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# FRIENDS OF ORNITHOLOGY

## Newsletter

Number 6  
November 2009



Grus, The Crane (Willughby & Ray 1678)



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### From the Curator

*Kevin Winker*

As noted in a letter sent to the Friends in May, we've switched to an autumn newsletter and mailing. This timing is more concordant with other nonprofit organizations, and, as hoped, it has put us past the bottom of the current economic recession. As a fellow donor, I recognize that it is easier to make contributions to worthy causes when there is less uncertainty in the economy.

A lot has happened since our last newsletter. Many personnel milestones have occurred; most of these are detailed below in the annual reports. In addition, Aldona Jonaitis has retired as the museum's director, and our new director, Carol Diebel, began in October. Four graduate students have completed their degrees, and Kyle Campbell has begun with us as a master's student. It has been support like yours that has kept our students moving forward in their endeavors here. Friends of Ornithology support has been spent on students through stipends (with a Federal work-study match), field travel, and research laboratory costs. We all thank you for your continued support.

### The Department of Ornithology

Although our existence and many of our activities are centered around the Bird Collection, it is the people involved who make it all happen:

#### Residents

*Kevin Winker* (Curator)

*Jack Withrow* (Collections Manager)

*Brina Kessel* (Curator Emeritus)

#### Students

*Elizabeth Humphries* (PhD student)

*Jack Withrow* (MS student)

*Kyle Campbell* (MS student)

#### Research Associates

*Heinrich Springer*

*Rose A. Z. Meier*

*Christin Pruett*

*Daniel Gibson*

*Johannes Erritzoe*

*Kevin McCracken*

*Thomas Braile*

*Matthew Miller*

#### Volunteers

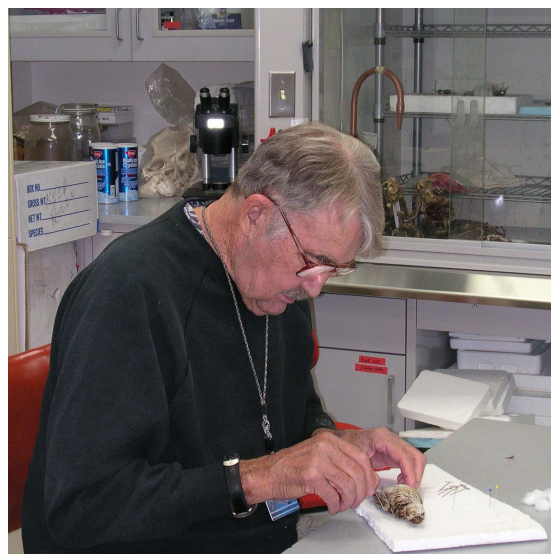
*Robert Dickerman*

*Steven Heinl*

*David Sonneborn*

*Michael Schwitters*

Robert Dickerman skins a bird in the lab.



### FROM STAFF, STUDENTS, ETC.

#### Jack Withrow

In January of 2009 I assumed the responsibilities of Collections Manager in the Department of Ornithology, transitioning from full-time student and part-time museum employee to full-time museum

employee and part-time student. Since then, we've made great progress in the organizational and clerical details that facilitate a quick retrieval of archived specimens and information. Coming out of several years of construction and moving, things were a bit disorganized. The skin collection is now sorted and arranged in a completely new taxonomic order. Similar organizational efforts in the tissue collection, the 8<sup>th</sup> largest for birds in the world and one of the most heavily used parts of the collection, are nearing completion. Much work remains to be done in the organization of the less heavily used, but no less important, skeleton and spread wing collections. Both have undergone rapid growth in the past few years. We are also switching to new and more user-friendly collections software.

Our efforts and those of many people throughout the state continue to provide a steady stream of specimens. A lot of important material comes through our collective specimen salvage efforts (e.g., from road and window kills), and we encourage everyone to watch for dead birds, freeze them with a label of the date and location, and get them into a collection if possible. We can facilitate this process for those interested. Specimens of two species on the Alaska checklist but lacking specimen documentation were added to the collection, Chinese Pond-Heron (*Ardeola bacchus*) and Nashville Warbler (*Vermivora ruficapilla*). Other acquisitions of import included nearly a dozen Red-legged Kittiwakes (*Rissa brevirostris*) from the Pribilof Islands, similar numbers of the endemic Prince of Wales Spruce Grouse (*Falci pennis canadensis isleibi*), and interesting distributional records salvaged from North Slope oil platforms. The State list is growing longer, too, but we'll have more on that in the next newsletter.

I have continued to work on my master's thesis and am in the final stages of completing an AFLP (Amplified Fragment Length Polymorphism) dataset of 720 loci from American and Pacific golden-plovers (*Pluvialis dominica* and *P. fulva*). These data should allow me to answer interesting questions concerning the genetics of speciation, the utility of AFLPs in resolving divergences, and the relative rates of intra-genomic divergence in birds and its relationship to the evolutionary forces that shape it, such as genetic drift and natural selection. Earlier this year Liz Humphries and I were awarded the Angus Gavin Memorial Bird Research Grant. This has allowed us to complete much-needed lab work.

## Tom Braile

I am unique in the world in holding Research Associate appointments at both the University of Alaska Museum and the National Museum of the Philippines. However, it is not unique among bird species to annually migrate between Alaska and Asia (including the Philippines). We do not know for sure exactly how many bird species migrate specifically between Alaska and the Philippines, but we can be sure that at least several do. Some examples of Alaska-Philippines migrants are the Eastern Yellow Wagtail (*Motacilla tschutschensis*), Arctic Warbler (*Phylloscopus borealis*), and the Aleutian Tern (*Onychoprion aleuticus*). This is quite remarkable, given the distances covered and the highly variable environments between these regions. Since 2001, I have been fortunate enough to conduct research on Philippine birds, and this includes research on some of Alaska's birds while they are in the Philippines.

The University of Alaska Museum's Department of Ornithology includes foreign research because the majority of Alaska's birds spend the winter months outside the state. We are not only interested in where Alaska's birds may be going, but also whether they may be bringing diseases such as avian influenza (AI) to Alaska. In my research in the Philippines I routinely take samples that will be screened for viral diseases. We are highly concerned that Alaska's migratory birds could bring pathogenic diseases from Asia to North America. Philippine authorities are also concerned about the potential presence of bird flu in their country. We hope our research will lead to a better understanding of this potential threat to human health, poultry, and wildlife.

In addition to studying Alaska's birds in the Philippines and the avian transport of disease, we also study the phylogenetics of Philippine birds. A recent paper with colleagues makes the case for a new Philippine endemic species, the Philippine Magpie-Robin (*Copsychus mindanensis*). We have identified other species that we believe will eventually lead to new endemic bird discoveries, and we continue working with collaborators on this and other aspects of Philippine birds.

Working in the Philippines on bird research has always involved many challenges and special opportunities. Recent worldwide news stories of

historic typhoons hitting the Philippines highlights a challenge to Filipinos and to conducting research here that is present nearly year-round, but which is not always told on the world news.

Typhoons Pepeng and Ondoy caused great calamity here in the Philippines recently, with terrible loss of human life and significant damage to infrastructure and property. Flooding and landslides are all too common here, with substantial consequences. Even the National Museum of the Philippines' collections were threatened by these storms, and the public exhibit building was substantially flooded, causing water damage to historical files. Few are spared in such large storms, and even birds can be highly impacted. The inconvenience and challenges of research delays and wet outings caused by storms pale in comparison with loss of human life, yet all are part of field work in the Philippines. Perhaps in a small way our research on birds can lead to greater appreciation for the natural environment and help in the preservation of forests and trees that can aid in the prevention of dangerous landslides. In the meantime, typhoons like these can really put life in perspective.

### **Elizabeth Humphries**

I received my MS from UAF last December and decided to stay on to work on my PhD. I'm lucky enough to work on what I consider one of the most fascinating systems in the world, the birds of Beringia (the area that includes Alaska, the Bering Sea, and eastern Russia). The unusual geologic history of Beringia has resulted in a wonderful diversity of species and subspecies. There is a pattern of sister species (different species on either side of the Bering Strait), sister subspecies, and sister populations found across Beringia, which makes it my ideal study system.

I'm interested in the genomics of speciation—examining the patterns in the genomes that are left by the process of a single species splitting into two. The strengths of the UAM Bird Collection provide a good representation of most of the Beringian species, which will allow us to fully examine the genetic consequences of speciation. Jack Withrow and I have already received a grant from the UA Foundation (the Angus Gavin Migratory Bird Research Grant) to study this topic. We will be working on a variety of species from seven different orders, including Passeriformes (perching birds), Charadriiformes (shorebirds), and Gaviiformes (loons, my

personal favorites). Additionally, we had a high school student, Tim Sanner from Pedro Bay, Alaska, join us this summer to work on the project. This was Tim's first chance to work in a genetics laboratory, although I'm fairly certain his favorite part of the experience was exploring the bird collection in the Museum. Tim worked with us as a part of the Rural Alaska Honors Institute, which is a program that offers college-level courses to high-performing high school juniors and seniors from rural Alaska. I am also proud to report that my first senior-authored paper (on the evolutionary relationships of auklets) was published this year. This paper was the first chapter of my Master's thesis, and seeing it in print is exciting.

I feel very fortunate that I get to live and work in a place like Alaska. I've been here four years, and watching the ravens riding the air currents created by the new Museum's exterior is still one of my favorite things to do. Everyone back home (I'm originally from Maryland) tells me that I'm so lucky to be living in Alaska. They don't know the half of it.

### **ANNUAL REPORT - ORNITHOLOGY FY08**

This was an important year for us in many respects. The biggest event was Dan Gibson's retirement at the end of this fiscal year. Dan worked for the museum since 1965, so if you felt the earth shake on 1 July, you now know the reason. Thankfully, Dan's expertise is not lost to us: he will continue as a Research Associate and volunteer. Other big personnel changes occurred, too. Three graduate students defended their theses: Carrie Topp (MS), Michael Lelevier (MS), and Matthew Miller (PhD). Congratulations to all! Carrie Topp heads the Institute of Arctic Biology's DNA Core Lab here on the UAF campus. Mike Lelevier has begun a Ph.D. program in ornithology at the Museum of Southwestern Biology at the University of New Mexico in Albuquerque. Matt Miller has begun a postdoctoral research position at the Smithsonian Tropical Research Institute in Panama. In addition to thesis presentations, department staff and students gave six scientific presentations at a variety of venues, including the American Ornithologists' Union meeting in Laramie, Wyoming. West Valley High School teacher Cyndie Beale, who completed two summers of research with us in the molecular genetics laboratory

this year, has had her overall excellence recognized by winning the prestigious Presidential Award for Excellence in Mathematics and Science Teaching! Congratulations, Cyndie! Jack Withrow, from Kodiak, Alaska, has joined us as a graduate student (MS). Department of Ornithology staff and volunteers conducted seven field efforts this year, including expeditions to the Near Islands (Attu and Shemya), the North Slope, the Copper River Delta, Belize, and the Philippines. Our collecting, salvaging, and preparation efforts resulted in the cataloguing of 1,000 new specimens into the collection. In addition, we published a lot of new material from our research. As always, we were fortunate enough to field a host of excellent volunteers, and we extend our deepest appreciation to them!

Volunteer hours	1,380
Acquisitions	1,000
Grants	4
Publications	13
Reports	12
Loans	18
Data requests	109
Professional visitors	25
Student visitors	50
Public contacts	~685

#### Students working with collections

PhD	3
MS	4
Undergraduates	3

### ANNUAL REPORT - ORNITHOLOGY FY09

(sorry to have to include two—it is a consequence of the switch to a fall newsletter)

It has been another productive year in the Department of Ornithology. Following Dan Gibson's retirement at the end of the last fiscal year (30 June 2008), we hired a new Collections Manager for Birds, John ("Jack") Withrow, from Kodiak Island. Jack began with us in this capacity in January 2009. Elizabeth Humphries defended her Masters thesis and continued on with us as a PhD student. Kyle Campbell continued with us as an undergraduate in the lab. Department personnel conducted seven field efforts this fiscal year, five in Alaska (Kodiak, Cordova, and the

Aleutian Islands) and one each in the Philippines and Russia. Staff and students were involved with eight scientific presentations at three different meetings, including the American Ornithologists' Union meeting in Portland, Oregon. Twelve publications appeared with students or staff as authors, and the collection grew by 1,000 specimens again this year. A collaborative global effort has shown that this collection now ranks among the top ten bird collections in the world with respect to vouchered genetic samples. As in the past, we take our hats off to our remarkable volunteers and the Friends of Ornithology, without whom we would not be able to accomplish nearly as much.

Volunteer hours	354
Acquisitions	1,000
Grants	2
Publications	12
Reports	11
Loans	15
Data requests	187
Professional visitors	45
Student visitors	36
Public contacts	~735

#### Students working with collections

PhD	3
MS	5
Undergraduates	2

### A Rare and Wonderful Gift *Kevin Winker*

Last December, Henry Springer, of Anchorage, Alaska, and one of our Research Associates, donated a Passenger Pigeon (*Ectopistes migratorius*) specimen to the UAM Bird Collection. This species was driven to extinction by unbridled market hunting in the 1800s; the last individual died in captivity in 1914. Of the comparatively tiny number of specimens that were preserved, some are still available to private collectors, and it was one of these that Henry obtained and so kindly donated. Although not a species that occurred in Alaska, it has inestimable educational and comparative value.



Passenger Pigeon and three *Zenaida* doves.

I recently had the pleasure of reading John James Audubon's 1831 account of this species in his *Ornithological Biography* (Vol. I, Adam Black, Edinburgh). "The multitudes of Wild Pigeons in our woods are astonishing," he wrote (p. 320). During a three-day flight of amazing proportions, witnessed near the Ohio River in Kentucky, Audubon noted (p. 321) that "The atmosphere, during this time, was strongly impregnated with the peculiar odour which emanates from the species." That is surely an aroma I wish I could experience; none of the many columbiform species I have had in the hand have had any remarkable aroma (although they all smell good when cooked). Audubon's descriptions of the sheer numbers of these birds when in migration and of their patterns of flight and of the colors displayed therein lie in stark juxtaposition to his descriptions of the astonishing levels of slaughter of these birds for food (for humans and pigs). He related that in 1830 he bought about 350 birds alive at four cents apiece from a market in New York, and that he distributed them to noblemen and to the Zoological Society in England. What a shame that they did not enjoy the same success there that the European Starling (*Sturnus vulgaris*) did when later brought to the New World.

While the Passenger Pigeon is the incomparable

core of this gift, the beautiful full mount of this bird, thought to originally have come from upstate New York, is accompanied by mounted specimens of three other New World doves: a Mourning Dove (*Zenaida macroura*; below the Passenger Pigeon in the photo), a Socorro Dove (*Zenaida graysoni*; lower left), and an Eared Dove (*Zenaida auriculata*; lower right). This group of species is thought to be closely related; the latter three are widely considered to be a superspecies complex.

It is a tribute to Henry's skill as a taxidermist that the three *Zenaida* doves are as presentable as the Passenger Pigeon, and he's arranged them together in an attractive, custom-made display. To me they make an impressive statement not only of an important assemblage of New World dove species, but also of the failures and successes of managing wildlife. In the case of the Passenger Pigeon, unregulated human greed for meat and timber caused the demise of one of the most abundant vertebrate species on the planet.

Yet, partly because of the lessons learned from the passing of the Passenger Pigeon, its close relative, the Mourning Dove, remains abundant and, through successful management, is one of the most popular avian game species in the United States, with tens of millions killed by hunters each year. Managing harvest seasons and bag limits can work well to satisfy the needs of humans and wildlife. Similarly with the Eared Dove in South America, although care must be taken to ensure their continued abundance. In contrast, the Socorro Dove went extinct in the wild due to introduced sheep and feral cats onto Socorro Island off of western Mexico. It survived total extinction only through successes in captive breeding; it was natural mortality in captivity that was the source of this specimen. Together, this group of birds represents an amazing story in biology and in the failures and successes of wildlife management. Henry Springer has contributed specimens to this collection for many years, but this gift certainly ranks among the most noteworthy.

### Important New Book

*Kevin Winker*

Jim King, a Patron of the Friends of Ornithology, has written a wonderful account of his career in Alaska, which began in 1949. *Attending Alaska's Birds: A*



*Wildlife Pilot's Story* (Trafford Publishing, [www.trafford.com](http://www.trafford.com)) is a very enjoyable firsthand account of the beginning and coming of age of bird study and management in Alaska. It is fascinating—both entertaining and educational—and I recommend it to everyone with an interest in Alaska's birds and in the history of bird management in the state.

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### **Contributors**

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*or point them to our web page at*

[www.uaf.edu/museum/bird](http://www.uaf.edu/museum/bird)

## RECENT PUBLICATIONS (ANNOTATED)

(**Bold** denotes our students)

- Sheldon, F. H., D. J. Lohman, H. C. Lim, F. Zou, S. M. Goodman, D. M. Prawiradilaga, K. Winker, **T. M. Braile**, and R. G. Moyle. 2009. Phylogeography of the magpie-robin species complex (Aves: Turdidae: *Coppychus*) reveals a Philippine species, an interesting isolating barrier and unusual dispersal patterns in the Indian Ocean and Southeast Asia. *Journal of Biogeography* 36:1070-1083.
- Gibson, D. D., S. C. Heinl, and T. G. Tobish, Jr. 2009. Checklist of Alaska birds, 15th ed. University of Alaska Museum.
- Spellman, G. M., A. Cibois, R. G. Moyle, K. Winker, and F. K. Barker. 2008. Clarifying the systematics of an enigmatic avian lineage: What is a Bombycillid? *Molecular Phylogenetics and Evolution* 49:1036-1040.
- Braile, T. B., K. Campbell**, and K. Winker. 2008. Body masses of some Philippine birds. *Occasional Papers of the Eurasian Pacific Wildlife Conservation Foundation* No. 4:1-7.
- Winker, K. 2008. What I do: Notes from the frontiers of academic curating in biology. *Curator* 51:393-406.
- Pruett, C. L., P. Arcese, Y. L. Chan, A. G. Wilson, M. A. Patten, L. F. Keller, and K. Winker. 2008. Concordant and discordant signals between genetic data and described subspecies of Pacific Coast Song Sparrows. *Condor* 110:359-364. *Song Sparrows* (*Melospiza melodia*) provide one of North America's best examples of geographic variation in phenotype, with approximately 24 described subspecies recognized. However, researchers have found mixed signals when making comparisons between subspecies and genetic markers. We examined seven microsatellite loci from 576 Song Sparrows of 23 western North American populations representing 13 recognized subspecies. We assessed the level of concordance between microsatellite loci and subspecies. We found that in some instances, but not all, neutral genetic structure corresponded to recognized phenotypic structure. However, some populations not currently recognized as subspecies were found to be genetically differentiated from all other populations that are considered to be the same subspecies. We suggest that a combination of phenotypic characters, behavioral traits, and multiple loci be used when assessing geographic variation in birds, and that sampling should be done in more than one location within broadly distributed subspecies.
- Winker, K., E. Spackman, and D. E. Swayne. 2008. Rarity of influenza A virus in spring shorebirds, southern Alaska. *Emerging Infectious Diseases* 14:1314-1316. *Results of avian influenza surveillance at an important Pacific and North American site in Alaska suggest that AI prevalence rates among shorebirds at Delaware Bay are not typical within North America. Given present evidence, it seems that the role of North American shorebirds in AI virus ecology and epidemiology is heterogeneous within the continent and within a genus (Calidris). This confirms that knowledge of how AI viruses cycle in wild bird hosts remains incomplete at continental and family-level taxonomic scales.*
- Wilson, A., P. Arcese, C. L. Pruett, K. Winker, M. A. Patten, and Y. Chan. 2009. The contribution of island populations to in situ genetic conservation. *Conservation Genetics* 10:419-430.
- Pruett, C. L., P. Arcese, Y. Chan, A. Wilson, M. A. Patten, L. F. Keller, and K. Winker. 2008. The effects of contemporary processes in maintaining the genetic structure of western song sparrows (*Melospiza melodia*). *Heredity* 100:67-74. *Historic events and contemporary processes work in concert to create and maintain geographically partitioned variation and are instrumental in the generation of biodiversity. We examined how contemporary processes such as movement and isolation maintain the structure of widely distributed, vagile species. Song sparrows (Melospiza melodia) in western North America provide a natural system for examining the genetics of populations that have different patterns of geographic isolation and differing migratory behaviors. Low levels of immigration and high levels of genetic drift characterized isolated, sedentary populations. Populations that are not geographically isolated showed a signal of high gene flow over time and little differentiation from other populations. Contemporary dispersal rates from migratory populations were higher and occurred over larger distances (> 500km) than dispersal from sedentary populations. But this contemporary gene flow was generally too low to counter the effects of drift in most populations. Geographic isolation and limited gene flow facilitated by migratory behavior are responsible for maintaining associations among Pacific coastal song sparrow populations.*
- Winker, K. 2008. [Review of] *Handbook of the birds of the world, Vol. 12: Picathartes to Tits and Chickadees*. Loon 80:103-104.
- Miller, M. J.**, E. Bermingham, J. Klicka, P. E. Escalante, F. S. Raposo do Amaral, J. Weir, and K. Winker. 2008. Out of Amazonia again and again: Episodic crossing of the Andes promotes diversification in a lowland forest flycatcher. *Proceedings of the Royal Society of London B* 275:1133-1142. *Most Neotropical lowland forest taxa occur exclusively on one side of the Andes, despite appropriate habitat on both sides of these South American mountains. Analyses*

- have generally supported that the Andean uplift created a vicariant barrier to lowland lineages. But a few widespread plant and animal species challenge the generality of this hypothesis. The phylogeographic history of a widespread Neotropical flycatcher (*Mionectes oleagineus*), based on nuclear and mitochondrial DNA sequences, showed an early basal split between montane and lowland *Mionectes*. Phylogeographic reconstruction of lowland taxa revealed a complex history, with multiple cases in which geographically-proximate populations do not represent sister lineages. Three populations of *M. oleagineus* west of the Andes do not comprise a monophyletic clade; each is an independent lineage with origins east of the Andes. Divergence estimates suggest that at least two cross-Andean dispersal events occurred after the Andean uplift.
- Pruett, C. L., and K. Winker. 2008. Evidence for cryptic northern refugia in both high- and temperate-latitude species in Beringia. *Climatic Change* 86:23-27. *Temperate and high-latitude landbird species on Bering Sea islands share similar cryptic glacial refugium histories.*
- Winker, K., and G. R. Graves. 2008. Moderate gene flow and weak genetic structure characterize breeding and wintering populations of Swainson's Warbler. *Wilson Journal of Ornithology* 120:433-445. *Swainson's Warbler (*Limnothlypis swainsonii*) is a species of conservation concern. Microsatellite DNA variation among 11 breeding populations from eastern Texas to Virginia and two populations from wintering areas in Jamaica and Mexico indicated a moderate level of gene flow among breeding populations, relatively small effective population sizes (< 200 individuals in each sampled population), and subtle population variation. Substantial mixing of breeding populations may occur in wintering areas (i.e., low connectivity). Genetic differences between the Mexican and Jamaican populations indicate that they may come from different subsets of breeding populations. Genetic variation among breeding and wintering populations suggest that a network of local and regional conservation programs may be necessary to maintain genetic diversity in this species.*
- Johnson, A. B., and K. Winker. 2008. Autumn stopover near the Gulf of Honduras by Nearctic-Neotropic migrants. *Wilson Journal of Ornithology* 120:277-285. *The southeastern Yucatan Peninsula hosts high numbers of Nearctic-Neotropic migrants during autumn migration, but its importance has not been addressed. We studied autumn stopover mass gains among passerine migrants in tropical lowland forest 20 km inland from the Gulf of Honduras. Most individuals were carrying some subcutaneous fat. Of 15 taxa studied, 10 showed significant positive diel (24 hr) gains in body condition index. Estimates of net mass gains suggested that they all were depositing fat, and average individuals in four taxa were depositing enough fuel to undertake an entire night of migration after only 1 day of fattening. Our data demonstrate the importance of the region as an autumn stopover site and suggest that stopover areas farther north are also important.*
- Topp, C. M., and K. Winker. 2008. Genetic patterns of differentiation among five species of landbirds on the Queen Charlotte Islands, British Columbia. *Auk* 125:461-472. *Using mtDNA, we evaluated four species with phenotypically-described endemic subspecies on QCI for uniqueness, conservation concern, and management (Northern Saw-whet Owl, *Aegolius acadicus*; Hairy Woodpecker, *Picoides villosus*; Steller's Jay, *Cyanocitta stelleri*; and Pine Grosbeak, *Pinicola enucleator*). The Chestnut-backed Chickadee (*Poecile rufescens*), with no endemic subspecies on QCI, was included for comparison. The four species with endemic phenotypes on QCI had significant genetic divergence from nearby conspecific populations, although variation in divergence times indicated varying colonization histories. Given the corroboration between morphological and genetic evidence for derived populations on QCI, the four endemic subspecies exhibit hallmarks of being evolutionarily significant units (ESUs) and at the least should be considered separate management units (MUs), distinct population segments (DPSs), or designatable units (DUs). This is reflected in existing subspecific nomenclature, which our genetic results support. Our results indicate that QCI has been an important area for the generation of avian diversity below the species level, and that it is an important area for the conservation and management of birds in northwestern North America.*
- Pruett, C. L., and K. Winker. 2008. The effects of sample size on population genetic diversity estimates in Song Sparrows, *Melospiza melodia*. *Journal of Avian Biology* 39:252-256. *To empirically determine the effects of sample size on commonly used measures of average genetic diversity, we genotyped song sparrows (*Melospiza melodia*) from two populations, one genetically depauperate ( $n = 100$ ) and the other genetically diverse ( $n = 100$ ), using eight microsatellite loci. These genotypes were used to randomly create 10,000 datasets of differing sizes (5 to 50) for each population to determine the effects of sample size. At small sample sizes (5-10), estimates of unbiased heterozygosity outperformed those based on observed heterozygosity or allelic diversity for both low- and high-diversity populations. Rarefaction provides a useful way to compare estimates of allelic diversity across populations of differing sample size. We recommend that standard errors be reported for all diversity estimators, and that at least 20 to 30 individuals be sampled when possible. However, when large sample sizes cannot be obtained measures of genetic diversity should be reported.*
- If you are interested in reading these papers, most can be found on our web site (Winker's CV site)
- University of Alaska Museum's  
Friends of Ornithology
- The birds of Alaska have never been in better hands.*