Sea Duck Joint Venture

FY05 Annual Project Summary

Project Title: (SDJV Project #56): **EVALUATION OF METHODS FOR ESTIMATING POPULATION ABUNDANCE AND MAPPING DISTRIBUTION OF WINTERING SCOTERS AND OTHER SEA BIRDS**

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Project Description:

Population status, trend, and habitat association information are identified as priority needs for scoters in the SDJV Strategic Plan. Survey design for wintering scoters is challenging because these species have large ranges, are subject to substantial distributional shifts among years and within a season, and occur in aggregations. Techniques and challenges for monitoring scoter populations on the breeding grounds are well established, and the weaknesses of current monitoring protocols are well understood. The efficiency and practicality of statistically-rigorous monitoring strategies for mobile, aggregated wintering scoter populations are less clear. This study evaluated an adaptive 2-phase stratified sampling plan to estimate wintering scoter (and other sea duck) population size and provide information on bird distribution. Experimental survey protocols were applied in near- and offshore waters of the mid-Atlantic Coast from New Jersey to Virginia and included estuarine waters of the Delaware and Chesapeake Bays.

Objectives:

1) Develop and implement an aerial survey for wintering scoters utilizing an adaptive, 2-phase, stratified sampling plan that optimally allocates a fixed sampling effort among offshore strata to minimize the variance of scoter population estimates.

2) Evaluate distance sampling methods, incorporating covariates, to estimate detection probabilities for each observer.

3) Evaluate imagery-based methods to correct for observer-bias in estimating flock size.

4) Using data collected, evaluate the relationship between estimate uncertainty and sampling intensity to inform future survey design.

Preliminary Results:

Surveys were completed by 2 crews in February 2005. Preliminary analyses and results will be presented at The Wildlife Society Conference in Madison, WI (Sept. 2005) and at the Sea Duck Conference in Annapolis, MD (Nov. 2005). In general, the 2-phase adaptive design was effective in dealing with regional aggregation of sea ducks, specifically in identifying and focusing sampling effort in strata holding concentrations of birds at the start of the survey. As could be expected, the 2-phase design was no more effective in dealing with local clustering into large flocks than a conventional stratified design. This is a perennial problem associated with locally clustered populations which inflates the variance of estimates of population total. There are no statistical solutions to this problem, but operational solutions such as high-level reconnaissance surveys to estimate the number of large flocks may be possible.

Distance sampling proved a practical alternative to estimating the perception component of detection bias. Analysis was complicated by the use of 2 different survey aircraft with markedly different visibility characteristics. Under low glare conditions estimated detection rates were perfect (1.0). Of covariates measured, glare showed the greatest effect on detection rate, however this effect was only apparent for the survey crew flying the Partenavia P68 Observer. The effect of sun angle and glare was probably more pronounced in this aircraft due to its much larger viewable area relative to the Cessna 206 used by the other crew.

Estimates of population total for combined scoter species, individual scoter species, and long-tailed ducks are presented in Table 1. Because we were unable to reliably discriminate species for all scoter observations, we pooled scoter observations to estimate a combined total. We then derived species-specific estimates for scoter from the species proportions of scoter observations made in the inner 100m of the strip transect width.

Table 1. Estimates of population total for scoters and long-tailed ducks wintering in near- and offshore waters of the mid-Atlantic region in early February 2005.

ESTIMATES OF POPULATION TOTAL			
SPECIES	N_hat	SE	CV
Scoters, Combined	178,992	50,528	28.2
Black	*60,678*		
Surf	*117,419*		
White-winged	*895*		
Long-tailed Duck	26,009	4,234	16.3

Using the study data collected this year to define the true population, we conducted Monte Carlo simulations (on scoter flocks, not individuals) to examine the effect of varying sample allocation among the 2 survey phases, varying overall sample

effort, and allocating the phase 1 sample proportional to stratum area rather than using historic data on scoter abundance and distribution (Table 2).

Sample (NM) Phase 1	Phase 2	N Truth	Mean N_hat	BIAS	CV	delta CV (%)
Phase 1 Historical Allocation						
Varying Allocation by Phase						
2400	0	12165.4	11806.3	-0.030	12.15	0.0
1800	600	12177.6	11574.2	-0.050	11.78	-3.0
1200	1200	12181.6	11532.9	-0.053	11.19	-7.9
600	1800	12173.9	11375.1	-0.066	11.94	-1.7
Varying Overall Sampling Effort With 50:50 Allocation						
2400	2400	12174.4	11822.8	-0.029	8.54	-29.7
600	600	12180.5	11072.2	-0.091	17.83	46.8
Phase 1 Proportional Allocation						
1200	1200	12177.8	11661.3	-0.042	10.37	-14.6
2400	2400	12172.3	11826.2	-0.028	8.50	-30.0
600	600	12173.1	11219.9	-0.078	16.64	37.0

As can be seen in Table 2 the 2-phase design shows improvements in CV over a conventional stratified random sample (phase1=2400, phase2=0), with peak improvement occurring at the 50:50 allocation ratio we employed (Delta CV -7.9%). Use of historical data to allocate the phase 1 sample was not advantageous suggesting differences in bird distribution from historical surveys. This confirms suspicions about significant inter-annual and seasonal bird re-distribution and lends support for 2-phase designs. Simulations confirm previous studies that indicate a small negative bias in estimates of population total resulting from applying formulae for conventional stratified designs to data generated through a 2-phase plan. We are presently investigating why simulations of conventional stratified plans (2400,0) also show small negative bias in estimates of population total. This bias was not present when we used a Poisson data generating model but is evident when using bootstrapping to simulate sampling in a manner that accounts for the over-dispersion in the data relative to strict Poisson assumptions.

Project Status: Completed, analysis ongoing, did not make progress on objective #3 due to small number of large scoter flocks encountered. We will be exploring methods for model-based estimation (model density as function of space and other spatially-referenced covariates).