juveniles are most vulnerable early on, early season harvest composition of around 35-40% adult males indicates poor productivity. Further, even during years of average to high juvenile numbers, the percentage of adult males can be used to monitor the composition of status of the harvested population. When the percentage of adult males harvested reaches ≥40% during the trapping season, one can assume that few juveniles remain. This information is advantageous to trappers in managing their trap lines as they can cease trapping based on catch ratios of YOY and possibly adult males to minimize capture of adult females. It can also be useful for managers monitoring marten population trends on the basis of trapper catch reports. We will conduct additional analyses to determine if there are other factors that can be easily used by managers to develop a more accurate forecast of marten numbers in a given trapping season.

**OBJECTIVE 2:** Test the hypothesis that total YOY/AdF ratios of >3:1 are adequate for marten population maintenance.

**JOB ACTIVITY 2A:** Compare sex and age ratios and total catch between years by trapper (trapper effort will remain comparable throughout the study).

The YOY/AdF harvest ratio is 2.5 which is lower this year than FY16 (5.05) across the region, with a correspondingly low pregnancy rate. This YOY/AdF ratio is lower than the recommended minimum of 3.0 YOY/Ad (Strickland and Douglas 1987). However, we still need confirmation of age through cementum annuli enumeration to ensure this ratio is correct. The pregnancy rate for FY17 was 44%, which is a small decrease from last year (FY15 = 43% and FY16 = 47%), and is still quite low in the context of the project dataset. This too may adjust once age is confirmed, although not significantly. These below average pregnancy rate indicate that marten numbers across the Interior may not increase next year and that summer survival continues to be critical. While YOY/AdF in FY16 indicated available of YOY, pregnancy was low and was predicted to lead to fewer YOY next season. The average number of blastocysts/pregnant female was 1.08 in FY15 1.22 for FY16 and jumped to 3.0 for FY17 which is on par with earlier years. Percent adult male in the harvest was 26.24% in FY15 and FY16 35.39%, whereas FY17 it was 29%.

**OBJECTIVE 3:** Assess how marten reproductive performance is related to diet and age by study area.

**JOB/ACTIVITY 3A:** Skinned marten carcasses were collected from trappers in study areas across the Interior during RY07–RY17.

We collected 300–2200 carcasses per year. Annual collections contain carcasses from all marten caught by these trappers. We necropsied all carcasses and identified gender and age classes, estimated fecundity, and collected muscle, hair, and claw samples to examine diets by sex and age using stable isotope techniques.

A premolar from the harvested females ≥1-year-old was collected to determine age structure of the harvest. Federal funds were used to pay for salary associated with extracting and preparing teeth for aging. Tooth samples were sent to Matson's Laboratory, LLC (Milltown, Montana) for aging. The average age was 3.1 years old and the oldest female caught was 15 years old ($n$ = 1). In FY17 we added 163 female samples but are awaiting age confirmation from Matson's Lab.

In FY15, stable isotope analysis was conducted by our cooperator Knut Kielland and associates at the University of Alaska Fairbanks; however, we processed samples in FY16. For FY15-16 we collected and analyzed claw samples from all adult females and then included juveniles and males further possible exploration.

Muscle, claw, and hair samples from each of the harvested females ≥1-year-old were collected for stable isotope analyses to determine seasonal diets. Samples from the claws were taken from 2 locations – the tip of the claw and the base of the claw. This was done in order to obtain a time difference in food consumption. In addition to the claw samples, we tested muscle tissue for comparison with the hypothesis that muscle and the base of the claw should be similar in isotopic concentrations. Federal funds were used to pay for salary associated with this task and for the contracted work by the University of Alaska laboratory to conduct stable isotope analyses in FY17.

**Job/Activity 3b**: Created a diet catalogue.

Preliminary comparison of diet between years indicate that during the year of low productivity (FY12) marten diets were dominated by squirrels when compared to more productive years (FY08 and FY10) when voles dominated the diet. Marten are dietary generalists but population declines have been documented following synchronous declines of rodents (Thompson and Colgan 1987, Flynn and Schumacher 2009).

An undergraduate student from University of Alaska Fairbanks was tasked with processing prey items to create an isotopic catalogue of possible foods marten would consume. 200 prey items were processed including voles, squirrels, hare, grouse, shrews and berries. All samples were analyzed but summary reports were not completed by the time of writing this report. We are limiting our analysis to these due to the limitations of using mixing models. Although voles are the predominant food item for marten, shrews have been identified as the host species for *Soboliphyme baturini*, a stomach parasite found in many marten. However, shrews are not a preferred species within marten diets

We will continue to evaluate diet for all sample areas over all of the sample years. We finished sampling small mammal and other diet items of marten to develop the baseline catalogue of isotopic signatures to properly evaluate marten isotopic signatures.

**Job/Activity 3c:** Assess stomach parasites and how this is related to reproduction and diet by study area.

Marten stomachs were sent to the Museum of Southwestern biology. Since 2015, 300 stomachs have been inspected for parasite presence. Two undergraduate students have worked on the analysis and have presented preliminary findings at scientific conferences (see Attached poster from 2017 in Appendix 1). This is an ongoing analysis that has not been finalized by the time of this report.

**Job/Activity 3d**: Assess heavy metal contamination related to reproduction and diet by study area.

Adult female marten livers are being processed at the University of Alaska Fairbanks in the Wildlife Toxicology Lab. 90 livers have been assessed for heavy metal contamination.

**Job/Activity 3e:** Analyze data of infection levels by sex, age, diet composition, geographic region and reproductive success

No work has been done on this activity as not all the data are available as of yet. When the individual analyses are completed, they will be compiled and analyzed as a group.

**OBJECTIVE 4:** If funding becomes available or if outside ADF&G cooperators become interested, assess the value of small mammal abundance indices as predictors for marten population status.

**JOB/ACTIVITY 4A:** Assess the status of small mammal populations during August–October and possibly during the spring in areas where carcasses are being collected.

Accumulate at least 600 trap nights (museum special snap traps) in a variety of available habitats in each study area to evaluate abundance of small mammals. Assess snowshoe hare abundance following techniques used by the University of Alaska Fairbanks (Knut Kielland, unpublished data). We will test if small mammal abundance can be used to predict marten population trend and productivity.

No work was accomplished on this objective during the report period.

**OBJECTIVE 5:** Analyze and compare corpora lutea and blastocyst counts

**Job/Activity 5a:** We will assess the relationship between blastocyst and CL counts. We will remove the ovaries from the carcass and store in formalin until processing. Ovaries can be hand-sliced, however this method is less accurate than examining microtome sections that have been stained and examined with a microscope (Wright 1963). Using an occupancy framework, we will determine the probability of missing a blastocyst in the counting procedure to obtain a level of accuracy regarding pregnancy rates.

We have compiled all counts of blastocysts from all years**.** We are seeking collaboration with Mattson's tooth laboratory to process the corpora lutea as our initial collaborator has left the project.

**OBJECTIVE 6:** Assess marten nutritional status affects fecundity

**Job/Activity 6a**: Assess body condition indices using omental fat.

The body condition analysis will be conducted cooperatively with the University of Alaska Fairbanks. We will measure the greater omental fat as recommended by Robitaille and Cobb (2003). We will weigh each body before removing the stomach and the omental and mesentery fats (OMF). Excised OMF will be weighed and dried and weighed again.

Marten have been weighed, necropsied and omental fat removed. Omental fat has been weighed, freeze dried and weighed again. This objective is now complete and data will be incorporated into the larger nutritional analysis.

**Job/Activity 6b:** Conduct a proximate analysis of the liver to determine nutritional condition.

The nutritional analysis will be conducted cooperatively with the University of Alaska Fairbanks. We will remove the liver and obtain weight and place into storage until the proximate analysis can be conducted. Proximate body composition will be assessed following methods similar to Whittaker and Thomas 1983. We will obtain a ratio of organ to body weight, lipid, protein, ash content. One concern for measuring proximate composition from marten carcasses is desiccation which will occur from the moment they are trapped. Therefore, we will be using dry weight and back calculate any wet weights necessary.

Body condition analysis was initiated by an undergraduate student at the University of Alaska Fairbanks. Liver samples from adult females were freeze dried, then ground or diced for lipid analysis (n=97) and for nitrogen analysis (n=65). We found no evidence to support lipid concentrations differed between fertilized or unfertilized marten (2-way ANOVA $F = 2.44$, $P$-value = 0.12) or by geographical region (2-way ANOVA $F = 2.02$ and $P$-value =0.083). We found no evidence to support nitrogen concentrations differed between fertilized and unfertilized adult female marten (2-way ANOVA results $F = 0.8265$ and P-value= 0.36724). We found evidence to support nitrogen concentrations differed by geographic region (2-way ANOVA $F = 3.03$, and $P$-value = 0.017). A post hoc t-test using the Bonferroni correction for multiple comparisons revealed that unfertilized females in the western group had significantly lower nitrogen concentrations ($\chi = 0.030$ N g/g) in the liver than fertilized ($\chi = 0.034$ N g/g) (P-value = 0.001) (see Attached poster from 2017). This work is preliminary as there are additional samples to be processed from males and juveniles.

**OBJECTIVE 7:** Literature review, data analysis, and publications.

**JOB/ACTIVITY 7A:** Analyze data and prepare reports and manuscripts.

Federal funds were used to cover salary when conducting literature reviews on a monthly basis. Literature searches were conducted for information on marten population dynamics, productivity, and food habits, and on the use of harvest data to monitor furbearer populations and on stable isotope analyses to monitor dietary choice of carnivores.

We began analyzing the capture data with the intent of preparing a manuscript evaluating the use of easily collected samples from harvested marten to forecast population status by trappers and managers. We will also be analyzing the data to identify any variables trappers and managers can monitor within season to track marten population status. In

FY17, we summarized our preliminary findings in an article published in the Alaska Trapper's Association monthly magazine. During the reporting period we also worked on a report summarizing each years' necropsy results through FY17; this report will be completed in FY18 and distributed to Region 3 area biologists and contributing trappers. Salary associated with these tasks was funded by federal aid (trapper effort will remain comparable throughout the study).

## II. SIGNIFICANT DEVIATIONS AND/OR ADDITIONAL FEDERAL AID-FUNDED WORK NOT DESCRIBED ABOVE THAT WAS ACCOMPLISHED ON THIS PROJECT DURING THIS SEGMENT PERIOD

None.

## III. PUBLICATIONS

None.

## IV. RECOMMENDATIONS FOR THIS PROJECT

None.

**LITERATURE CITED:**

Flynn, R. W., and T. V. Schumacher. 2009. Temporal changes in population dynamics of American martens. Journal of Wildlife Management 73(8):1269–1281.

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**PREPARED BY:** Kerry L. Nicholson

**DATE: -**19 August 2017

Appendix 1. Attached are articles published in the 2016-17 ATA magazine and the student posters presented at the Alaska Chapter of The Wildlife Society meeting 2017.

# Patterns of infection of American marten (*Martes americana*) by *Soboliphyme baturini* in Interior Alaska

Steven Guerin[1], Elisa Gagliano[1], Emma Fries[1], Mariel L. Campbell[1], Kerry L. Nicholson[2], and Joseph A. Cook[1].
[1]Department of Biology and Museum of Southwestern Biology University of New Mexico, [2]Alaska Department of Fish and Game

## Introduction

American marten (*Martes americana*) are mustelid mesocarnivores that are commercially important furbearers. (Fig. 1). It is widely distributed in boreal forests of North America. Populations demonstrate regional and historical fluctuations which are primarily driven by prey abundance and variability in weather. The degree to which other factors, such as disease or parasitism, affect populations is largely unknown. One of the most common parasites of marten is the stomach nematode, *Soboliphyme baturini*, (Fig. 2) which reaches high intensities of infection. As part of a larger study investigating marten population variability, marten stomachs were collected in 2015 by trappers throughout Interior Alaska. They were examined to determine patterns of prevalence and intensity of *Soboliphyme baturini* infection. These results will be compared with data on host sex, age, abdominal fat, diet, and reproductive status to investigate the influence of *Soboliphyme* parasitism on American marten.

**Figure 1:** *Martes americana*


Figure 2. Soboliphyme baturini

## Materials and Methods

- Trappers donated marten carcasses which were grouped by geographic location (Fig. 3) and aged as juvenile or adult based on muscular coalescence.
- 300 stomachs were opened and examined for the presence of parasitic worms such as *Soboliphyme baturini*. Any nematodes present were counted by sex and archived in 70% ethanol.
- Prevalence (percent of infected hosts) of Soboliphyme baturini and intensity of infection (number of individual parasites/host) were calculated by sex, age class, and for each geographic region.
- We used the program Quantitative Parasitology 3.0 for all analysis

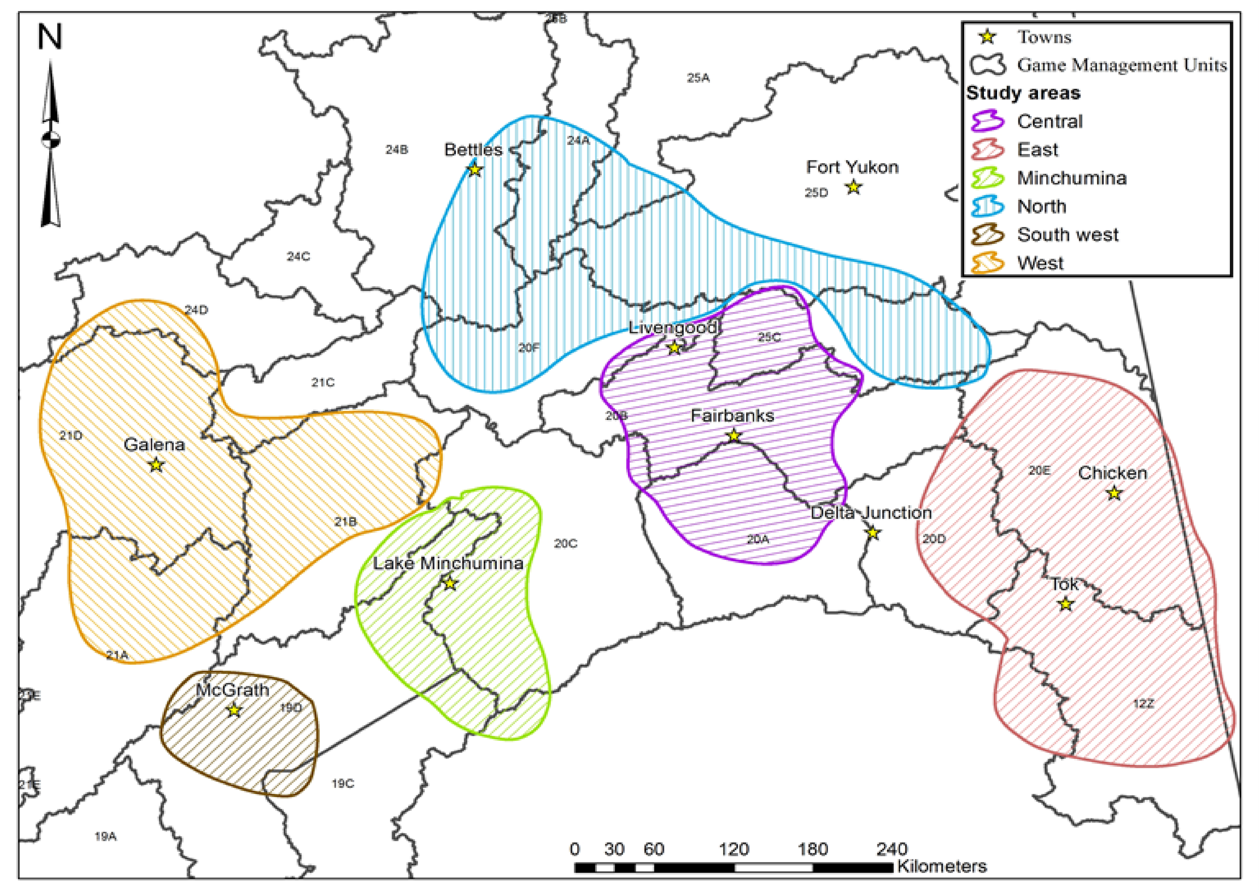



**Figure 3: Geographic distribution of marten from Interior Alaska**

## Results

112 stomachs of 300 (37%) had ≥1 *S. baturini* (Fig 4).

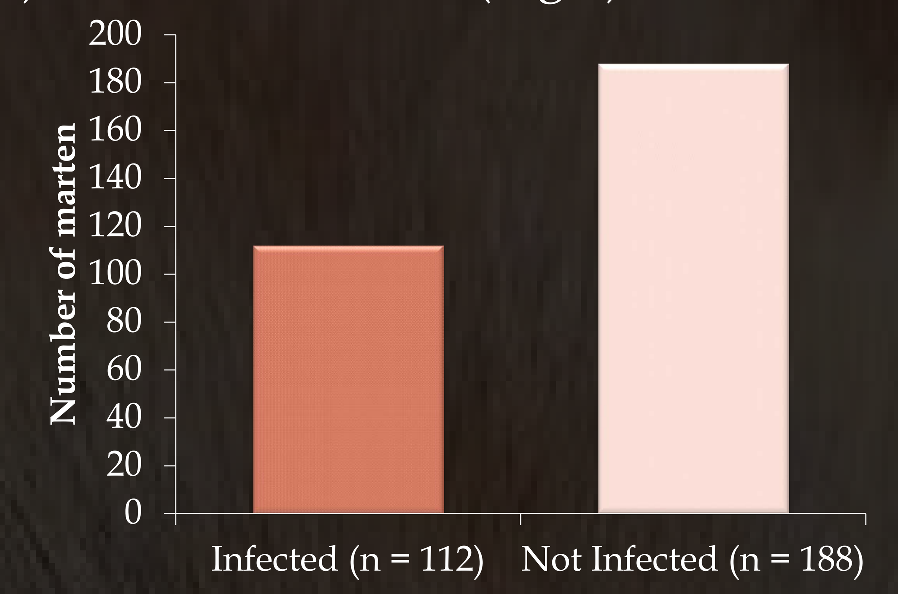



Figure 4: Number of infected marten stomachs.

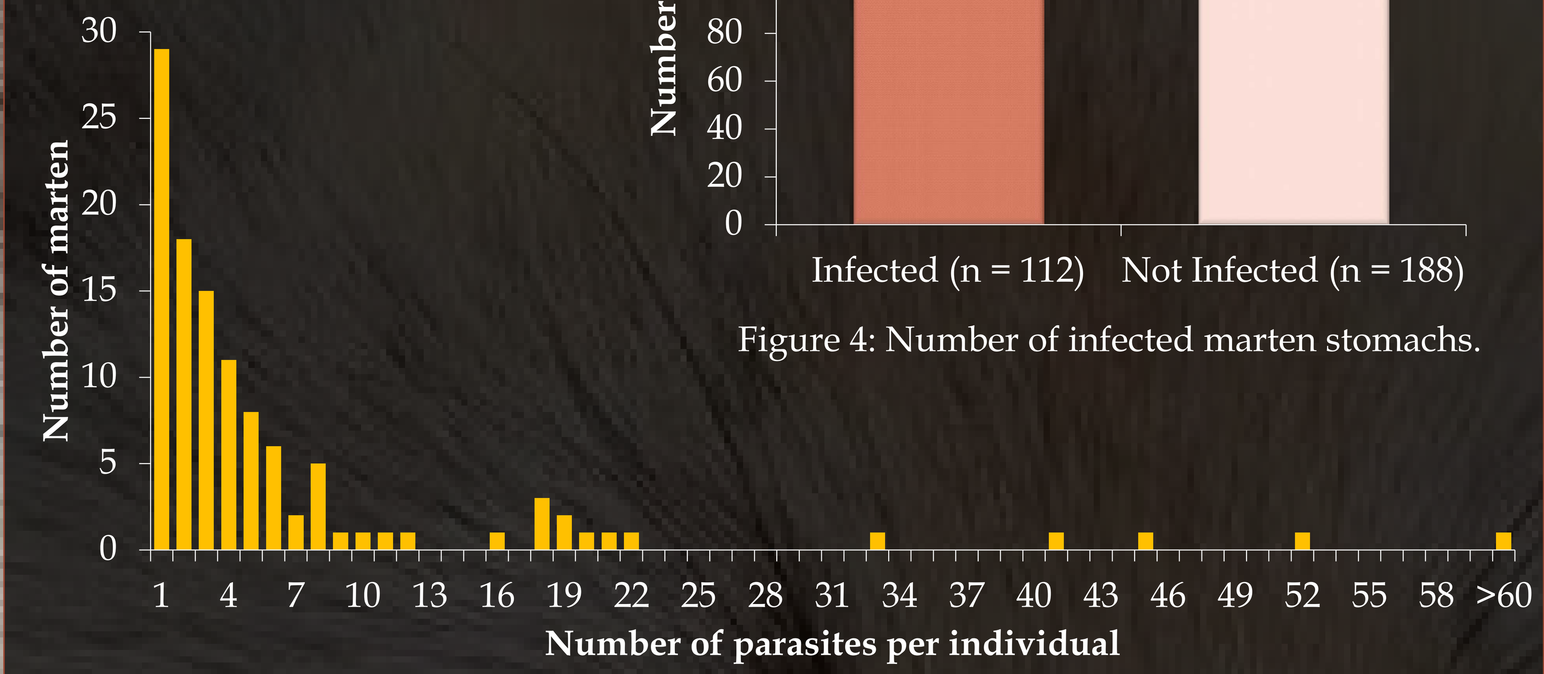



Figure 5: Intensity of *S. baturini* infection in 112 marten stomachs. *One Marten that had 130 parasites was not included in this graph.

Parasites were aggregated and right skewed (Fig. 5)

Prevalence differed by geographic distribution (Fig. 6 Fisher's Exact *P*-value <0.0001)

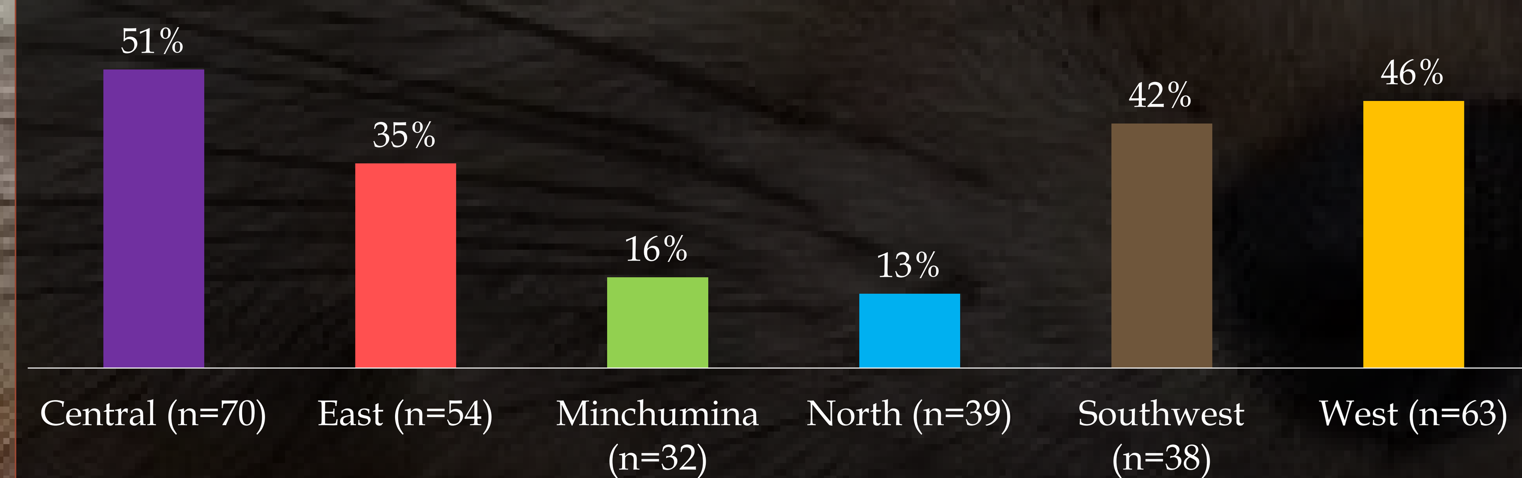



Figure 6: Percent of marten stomachs infected by geographic distribution (see Fig 2).

Crowding of parasites in the stomach was 36.8 (95% C. I. = 16.3-76.7). Poulin's Discrepancy Index was 0.86 (95% C. I. 0.82-0.90). Values close to 1 indicates increased aggregation.

Mean intensity was 7.12 (95% C. I. = 5.19-11.2%) and mean abundance was 2.66 (95% C. I. 1.9 -4.32). Both intensity and abundance differed by Age and Sex class (Table 1). Juvenile males had highest levels of intensity or abundance of parasites in the stomachs.

Table 1. Mean intensity (excluding non infected) and mean abundance (including non infected) of adult and juvenile male and female martens using bootstrap methods (*P*-value = 0.001)

| | Ad. Female | Juv. Female | Ad. Male | Juv. Male |
|---|---|---|---|---|
| Mean Intensity | 3.33 | 3.26 | 3.13 | 17.73 |
| Mean Abundance | 1.19 | 0.925 | 1.32 | 7.6 |

This project was supported by NSF-DEB 1258010.

## Results

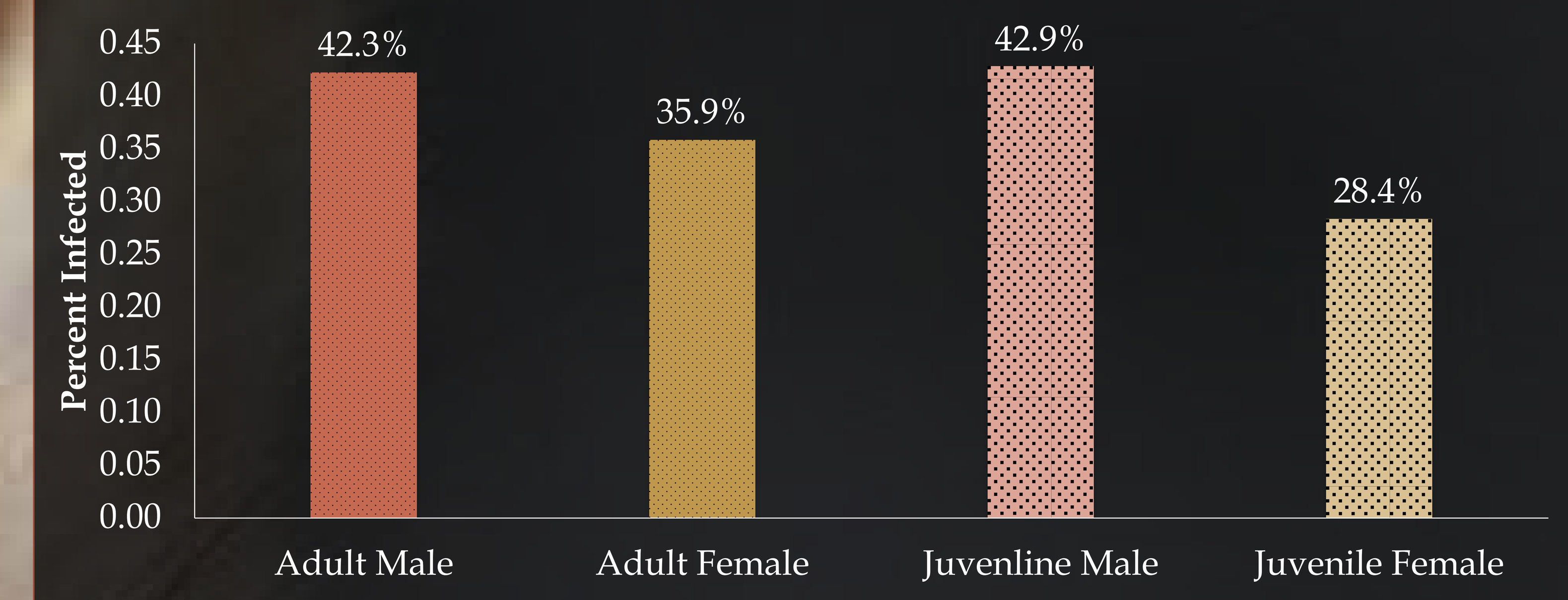
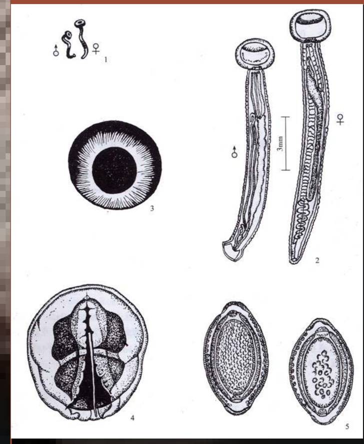



Figure 7. Prevalence of infection by sex and age class

## Discussion



So far, we have examined 300 marten stomachs, 37%were infected with *Soboliphyme baturni.* Parasite prevalence was higher than reported from previous studies of marten parasites in Alaska. Scranton 1986 reported 0.7% infection from in the same region which we consider as "Central" and they also sampled Fort Yukon area which is North East of our "Central" area. We found similar prevalence and that prevalence differed on a north to south gradient, where infection was highest in the southern portion of the study as was found by Zarnke et al. 2004. Increases in prevalence through time and space may be a result of ecological factors affecting nematode transmission via shrews, the likely intermediate (paratenic) host. (Karpenko et al. 2007, Koehler et a. 2007, Thomas et al 2008).

Although sex differences in parasite prevalence are common in many taxa (Zuk and McKean 1996), we found no significant differences between sexes in our study, similar to findings by Thomas et al 2008. These authors suggest that the similarity in parasite prevalence may indicate similar foraging strategies by males and females. We found no difference in prevalence or intensity between age classes, in contrast to earlier studies in interior Alaska but similar to findings for Southeast Alaska in the 1990s (Poole et al 1983,Zarnke et al 2004).

It is not until we combine sex and age that we begin to see a statistical difference (Fig 6.). This was primarily driven by juvenile males (Table 1). In our study they were most often infected and had the highest intensity of infections. The one individual with 130 *S. baturini* was a juvenile male. Analysis, with or without this male, still suggested juvenile males have the highest infection. This was not similar to findings by Zarnke 2004, where they reported adult males with significantly higher rates of infection in the south eastern portion of their study.

## References

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Thomas, J. G., J. N. Pauli, E. Donadio, and S. W. Buskirk. 2008. *Soboliphyme baturini* infection does not affect the nutritional condition of American marten (*Martes americana*) in Alaska. Journal of Parasitology 94:1435-1436.
Zarnke, R. L., J. S. Whitman, R. W. Flynn, and J. M. Ver Hoef. 2004. Prevalence of *soboliphyme baturini* in marten (*Martes americana*) populations from three regions of Alaska, 1990-1998. Journal of Wildlife Disease 40:452-455.
Zuk, M., and K. A. McKean. 1996. Sex differences in parasite infections: Patterns and processes. International Journal for Parasitology 26:1009-1024.

# Furthering Population Genetics Study of Interior Alaskan Marten

URSA
UNDERGRADUATE RESEARCH & SCHOLARLY ACTIVITY

Elise Stacy - University of Alaska Fairbanks

Dr. Kris Hundertmark - UAF Biology & Wildlife Chair
Dr. Kerry Nicholson - Alaska Department of Fish and Game

ALASKA DEPARTMENT OF FISH AND GAME

ALASKA TRAPPERS ASSOCIATION

## Importance

No current research on genetic diversity of American marten (*Martes americana*) in Interior Alaska

- Marten are commercially valuable with $85 (high of $220) per pelt (NAFA 2014) & important for subsistence

- Considered a forest health indicator species (Ruggiero et al 1994)
- Data on genetic health and potential subpopulations important for management

## Methods

Extract & analyze DNA from donated marten carcass tissue samples (ADF& G)

- Microsatellite markers from marten, wolverine, mink and ermine used

Visualize and compare alleles

- Score alleles for each marker in each marten with Genemapper
- STRUCTURE, GenAlEx & GenePop

## Preliminary Results

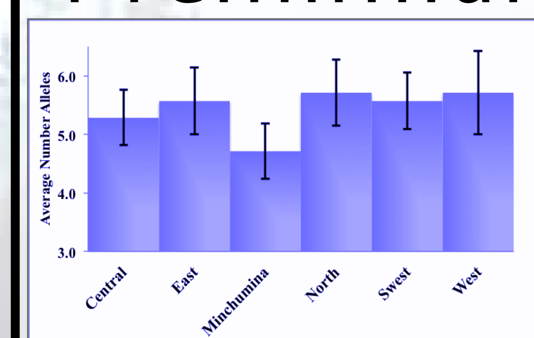


Figure 1. Average number of alleles per region indicates genetic diversity (GenAlEx).

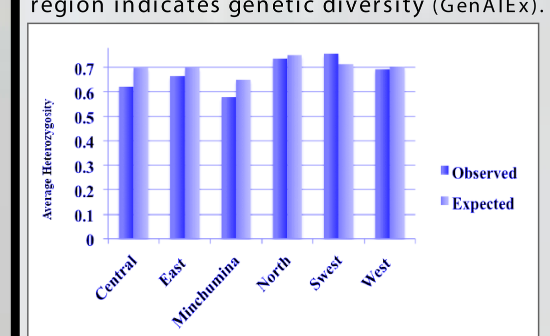


Figure 2. Differences in observed and expected average heterozygosity (GenePop).

East, North, Southwest & West regions show similar numbers of alleles per region (Fig 1) and high levels of heterozygosity (Fig 2).
Minchumina & Central have the lowest average number of alleles (Fig 1) and greater observed deviation from expected heterozygosity (Fig 2).
North, Southwest & West regions least genetically distant (Fig 3) & most similar allelic composition (Fig 4).
Minchumina, Central & East most genetically distant from neighboring regions (Fig 3) & most different in allelic composition (Fig 4).

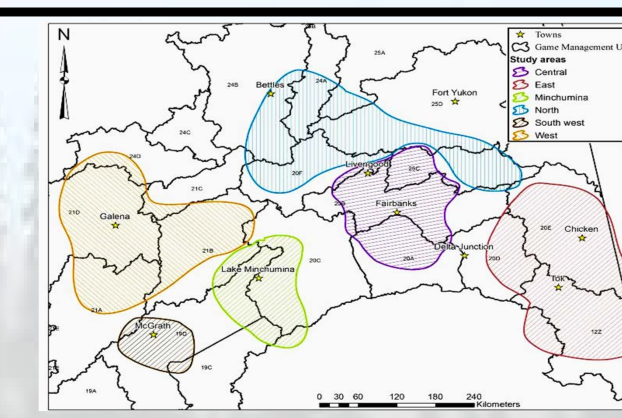

Figure 5. Map of Interior Alaska highlighted to show the originally used broad region of each study area, from which trapped marten carcasses originated. (ADF& G)

| | Central | East | Minchumina | North | Swest | West |
|---|---|---|---|---|---|---|
| Central | 0.000 | 0.027 | 0.074 | 0.002 | 0.012 | 0.322 |
| East | 0.046 | 0.000 | 0.001 | 0.009 | 0.001 | 0.104 |
| Minchumina | 0.029 | 0.083 | 0.000 | 0.001 | 0.001 | 0.095 |
| North | 0.083 | 0.069 | 0.119 | 0.000 | 0.286 | 0.143 |
| Swest | 0.053 | 0.108 | 0.070 | 0.009 | 0.000 | 0.339 |
| West | 0.009 | 0.026 | 0.026 | 0.023 | 0.006 | 0.000 |

Figure 3. Genetic distance between regions using Jost's Dest values below diagonal. Less than P-value = .05 are highlighted.

| | Central | East | Minchumina | North | Swest | West |
|---|---|---|---|---|---|---|
| Central | 0 | 0.00045 | 0.00072 | 0.00013 | 0.0046 | 0.102 |
| East | 38.4 | 0 | <0.0001 | 0.0095 | 0.00011 | 0.141 |
| Minchumina | 37.1 | 47.4 | 0 | <0.0001 | 0.00028 | 0.024 |
| North | 47.2 | 29.3 | 57.5 | 0 | 0.502 | 0.238 |
| Swest | 31.6 | 42.3 | 39.7 | 13.3 | 0 | 0.697 |
| West | 21 | 19.7 | 26.2 | 17.4 | 10.9 | 0 |

Figure 4. Comparing region's allelic composition. Chi^2 values on lower diagonal, Significant values upper (P-value = .05) highlighted.

## Expanding the Study

Preliminary results were not concrete and expanding the study was necessary for use of program STRUCTURE to separate out different populations.

- Increased accuracy and number of study regions
- Increased number of samples from 120 to 240
- Increased number of microsatellite markers used from 7 to 12
  - Old markers: Ma1, Ma2, Ma8, Ma9, Ma10, Ma19, Gg7
  - New markers: Mvis072, Mvis075, Mer041, Ma5, Ma18, Gg3

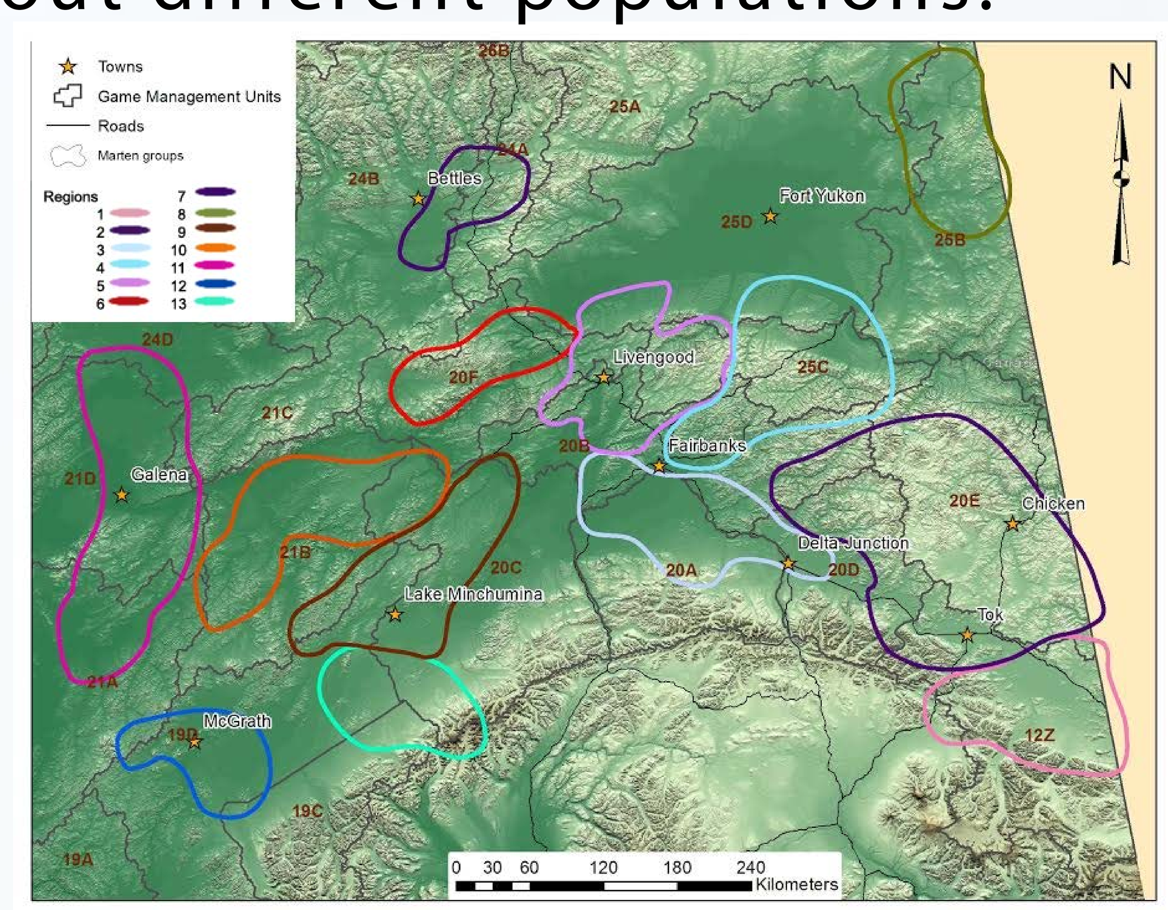


Figure 6. Map of Interior Alaska highlighted to show new study regions with increased accuracy based on habitat and marten home range from trapping area. (ADF& G)

## Troubleshooting

Multiplex Manager to choose best multiplexes based on

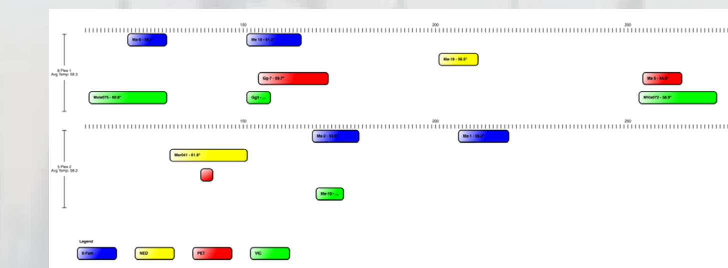

Figure 7. Using Multiplex Manager for marker arrangement

- Allele size range
- Annealing temperatures
- Primer fluorescent dye colors

Ran into issues with Gg3 and Mvis075 overlap due to size range being based on wolverine and mink size range, not marten

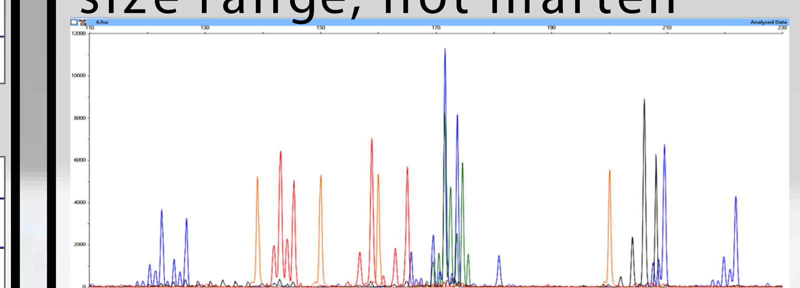

Figure 8. Electropherogram of peaks associated with marker's alleles

Increased concentration for underperforming primers for Ma 2, Ma5

## Expected Results

Due to the interior being a homogenous habitat and there being few geographic barriers, there is little reason for

- Impeded gene flow
- Isolated populations

With increased samples size and number of markers, we expect to see good genetic health and diversity within and between study regions

- Predict STRUCTURE shows all regions are the same population

# Proximate Liver Analysis of American Marten in Interior Alaska

*Michaela Pye[1], Kerry L. Nicholson[2], J. Margaret Castellini[1], Molly Murphy[1]*
*University of Alaska Fairbanks Department of Veterinary Medicine[1] Alaska Department of Fish and Game[2]*

## Introduction

American Marten (*Martes americana*) are important furbearers in Interior Alaska. Marten are an economic resource for trappers as well as biological indicators of ecosystem health. They are generalist feeders, eating small mammals, birds, insects and fruits depending on availability and season (Strickland et al. 1982). In 2014/15, 331 marten carcasses were donated by Alaskan trappers to ADF&G for a larger study regarding nutritional health and population status. Adult females were examined for pregnancy potential (blastocysts) and livers were sampled for a proximate composition analysis. Proximate analysis measures the relative fat (lipid), protein(nitrogen), and ash (mineral) content which may serve as an index to evaluate the physical condition of carnivores inhabiting temperate and cold regions (Garant and Crete, 1994). Reproductive potential and physical condition may be linked and have the potential to vary based on geographic location.

## Hypothesis

- Reproductive potential is directly related to body condition.
- Body condition may vary across a geographical distribution, which may in turn correlate with reproductive potential

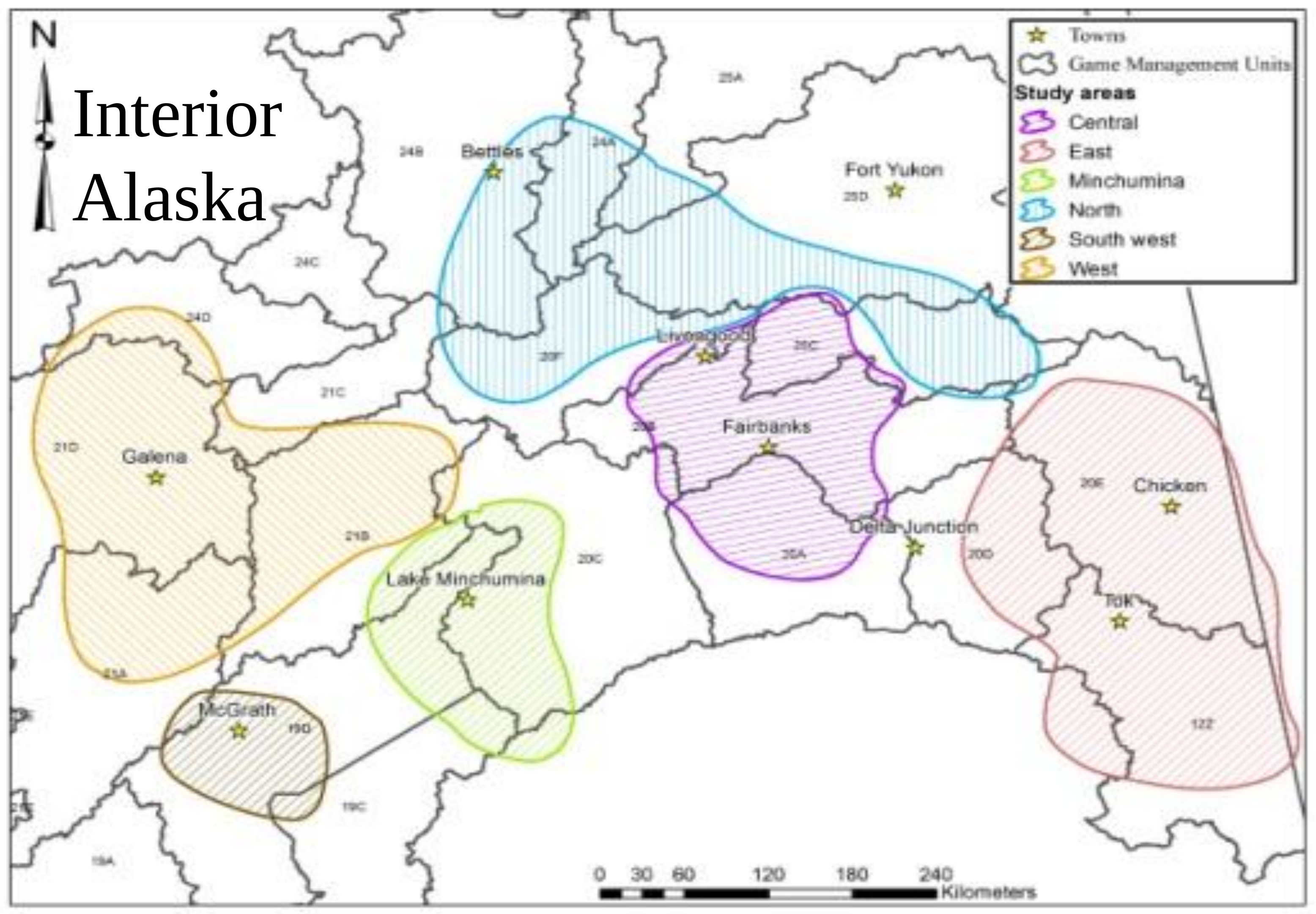


Figure 1: Geographic distribution of sampled marten populations in Interior Alaska 2014-2015

## Objectives

1. Determine the relative levels of nitrogen, lipid and minerals in female marten in Interior Alaska from 2014-2015.
2. Determine relationship between proximate analysis results and reproduction potential by region (Figure 1).

## Materials and Methods

Proximate analysis is composed of 3 elements : Nitrogen, Lipid and Ash content.

- Liver samples from adult females were freeze dried, then ground or diced for lipid analysis (n=97) and for nitrogen analysis (n=65).
- Nitrogen was analyzed using a LECO analyzer. Combustion gases are measured through infrared adsorption and thermal conductivity and-nitrogen is released as $N_2$.
- Lipid was analyzed by Soxhlet solvent extraction of pre-weighed dry samples using choloroform:methanol (2:1).The solution dissolves only the lipid in samples.
- Ash content is yet to be determined.
- Analyses were run in R using α = 0.05 as a significance level.

## Preliminary Results

| REGION | Lipid (g/g) | Nitrogen (g/g) |
|---|---|---|
| East (n=20) | 0.0744 ± 0.051 | 0.0349 ± 0.002 |
| Northern (n=19) | 0.0965 ± 0.053 | 0.0345 ± 0.004 |
| Western (n=27) | 0.1180 ± 0.054 | 0.0315 ± 0.002 |
| South Western (n=4) | 0.1220 ± 0.002 | 0.0341 ± 0.034 |
| Minchumina (n=12) | 0.1842 ± 0.275 | 0.0330 ± 0.003 |
| Central (n=11) | 0.1047 ± 0.036 | 0.0364 ± 0.007 |

Table 1: Mean proportions of wet mass (g/g) of lipid and nitrogen from a proximate analysis of liver in adult female American marten from Interior Alaska 2014-2015.

- Reproductive potential was determined by counting blastocysts which are fertilized eggs ready for implantation. Marten with present blastocysts will be referred to hereafter as "fertilized".
- 36 of the 97 adult females were fertilized.
- We found no evidence to support lipid concentrations differed between fertilized or unfertilized marten (2-way ANOVA F = 2.44, *P*-value = 0.12) or by geographical region (2-way ANOVA
- F = 2.02 and *P*-value =0.083; Table 1).
- We found no evidence to support nitrogen concentrations differed between fertilized and unfertilized adult female marten (2-way ANOVA results F = 0.8265 and P-value= 0.36724, Figure 2).
- We found evidence to support nitrogen concentrations differed by geographic region (2-way ANOVA F = 3.03, and *P*-value = 0.017; Table 1, Figure 3)
- A post hoc t-test using the Bonferroni correction for multiple comparisons revealed that unfertilized females in the western group had significantly lower nitrogen concentrations (χ = 0.030 N g/g) in the liver than fertilized (χ =0.034 N g/g) (P-value = 0.001)

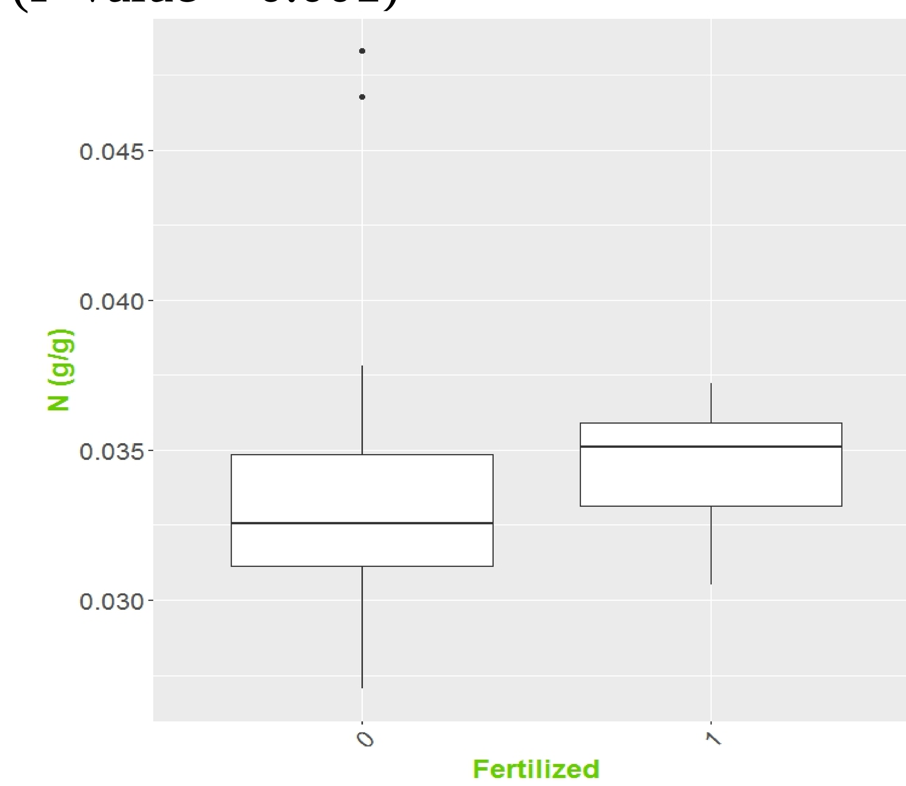


Figure 2: Nitrogen concentration (g/g) of fertilized and unfertilized marten throughout the 97 samples.

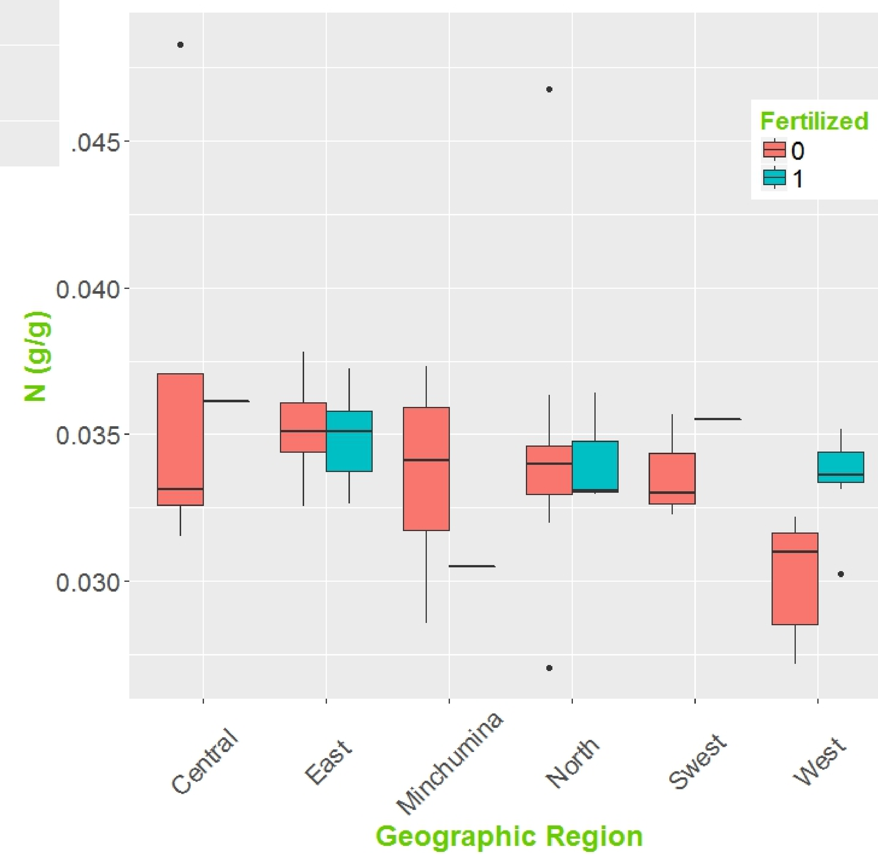


Figure 3: Wet mass nitrogen (g/g) proportion and fertilization by region. Blue indicates fertilized marten.

## Discussion

The difference found in nitrogen concentration is driven by the marten from the western region (Figure 1, Figure 3). These differences displayed lower nitrogen (protein) concentration in livers of marten from the west, driven by lower values in unfertilized females. The western region is near the coast of Alaska which may have a different prey base available for marten. This concentration difference may be a result of varying food resources or divergent energy allocation. Another consideration of this difference may be that higher protein content can be indicator of nutritional deficits. We will be comparing liver results with amounts of omental fat and age to better understand these results.

## Moving Forward

1. Increase sample size for nitrogen analysis.
2. Expand analysis to include adult males and juveniles.
3. Conduct ash analysis to determine relative carbohydrate and mineral content.
4. Using stable isotope information to describe diet.
5. Examine the relationship between omental fat, body weight, diet and liver composition.

## Acknowledgements

Funding for this project was provided by Federal Aid Grant and BLaST. We would like to thank the trappers who donated their carcasses for this project. We also thank the ADF&G necropsy crew R. Dorendorf, T. Nichols, B. Wiltzen, J. Dunshie and C. Roberts. We thank the faculty and students from the Wildlife Toxicology Laboratory at UAF – T. O'Hara, M. Lian, A. Grimes; the Animal Resources Center at UAF for providing necropsy facilities. We thank L. Gildehaus, M. Hoffman, J.Kim and K. Hautala for lab assistance and sample preparation.

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# Preseson Harvest Forecasts for Marten: Do They Work?

**By Craig Gardner, Kerry Nicholson and Alyssa Crawford**

Marten harvest in Interior Alaska is managed using the refugium strategy. Refugium is a fancy word for "refuge." Under this strategy, there must be large untrapped or lightly-trapped tracts of marten habitat interspersed among intensively-trapped areas to serve as population sources for marten. During most years, surplus juvenile marten disperse from these source areas and repopulate the more heavily-harvested areas. History tells us that managing marten harvest in Interior Alaska using the refugium management system works. It allows liberal seasons and bag limits without concentrated management. However, speaking from my experience of being an ADF&G Area Biologist, I suspect that most managers and trappers would still appreciate a dependable pre-season marten forecast. As a trapper, it would be nice to know prior to the season if marten numbers are going to high or low. Instead of having to wait for the first snow to assess marten numbers on your 'line, a forecast available by mid-summer would make it much easier to prepare for the season. As wildlife managers, we are happier if we have reliable population trend data. With these data, we are better equipped to answer public inquires and give recommendations to the Board of Game and Advisory Committees. Unfortunately for everyone, furbearer population trend data has always been difficult to obtain. Fish & Game biologists in Interior Alaska have rarely had the necessary data to respond to annual marten population changes. Thus, we must depend on the refugium system working. Therefore, if a relatively inexpensive and easy system to forecast marten harvest could be developed, both trappers and managers would benefit.

Most successful forecast systems use a combination of the past year's:

- harvest composition and trapping success,
- prey availability and
- fecundity rates.

Fecundity is a measure of the capacity of an adult female to produce offspring. Forecasts have allowed managers to maximize the biological potential in the harvest, ie, allow trappers to take a significant number of marten without taking too many. A marten forecast model has been used in Canada for more than 30 years. Marten carcasses from trappers were used to develop these pre-season forecasts. Forecasts of marten population and harvest in Interior Alaska are now possible, as well. These forecasts are not dependent on surveys of marten population and prey abundance. Instead, the forecasts are based on data available from marten carcasses. While we have evidence that a pre-season forecast may work, we need to continue to test the forecast in various conditions.

For the past ten years, many Interior trappers have been donating marten carcasses to us at the Fairbanks Fish and Game office. These donations have allowed us to pursue a number of questions about marten populations across Interior Alaska and how to develop the best forecasts. One question we had to answer was how large of an area could we forecast? In Alaska, wildlife populations and harvest are generally managed by Game Management Units (GMU). Could marten forecasts be that far reaching? The short answer is "no." There is too much variation in marten habitat quality,

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Similar to other studies, we based the forecast on the previous year's pregnancy. Pregnancy rate is one of the primary factors influencing marten population dynamics and is a strong predictor of a population's age structure and trend. So why are we using the previous year's pregnancy rate and not the current year's pregnancy rate to explain juvenile numbers? The reproductive biology of marten has a very interesting element -- delayed implantation. Marten breed during July and August but the fertilized eggs (blastocysts) are free-floating in the uterus and do not implant for six months. Unembedded blastocysts can be easily flushed from the uterus which we collect from the carcass. This means the reproductive status (pregnant/not pregnant) of adult female marten which you catch during ***this year's*** trapping season indicates the abundance of the juvenile segment of the population during ***next year's*** trapping season.

Our marten forecasts predict juvenile harvest and not population size. However, other studies have shown that juvenile harvest is also a good indicator of population trend. In general, the presence of a lot of juveniles indicates a growing population. You may be surprised to find out that the sex ratio of the harvest does not provide a good forecast of the next year's population. Other studies have found that sex ratio was a poor predictor of marten population size or age structure and it was not correlated to the reproductive rate. The problem with relying on the sex ratio of the harvested animals is that it does not vary much by area or year. During the ten years we have been collecting data, the sex ratio was always dominated by males. When all ages are combined, the ratio ranged 1.3 to 2.2 males per female. With the exception of one year, the sex ratio for juvenile marten ranged from 0.8 to 1.2 males per female. The year with the lowest percentage of juveniles in the harvest was 2012. The sex ratio that year was 1.4 males per female. The year with the highest percentage of juveniles in the harvest was 2015. The sex ratio that year was 1.5 males per female. Thus, (as stated above) the sex ratio does not vary much and is not a good predictive tool.

Are our forecasts reliable enough you could use them to plan your trapping season? Shown below are the results of the seven different geographic areas we have been evaluating. With these graphs, we compare our predictions for juvenile abundance (measured by percent juvenile in the harvest) to the actual percent juveniles in the harvest.

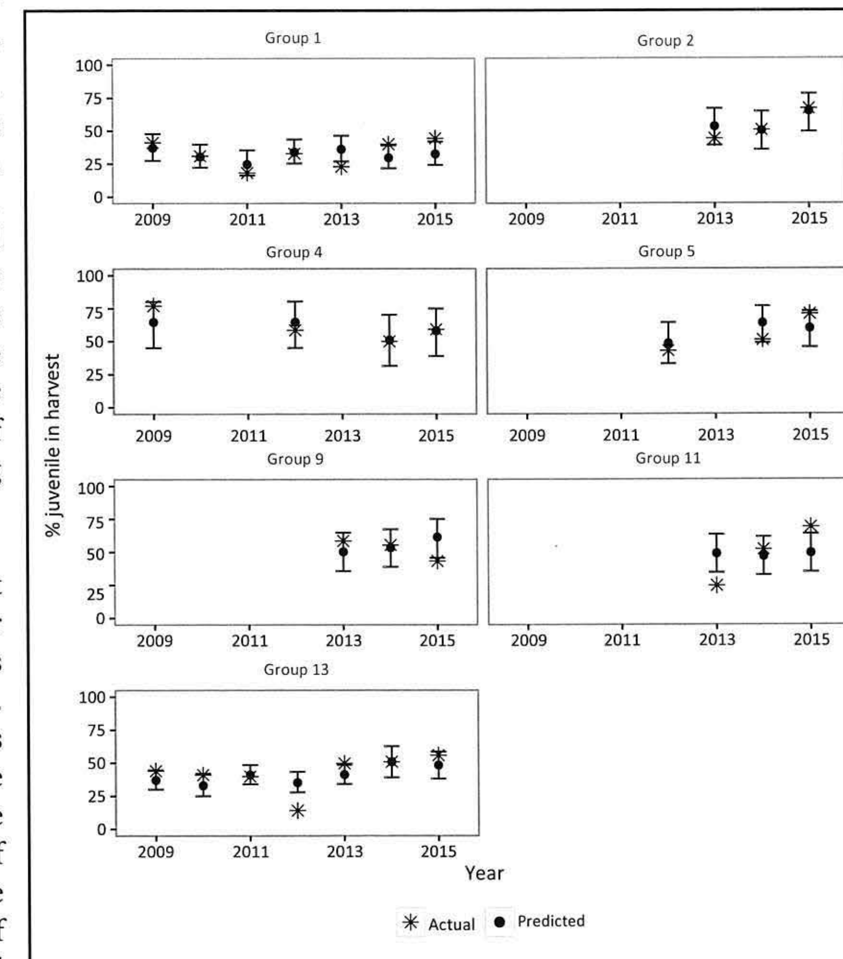


*Figure 1. Predicted and observed % juvenile marten in harvest by study area and year in Interior Alaska, 2009 - 2015.*

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As you can see, the statistical predictions of percent juveniles in the past are pretty good, but not perfect. There are a number of reasons why our forecasts can be wrong. The most important reason being recruitment failure due to elevated summer mortality. We cannot forecast these events because they occur after the data is collected. However, we have developed a safeguard in-season harvest tracking strategy (explained in ATA November 2016 issue) that allows you to recognize a reproductive failure within the first month of the season.

Sometimes, there are more juveniles in the woods than what we forecast. This error can be due to higher than expected survival of juveniles over the summer. It can also be due to small sample size. Because adult females are the least likely sex and age to be harvested (average from our data is 17%), sometimes we are basing our forecast on the pregnancy results of just a few females for entire trapping areas. The good news with this type of error is that it will be like an unexpected Christmas gift, ie, there will be more marten on your 'line than what we predicted.

Our forecasts can be improved if more trappers contribute from already established trapping areas. To increase our number of forecasts we need trappers from new areas of the Interior to contribute their carcasses. It will take three to four years of data before forecasts can be generated and probably five years before they get really good. Such is the bane of working and trapping a species that can undergo sudden population changes. For trappers who are contributing this year, please remember to bag or box your marten by month and label with your name and phone number before sending them to Fairbanks. Contact Kerry if you have questions or concerns or if you need us to pick up carcasses.

If you have any questions, please contact
Kerry at kerry.nicholson@alaska.gov or
Craig Gardner at crla.gardner@gmail.com.

Good luck trapping.

# Managing Your Marten Harvest

By Craig Gardner, Jack Whitman and Kerry Nicholson

Marten are the most sought after furbearer in Alaska. Over 70% of the 21,000 plus marten harvested in Alaska each year come from the Interior. Interior trappers enjoy long seasons and an unlimited bag limit. Amazingly enough, harvest regulations for marten have not changed in Interior Alaska since statehood. How can this be? We know that even unharvested marten populations can undergo dramatic swings. So how can we have continuous liberal regulations that still provide adequate protection during population declines? Ultimately it can be explained in one word: habitat.

Marten harvest in Interior Alaska is managed using the *refugium* strategy. Refugium is a fancy word for "refuge." Under this strategy, there must be large untrapped or lightly-trapped tracts of marten habitat interspersed among intensively-trapped areas to serve as population sources for marten. During most years, surplus juvenile marten disperse from these source areas and repopulate the more heavily-harvested areas.

Basically what drives high or low harvest levels is juvenile recruitment for that year. Recruitment is defined as the number of animals added to the population. In general, high recruitment means a lot of juveniles have been added and therefore the population can sustain higher harvest. This is important because numerous studies conducted across North America have found that the optimum marten harvest strategy is to select for juveniles and to avoid over-harvest of adult females. This management strategy is generally appropriate for Interior Alaska because of the large expanses of lightly trapped marten habitat. The benefits of the strategy are that it:

- eliminates the need for annual harvest limits,
- optimizes trapper opportunity, and
- (in most years) provides adequate protection to marten.

What about the years the refugium strategy does not work? These are the years when wide scale reproductive failures occur. During these years, few juveniles are produced by resident females and juvenile dispersal from refugia areas is severely limited. These conditions can increase the harvest vulnerability of adult resident marten and the possibility of an over-harvest. High harvests during those years can cause the marten population to be depleted for a number of years. It happened in 2012, and the longer term trappers can remember the lack of marten during the early 2000s and late 1980s. Reproductive failures can occur in smaller areas and can be just as problematic to local trappers depending on the location of adequate refugia.

Results from other studies across North America indicate that prey shortages are the primary cause of reproductive and juvenile recruitment failures. Recruitment failures due to summer mortality are not easily predicted because it is difficult to monitor juvenile survival and rarely are prey populations over a large area being monitored. Neither high or normal pregnancy rates nor previous sex and age composition in the marten population guarantees high recruitment. Juvenile recruitment failures have occurred in years when pregnancy rates and previous year's juvenile composition were average to high.

Few marten studies have been conducted in the Interior and no studies investigated marten harvest relative to marten population status. Jack Whitman (retired ADF&G wildlife biologist) studied the effects of harvest on marten numbers during his tenure as the McGrath Area Biologist (1988 - 2003). He examined marten carcasses donated by area trappers and monitored pregnancy rates, age structure, and sex and age composition of the harvest. Jack used these data to evaluate the status of the marten population and to inform Upper Kuskokwim area trappers if their harvest was appropriate for the year. Because Jack evaluated the catch throughout the season, he was able to identify reproductive failures by monitoring the ratio of juvenile marten to adult females in the catch. His efforts were successful in identifying a region-wide reproductive failure by January 1989 during the 1988-1989 trapping season.

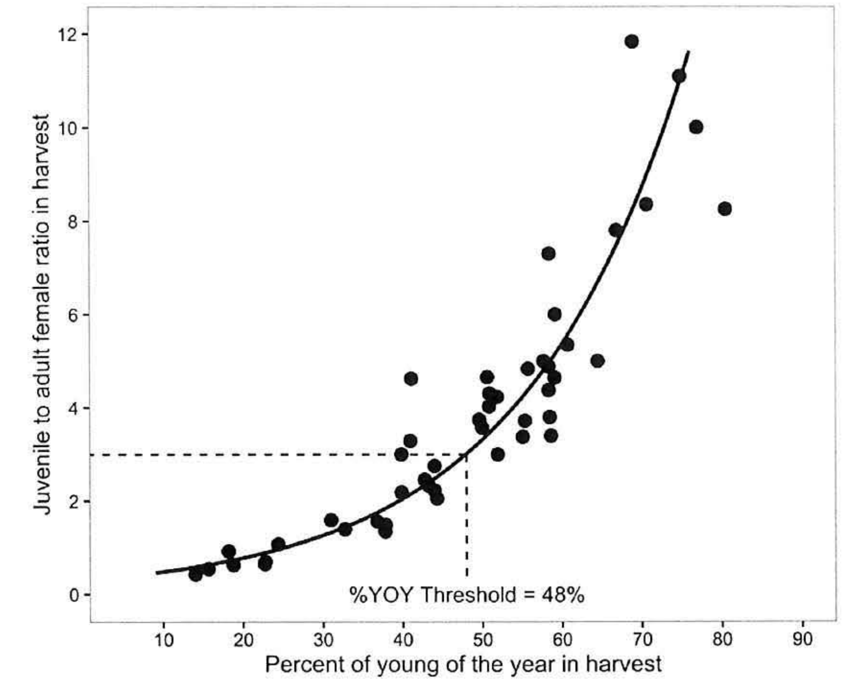
Jack relocated to Fairbanks in 2003 and again requested that area trappers donate their marten catch. I began helping Jack in 2007. We expanded the number of trappers and areas from which we collected carcasses. Our study objectives evolved to focus primarily on identifying carcass data that could be reliably used by managers and trappers to forecast marten population status prior to the trapping season and to develop an in-season check for trappers to determine the validity of the forecast and how they should proceed with their trapping season. Jack and I have retired but the program continues under the guidance of Kerry Nicholson.

In the next issue of "Alaska Trapper" we will discuss how well we can forecast marten abundance and what biological factors we use but because the marten trapping season is now upon us, we thought it would be more timely for us to explain how you the trapper can identify a reproductive failure or when juveniles become depleted on your trapline. For those of you with short 'lines surrounded by other trappers, your catch is most likely determined more by the number of dispersing juveniles than resident marten. In your case, a reproductive failure will probably just mean fewer marten caught. However, for those of you with longer 'lines and higher annual catches (if you consistently catch more than 20 marten) with adjacent refugia, a reproductive failure can have more of an impact but also be recognized more easily.

### So what do you look for?

Past studies have found differences in trap vulnerability by sex and age class. Juveniles are most vulnerable followed by adult males and finally by adult females. During early trapping season, juveniles should dominate the harvest. As the harvest season progresses, the proportion of juveniles will decline as their numbers become depleted. It is reasonable that in years of poor juvenile recruitment, the absence of juveniles in the harvest will occur earlier in the season.

Previous studies have recommended that trappers not exceed a harvest of one adult female for every three juveniles. We compared this 3/1 ratio to a simple calculation of the percentage of juveniles in the harvest. Following is a graph showing what we have found.




In all cases when the ratio of juveniles to adult females was greater than 3 (vertical axis), the percentage of juveniles in the harvest was greater than 52% (horizontal axis). Monitoring your juvenile catch relative to total capture will be a quicker method compared to using the ratio of juveniles to adult females to detect a reproductive failure because adult females are normally last to be caught. We took it a step further and made these comparisons for each week or month of the trapping season. During the first two weeks of the season, the percentage of juveniles in the harvest should exceed 56% and actually be closer to 70%.

The benefit of early detection of a reproductive failure is that you can decide how to proceed with your trapping effort relative to fur price. However our warning to you is to continue trapping at the same intensity could cause an over-harvest of adult females resulting in lower marten numbers in subsequent years. We suggest

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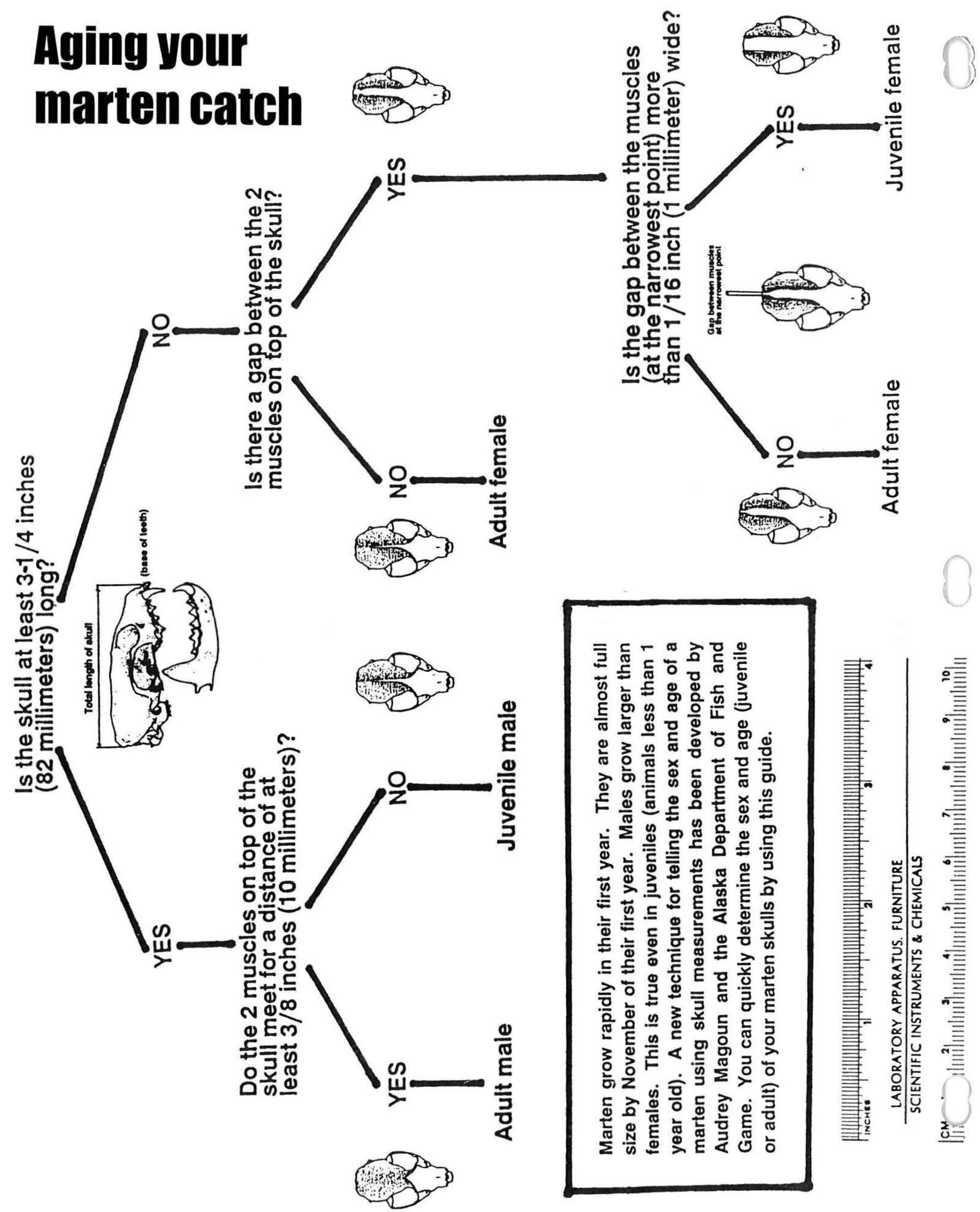
# Aging your marten catch

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that if you find that juveniles comprise less than 40% of your harvest during November, you should consider pulling most of your traps and plan to end your season early.

**So how do you monitor your harvest?**

After the skinning is done following each trap check, you need to determine the age of each marten in your catch. A key to identify each sex and age class was printed in this magazine many years ago. We reprint it here on page 10. To be honest, no matter how experienced you are, aging mistakes will occur, particularly with females. However, if the key is followed closely, the error rate will not mask a juvenile recruitment failure.

Severe recruitment failures are not common but if one occurs along with a year of high harvest, marten numbers could become depressed for several years. We suggest this happened in 2012. The carcass data showed the lowest ratio of juveniles to adult females (1.1 juveniles for every 1 adult female), the lowest proportion of juveniles (27%), and the highest proportion of adult females (26%) in the harvest for the nine years of collection. The projected and actual marten prices were high in 2012. The harvest was high, as well. These numbers suggest that a large proportion of the breeding stock was harvested in 2012 and as a result marten numbers were depressed over large areas in the Interior for a couple of years.

If you have any questions related to this study or interpretation of the date, contact Kerry (328-6117) or me (835-298-1098; crla.gardner@gmail.com) . We hope you give this in-season monitoring method a try. As Kerry gets more data, we believe we will be able to fine tune this method. It could be used during years of average reproduction to determine when juveniles are depleted as the season progresses.

More next month on how we forecast the subsequent year's harvest.