Sea Duck Joint Venture
Annual Project Summary for Endorsed Projets
FY 2008 (October 1, 2007 to September 30, 2008)

Project Title: Population delineation, winter/spring habitat use, and winter ecology of Pacific Surf Scoters (*Melanitta perspicillata*) from the southern portion of their winter range (SDJV Project # 63).
YEAR 3 of a 3-YEAR STUDY

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Project Description:
Thousands of surf scoters (*M. perspicillata*) winter along the west coast of Baja California, Mexico (Conant and Voelzer unpubl. data), which represents the southern extent of their wintering range, yet virtually nothing is known about their wintering ecology (e.g., movements, foods, habitats used) in the region. Efforts to delineate populations of Pacific surf scoters have been substantial, with deployment of radios (VHF and PTT) across wintering sites from Alaska (Rosenberg and Petrula 1999), British Columbia (D. Esler and S. Boyd, unpubl. data), Puget Sound, Washington (D. Nyeswander and J. Evenson, unpubl. data), and San Francisco Bay, California (J. Takekawa and S. Wainwright-De la Cruz, unpubl. data). These projects have led to important advances in our understanding of winter habitat use, movements during migration, and breeding distributions. Lacking, however, is a comprehensive assessment of these issues for surf scoters that winter in the southern portion of their winter range (southern California to Cabo San Lucas, Baja California), a region that historically supported tens of thousands of Surf Scoters (Saunders and Saunders 1981; Takekawa unpublished data).

This project was designed to contribute to coast-wide considerations of population delineation, and to study the wintering ecology of surf scoters at the southern extent of their winter range. From November 2007 through April 2008, we monitored the locations, movements, and foraging activities of Surf Scoters wintering in Bahia San

Quintín (BSQ), Baja California, and Laguna Ojo de Liebre (ODL), Baja California Sur, Mexico. We used radio telemetry to document movements, habitat-use patterns, and foraging effort of Surf Scoters wintering at the two lagoons. Additionally, we conducted age- and sex-specific surveys of surf scoters wintering in Baja California to document demographic structure and patterns of differential habitat use by cohorts. Surveys were conducted in a variety of habitats with varying degrees of wave exposure that included the two embayments (BSQ, ODL) and three exposed coastal sites, The coastal sites were located in the vicinity of San Quintín, El Rosario (Agua Blanca), and Santa Rosalita. All monitoring and survey methods were adopted from other studies in the Strait of Georgia, British Columbia to facilitate comparisons. The data will contribute to a region-wide assessment of class distributions, habitat-use patterns, and habitat quality for surf scoters wintering in the Pacific.

Diet analysis is an additional element of this project. Food items were obtained from (a) gastrointestinal tract contents of scoters that were collected in BSQ in the 2007/08 winter, (b) feces from scoters captured over two winters during radio deployment, and the relative contribution of prey types to the diet are being assessed using isotopic signatures from blood samples (e.g., Hobson and Clark 1992) collected from captured and collected scoters. Isotopic signatures from red blood cells and blood plasma, which have different turnover rates, will provide information regarding short and long-term diet composition because the signatures will correspond with the period that the cells were produced.

Objectives:
Our objectives were to use satellite and VHF telemetry to: (1) Describe key migration routes, timing of movements, and affiliations with staging (spring and fall), breeding and molting areas; and (2) Evaluate survival, habitat use patterns, foraging behavior, and diet of birds wintering in Baja California.

Preliminary Results
We fixed 37 VHF transmitters to surf scoters captured in Bahía San Quintín (BSQ) and Laguna Ojo de Liebre (ODL) between late November 2007 and January 2008 via prong subcutaneous attachment. See Table 1 (winter 2007/08) and Table 2 (winter 2006/07) for details about site, age, sex, and radio fates. Unfortunately, we lost signals from 22 radios even though the land-based antenna we constructed in BSQ detected radio signals as far as 27 km away. Because a few of the radios broke away from the prong before they were deployed and because we found one radio without a prong emitting a mortality signal after deployment, we suspect the epoxy we used to mount the prongs to the radios may have been brittle or poor quality and at least partially responsible for the relatively high number of lost radios. We collected data from 14 marked scoters, including two returning adult males that were marked the previous winter (SDJV FY07 #63), acquiring locations to assess habitat-use patterns and diurnal and nocturnal foraging effort to asses habitat quality until the last marked scoters left in mid-April. We had two confirmed mortalities among radio tagged scoters in 2007/08.

Foraging Effort – For each sample, we calculated the proportion of time of the 1-hour diurnal or 30-minute nocturnal observation the scoter spent foraging as an indication of habitat quality. During the day scoters spent 28.1% (± 2.2 SE) of the time foraging, which was similar to the previous winter (Table 3). The data were pooled from both years to evaluate variation in foraging effort but effort did not vary significantly by age/sex class or site, nor did it vary over the season. We also monitored frequencies during the night because nocturnal foraging in scoters in the core of their wintering range is rare (Lewis et al. 2005) and might be an indication of habitat condition. During the night scoters spent 3.1% ± 2.3 SE of the time underwater, which was significantly lower than in the previous winter (11.8% ± 3.7 SE). The probability of nocturnal foraging did not vary by site or age/sex class (Table 4). The probability of nocturnal foraging did vary over the season, with the greatest probability later in the season, presumably a pre-migratory fattening strategy. The large difference in nocturnal foraging effort between years is unexplained but indicates either temporal variability in foraging resources, or that the quality of forage in Baja California is not sufficient if other seasonal-dependent conditions are particularly taxing (e.g., environmental conditions, body condition carried over from the breeding season). We will be conducting a more in depth analysis of scoter foraging effort, but our preliminary results indicate that scoters in Baja California exert more foraging effort than scoters that winter further north in British Columbia (diurnal effort:18-23% (Lewis 2005, Kirk 2007); nocturnal effort: 3% (Lewis et al. 2005)).

Diet – We collected scoters in BSQ in late December (n=10) and early April (n=10) to obtain gastrointestinal contents as part of a study on the diet of scoters wintering in Baja California. Gut contents, as well as feces samples from captures (n=47) and blood samples for isotope ratios (n=98) are being analyzed by Dr. Sharon Herzka at the Centro de Investigación Científica y de Educación Superior in Ensenada, Baja California. Although the analysis has not been completed, we observed that one of the main prey items appeared to be ghost shrimp (*Neotrypaea sp.*), which are common invertebrates in the intertidal mud flats in the bay.

Age- Sex Ratio Surveys - During the 2007/08 season, we completed 117 mid-winter age-sex ratio point counts (see Iverson et al. 2003; Iverson et al. 2004; Iverson et al. 2005) by foot from elevated shores and exposed intertidal mudflats, and by boat. Overall we counted 4,149 surf scoters. All reported means and associated variance are from point samples weighted by sample size. Population sex composition in Baja California was relatively even with the mean proportion of females estimated at 0.492 ± 0.062 SE, which did not differ from the previous winter (0.513 ± 0.127 SE). The estimated proportion of first-year males in the Baja California population in 2007/08 winter (0.140 ± 0.071) was somewhat higher than we estimated in the previous winter (0.106 ± 0.137). The proportions for first-year males are similar to, and the proportions for females are higher than, what has been reported for wintering populations in British Columbia (Iverson et al. 2004).

Among sites and between years, the proportions were strikingly similar with the exception of between-year proportions of first-year males in BSQ (Table 5). BSQ supported high proportions of both females and juvenile males compared to other sites. While the proportion of females was similar in both years, the estimates for first year males were strikingly different between years. However, we believe the 2006/07 estimate at BSQ is unreliable because the calculation is based on a small sample (n=6) of an especially variable and non-normally distributed measure (either few to no first-year males or high proportions of first-year males in most samples) from a limited area of the bay. In fact, we did not count any first year males at BSQ survey points in 2007/08 (n=5) that were spatially proximal (< 300 m) to the 2006/07 BSQ points; despite the high proportion of first-year males estimated in 2007/08. ODL supported the lowest proportions of first-year males to adult males and females to males; estimates were similar in both years (Table 5). Estimates from coastal sites showed that females were present in equal numbers to males, that first-year males were present in proportions moderate to ODL and BSQ but still relatively high, and that proportions were similar in both winters.

Project Status:
In studying the ecology of scoters wintering in Baja California, we collected information about a largely unstudied population, including habitat-use patterns, habitat quality, and seasonal movements; these data will be important for understanding geographic variation in winter ecology of surf scoters throughout their Pacific range. Additionally, in the near future we aim to conduct cohort-specific analyses and compare these data with data from other wintering populations, which has the potential to contribute to the overall understanding of population dynamics and demographics of scoters wintering in the Pacific.

To meet the first objective as originally stated, which was to describe key migration routes, timing of movements, and affiliations with staging (spring and fall), breeding, and molting areas, we relied heavily upon the spatial and temporal data from PTT-tagged females. We received data from a small number of individuals marked in Baja California, and confirmed that migration timing, routes, and breeding areas correspond with that observed from other southern sites (i.e., San Francisco Bay). These data are being used in a number of papers describing various aspects of Pacific scoter ecology, habitat use, and population delineation.,

We were able to satisfactorily meet most of the content in our second stated objective: to evaluate survival, habitat-use patterns, foraging behavior, and diet of scoters wintering in Baja California. The large dataset we have of daily locations of radio-marked scoters, in conjunction with the age-sex ratio data from different habitat types, will be used to evaluate site fidelity, movements within a site, and habitat-use patterns. We have a solid dataset of foraging effort by scoters in Baja California, which we will use to compare habitat quality at this site to other sites in the wintering range (BC, SE Alaska) and, in conjunction with distribution data from surveys, evaluate class-specific foraging strategies. We have demonstrated that the distributional patterns of the scoters differ by age and sex class. We will continue analyzing the age- and sex-ratio survey data to evaluate for class-specific habitat-use patterns and test hypotheses to explain the reasons for differential distributions (e.g., competitive exclusion, habitat specialization). We expect to have a profile of the diet preferences of scoters wintering in Baja California once the blood and feces samples have been analyzed by our collaborator in Mexico.

Literature Cited:

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Tables:

Table 1: Summary of VHF radio distribution among scoters and sites, and the scoters' fates from radios deployed in Baja during the 2007/08 winter.

	Male				Female			
	Juvenile (HY)		Adult (AHY)		Juvenile (HY)		Adult (AHY)	
Nov-07 – Jan-08	7		8		12		10	
	BSQ	ODL	BSQ	ODL	BSQ	ODL	BSQ	ODL
	5	2	3	5	11	1	6	4
Monitored (> 1)	0	0	1*	2	5	1	3	0
Missing	4	2	2	3	5	0	2	4
Confirmed Mortality	1	0	0	0	1	0	0	0
Other (radio fell off)	0	0	0	0	0	0	1	0

* Value does not include two returning adult males marked Nov-Dec 2006 that were monitored in BSQ over the 2007/08 winter.

Table 2: Summary of VHF radio distribution among scoters and sites, and the scoters' fates from radios deployed in Baja California during the 2006/07 winter.

	Male				Female			
	Juvenile (HY)		Adult (AHY)		Juvenile (HY)		Adult (AHY)	
Nov-Dec 2006	9		10		6		7	
	BSQ	ODL	BSQ	ODL	BSQ	ODL	BSQ	ODL
	7	2	5	5	1	5	3	4
Monitored (> 1)	2	2	3	3	1	2	2*	1
Mortality	4	0	1	0	0	0	0	0
Unknown	1	0	1	2	0	3	1	3

*Value does not include four returning adult females marked Feb-06 that were monitored in BSQ over the winter 2006/07 season.

Table 3: Diurnal foraging effort (DFE) by radio tagged surf scoters. Foraging effort is measured as the proportion of time the scoters spent foraging during one hour observations. The number of scoters observed (Nsusc) and the number of foraging observations (Nobs), mean diurnal foraging effort (DFE), and 95% Confidence Intervals (LCI, UCI) are listed.

		nOBS	**nSUSC**	**DFE**	**LCI**	**UCI**
Season	2006/07	154	27	0.307	0.271	0.342
	2007/08	86	14	0.281	0.238	0.324
			all data			
Site	BSQ	161	24	0.294	0.260	0.328
	ODL	79	17	0.304	0.257	0.351
Class	Juvenile(HY)	95	16	0.270	0.227	0.313
	Adult(AHY)	145	25	0.315	0.279	0.351
	Adult Fem	75	13	0.299	0.249	0.348
	Adult Male	70	12	0.333	0.280	0.386

Table 4: The probability of nocturnal foraging by radio-tagged surf scoters wintering in Baja California. The probability of nocturnal foraging (PNF) is based on the presence or absence of diving during a 30-minute nocturnal observation. Probabilities are calculated for year, site, age/sex class, with associated Wilson score confidence intervals (95%) (LCI, UCI), and number of observations (N).

		N	PNF	LCI	UCI
Season	2006/07	42	0.310	0.191	0.460
	2007/08	32	0.125	0.050	0.281
2007/08					
Site	BSQ	29	0.138	0.055	0.306
	ODL	3	0.000	0.000	0.561
Class	Juvenile (HY)	15	0.067	0.003	0.298
	Adult Fem (AHY)	8	0.125	0.006	0.471
	Adult Male (AHY)	9	0.200	0.057	0.510
2006/07					
Site	BSQ	33	0.303	0.174	0.473
	ODL	9	0.333	0.121	0.646
Age	Juvenile (HY)	16	0.438	0.231	0.668
	Adult Fem (AHY)	16	0.313	0.142	0.556
	Adult Male (AHY)	10	0.100	0.005	0.404

Table 5: Results of Age- and Sex-Ratio Surveys conducted in Baja California over the two seasons of the study. The results are grouped by site including surveys conducted by boat in two embayments: Bahía San Quintín (BSQ), Laguna Ojo de Liebre (ODL), and surveys conducted by foot along the Pacific coast (Coast). Means and standard errors are weighted by sample size. The number of surveys (N) are reported.

Sites by Year	**BSQ** 2006/07				**BSQ** 2007/08		
	N*	Mw	SEw		N*	Mw	SEw
Proportion Juvenile Male (PJM)	6	0.090	0.329	PJM	27	0.365	0.171
Proportion Female (PF)	6	0.724	0.275	PF	27	0.733	0.098

	ODL 2006/07				**ODL** 2007/08		
	N*	Mw	SEw		N*	Mw	SEw
Proportion Juvenile Male (PJM)	22	0.079	0.173	PJM	62	0.098	0.063
Proportion Female (PF)	22	0.488	0.135	PF	62	0.468	0.074

	COAST 2006/07				**COAST** 2007/08		
	N*	Mw	SEw		N*	Mw	SEw
Proportion Juvenile Male (PJM)	19	0.185	0.230	PJM	26	0.198	0.165
Proportion Female (PF)	19	0.548	0.228	PF	26	0.506	0.136