Sea Duck Joint Venture, Annual Project Summary for Endorsed Projects
FY 2009 – (October 1, 2008 to Sept 30, 2009)

Project Title - SDJV Project #105: Examining the Impact of Avian Cholera on the Population Dynamics of a Long-lived Sea Duck, the Northern Eider (multi-year 2 of 3)

Principal Investigators
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Project Description:
Field studies were conducted at East Bay, Southampton Island, Nunavut in 2009 to document the continuing impact of avian cholera on northern common eiders. The East Bay colony has been monitored intensively since 1996, thus yielding before (pre-2005) and after (post-2005) outbreak data for comparison of trends in abundance, survival and productivity. Live birds were again captured in mist nets, marked, and sampled for disease prior to breeding. These data will be used to test hypotheses related to morbidity, mortality, and breeding performance in relation to infection status.

Since 2007, we have been investigating the potential sources of *Pasteurella multocida* strains causing these outbreaks, by examining pre-outbreak infection status in common eiders and other species (e.g., snow geese), and evaluating environmental survival and overwintering potential of *P. multocida*. Carcasses collected during outbreaks undergo complete necropsies, and any *P. multocida* isolates obtained are further identified to serotype. We are using amplified fragment length polymorphism (AFLP) analysis, a whole-genome DNA fingerprinting technique to compare about 400 *P. multocida* isolates collected from avian cholera outbreaks that occurred throughout Canada between 1999 and 2009, including samples from East Bay Island outbreaks (2006-09).

We are also in the process of developing new genotyping tools to compare the above isolates at a finer resolution. Between these two different techniques, we can potentially identify the source of this newly emerging disease affecting sea ducks in the eastern arctic.

We are developing a new PCR screening tool to detect the presence of low concentrations of *P. multocida* in avian and environmental samples, and will use this tool to screen thousands of samples collected from 2007 to 2010 (and potentially later). This tool will allow us to eliminate the need to run bacteriological analyses on every sample, and to select only those which are PCR-positive for culturing if further characterization is deemed necessary, providing more reliable results in a more timely manner, and saving valuable research dollars. This tool will markedly enhance our ability to investigate the ecology of avian cholera outbreaks and patterns of spread among sea ducks.

Objectives:

The East Bay research program is the only location in North America where demographic data exists for a sea duck species prior to, and during a major disease epizootic. Consequently, the research team is in a unique position to evaluate transmission pathways, quantify the impact that the disease is having on the population, and predict how it will spread. These are questions of particular relevance to wildlife managers in Canada, the United States, and Greenland, given predictions for how disease prevalence will increase and spread northward under current climate change scenarios.

Preliminary Results:

- *Temporal Dynamics of Cholera Outbreaks* - Outbreaks of cholera have occurred at East Bay every year since 2005; however there has been considerable variation in their severity within and among years. Susceptibility to infection and mortality has been determined to be strongly related to bacterial serotype and stress. Contrary to predictions for density-dependent mortality, our data indicate that colony size did not influence the severity of the epizootic, but instead mortality rate was a function of the duration of exposure (Fig 1).
- *Demographic Effects* - Mark-resight analyses indicate that the survival rate in 2009 was the lowest since on record (S = 49%) and that the mortality rate was nearly double the pre-cholera rate (Figure 2). Nest success in 2009 also was very low, which is similar to the situation in other years of severe adult mortality. Given that cholera has persisted at East Bay for the last 5 years, it now appears that the pool of subadults arriving for the first time to breed has dwindled and it no longer should be expected that recruitment by individuals born before the outbreaks will help to rebuild the population.
- *Disease Sampling* –A total of 20 common eider carcasses (tissues only) were recovered on the island in 2009, and, as per previous years, avian cholera was confirmed as the cause of mortality. The strains of *P. multocida* causing the epizootics shifted from serotype 1 in 2005 to serotype 3x4 in 2007 and 2008, with both types present in 2006. Serotyping of bacterial isolates obtained from carcasses in 2009 is underway. Serotype 1 is most frequently associated with waterbirds in the Pacific, Central, and Mississippi flyways, whereas serotype 3x4 predominates in the Atlantic flyway. Southampton Island is a region of convergence for migratory birds from different regions and these results suggest multiple sources. Bacteriology has been conducted on all apparently heathy eider and snow goose samples collected in 2008, most of the eider samples collected in 2007 (507 cloacal, 57 choanal), and 172 of the environmental samples collected in 2007 (see Table 1 for total samples collected). *Scientific contributions* – in addition to several conference proceedings, the following journal articles were published or submitted:

Descamps, S., H.G. Gilchrist, J. Bety, and I. Buttler. 2009 Costs of reproduction in a long-lived: large clutch size reduces survival in the presence of a highly virulent disease. Biology Letters 5:278-281.

Buttler, I., H.G. Gilchrist , Descamps, S., and M.R. Forbes. Handling stress lowers survival and delays nesting among female common eiders during an avian cholera outbreak (in review Journal of Wildlife Management).

Buttler, I., H.G. Gilchrist , Descamps, S., and M.R. Forbes. Annual variation in the temporal dynamics of avian cholera epidemics among common eiders nesting in the Arctic. (in review Journal of Wildlife Diseases).

Project Status:

Our objectives for the 2009 field season were met. Our next priority is to complete ongoing lab work by C. Soos, including the above-mentioned AFLP analyses, molecular screening and genotyping analyses, blood smear screening, feather corticosterone analyses, and analyses of serum samples. A new graduate student, S. Iverson, has been added to our research team, whose focus will be on investigating the spatial epidemiology of cholera in the Arctic and modeling its

effects on eider population dynamics. Our overall project objectives have not changed.

Tables and Figures:

Table 1. Biological samples collected from the East Bay Island (2005 to 2009). AC = avian cholera, AI = avian influenza.

Year	2005	2006	2007	2008	2009
Common Eider mortality*	203	3230	796	1470	In prep
Common eider carcass*- necropsy, bacteriology, AC serotyping, AC DNA fingerprinting	21	19	42 full, 23 partial	33 full, 6 partial	20 partial
Serum- serology, corticosterone, NMR, other diseases	none	none	319	232	102
Smear - leukocyte differentials and haemoparasites	none	none	355	265	102
Blood - haemoparasites, DNA	none	none	330	266	102
Cloacal and Choanal Swabs - AC (# birds) for PCR screening and bacterial isolation	none	none	584	593	498
Cloacal and Choanal Swabs- for avian influenza PCR screening (#birds)	none	none	453	0	509
Feathers (for corticosterone analysis)	none	None	539	582	504
Water, ice, pond sediment – for PCR screening and bacterial isolation	none	none	189	175	146
# adults banded	549	486	732	547	532
# ducklings banded	180	58	269	180	175

*King Eider, Brant, Snow Bunting, and Herring Gulls have also been killed by cholera, and have been necropsied and cultured for *P. multocida*.

Figure 1. Annual mortality of breeding female common eiders in relation to epidemic duration (2004-2008).

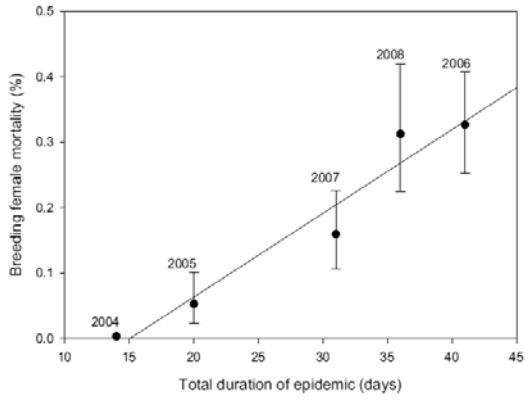

Figure 2. Annual survival rate of breeding female common eiders (pre-cholera: 1997-2004 and post-cholera: 2005-2009).