

Sea Duck Joint Venture
Annual Project Summary for Endorsed Projects
FY 2006 – (October 1, 2005 to Sept 30, 2006)

DEMOGRAPHY AND MOULT ECOLOGY OF SURF SCOTERS IN EASTERN NORTH AMERICA (SDJV#49)

Multi-year funding, year two of three.

2006 September 27

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Project Description:

This study has two components that will provide information on Surf Scoter demography and molting ecology. Estimates of demographic parameters are required for understanding population dynamics and may be important for identifying factors related to scoter declines. To our knowledge, there is no estimate of survival for Surf Scoters. In addition, molting and migration constitute major energy expenditures in migratory birds (King 1974). For Surf Scoters, little is known about annual variation in molt chronology, about the resources that make sites attractive to molting birds or about their behavior, food, habitat requirements or energetic requirements during molt. Follows are preliminary results from the pilot study that was endorsed by the SDJV in 2004 and funded by the SDJV in 2005 and 2006.

Objectives:

The project has two major components: 1) A traditional banding program to measure vital rates of male Surf Scoters, and their affiliations between molting and harvest areas. We hope to improve survival estimates and measure site fidelity by using mark-recapture models that combine information from live recaptures and band recoveries (Barker 1997). Also, estimates of recruitment and population growth rate from mark-recapture data, should provide an independent assessment of population trajectory to the aerial surveys currently in place (Pradel 1996, Nichols et al. 2000). 2) A study of molting ecology (chronology, behaviour and habitat use) of Surf Scoters. Specific objectives for this component of the project are:

Demography:

- 1) measure direct and indirect band recovery rates for scoters,
- 2) refine and develop new capture techniques for molting scoters,
- 3) band up to 1000 in 2005, with a goal to double banding effort for 2006,
- 4) develop methods for aging molting male Surf Scoters,
- 5) develop annual indices for species, age, sex composition and recruitment,
- 6) evaluate mark-recapture or mark-resighting techniques for estimating survival,

Ecology:

- 7) evaluate use of stable isotopes analyses of juvenile feathers to identify affiliations between molting and breeding areas,
- 8) screen a sample of birds for heavy metal and organic contaminants and parasites,
- 9) determine differences in molt chronology of subadult and adult males, and to document annual variability in chronology,
- 10) compile time-activity budgets throughout the molting period and to estimate the energetic costs of molting activity,
- 11) monitor behavioral effects of disturbance on molting scoters,
- 12) document habitat use during the molting period,
- 13) determine differences in geographic ranges occupied during feather replacement from stable isotope signals in feathers of males, females and sub-adults.

Preliminary Results:

Our primary study area was near Nain, Labrador. Here, concentrations of molting scoters occur around the archipelagos of Black, Nukasusutok and Iglosiatik Islands (Fig 1.). We made several modifications to our program in 2006. First, in 2005 we encountered logistic constraints while running the behavioral component of the study at Black Island, so in 2006, we moved the behavioral study to a tent camp on the east end of Iglosiatik Island. In addition, we acquired 15 Satellite Platform Transmitter Terminals (PTTs) from Microwave Telemetry that were deployed with the help of Matt Perry and Glenn Olsen of the USGS. Follows is a general schedule of field activities:

14 July:	Arrive at Nain.
17 to 22 July:	Establish tent camp on east Iglosiatik Island.
22 July to 20 August:	Collection of behavioral data.
28 July to 17 August:	Banding operations.
28 July to 5 August:	Deploy PTTs.
21 to 25 August:	Tear down camps and return from field.

Fieldwork was limited by poor weather in 2006. Weather conditions were excellent during July, however, in the 20-day banding season; we were limited to two full days and six partial days of banding.

a).



b).

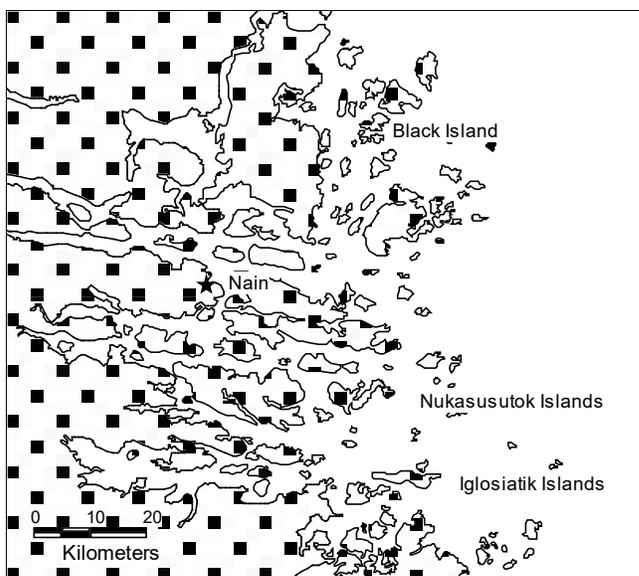


Fig. 1. Maps showing the general location of the study area (a) and specific location of the study sites (b).

Captures and Band Recoveries--. From 8 to 17 August 2004, 21 July to 22 August 2005, and 28 July to 17 August 2006, we caught 657, 671 and 443 molting sea ducks, respectively (Table 1). Male Surf Scoters comprised about 95% of all captures. There was a significant difference in the age composition of male Surf Scoters between years (Chi-square =23.3, df=2, $p \leq 0.0001$) with about 10% of captures in 2004, and 4% of captures in 2005 and 2006, being second-year males (Table 2). The difference in age composition may reflect annual variability in recruitment rate and suggests significant annual variability in productivity and or over-winter survival of immature males.

Table 1. Number of waterfowl caught in molt drives, Nain, Labrador, 2004 to 2006.

Year	Sex	Species ¹			
		COEI	SUSC	WWSC	BLSC
2004	Female	1	37	2	1
2004	Male	3	595	19	0
2005	Female	1	40	0	1
2005	Male	6	622	1	0
2006	Female	0	15	0	0
2006	Male	1	415	4	2
Total		12	1724	26	4

1. COEI = Common Eider; SUSC = Surf Scoter; WWSC = White-wing Scoter; BLSC = Black Scoter.

Table 2. Age composition (%) of male Surf Scoters caught in molt drives, Nain, Labrador, 2004 to 2006.

Age ¹	2004 (n=595)	2005 (n=622)	2006 (n=415)
AHY	90	96	96
SY	10	4	4

1. AHY= after hatch year, SY= Second year.

Twenty-five hunter-shot band recoveries of Surf Scoters were reported to the banding office up to 27 September 2006. The direct recovery rate was between 1% and 2% for 2004 and 2005 (Table 3). Six recoveries were reported from PQ, one in NS, one in ME, two in NY, one in CT, one in NJ, eight in MD, two in VA and two in NC. The number of live recaptures by the banding crew has been low, with one within-year recapture in each of 2005 and 2006, and a total of seven among-year recaptures (Table 4).

Table 3. Hunter shot band recoveries of Surf Scoters banded in Nain, Labrador 2004 to 2006

	No. Recoveries			Recovery Rate	
	Direct	Indirect	No. Banded	Direct	Indirect
2004	8	4	632	0.013	0.006
2005	13	-	662	0.020	-

Table 4. Occurrences of live recaptures of Surf Scoters during banding molt operations in Labrador in 2005 and 2006.

Year Banded	No. Banded	Year of Recapture	
		2005	2006
2004	632	3	3
2005	662	-	1
2006	430	-	-

Satellite Telemetry--. Satellite Platform Transmitter Terminals (PTT) weighing 43 g were surgically implanted into the abdomen of 15 males (Perry et al. 2004). Transmitters were programmed with a duty cycle of 3 hours on, 4 hours off for the first 35 days to provide adequate spatial accuracy to detect patterns of daily movements and estimate home range during molt. This was followed by a duty-cycle of 7 hours, on 72 hours off for the remainder of the batteries life (estimated 15.2 months) to follow long-range movements, identify staging areas, and breeding locations. Because of poor weather conditions, several birds were held 1-2 nights before they were released. At least six birds died and one transmitter failed within a few days from release.

2005 Collection--. We collected 36 Surf Scoters in 2005. The collection was distributed evenly across observed range of ninth primary length. Blood smears were collected from about 25 birds. All birds were dissected, and aged by presence of a bursa. The statuses of various analyses are summarized in Table 5. Representative tissue samples are maintained at the Canadian Wildlife Service--Atlantic and the National Tissue Bank, and parasite samples at the Canadian Museum of Civilization and the US National Parasite Collection.

Table 5. Status of various analyses to be performed on a sample of Surf Scoters collected in Nain, Labrador 2005

Sample	Laboratory Analyses	Current Status
Contaminants (metals)	Complete	Data summarized
Contaminants (organic)	Pending (Oct 06)	-
Parasites	Complete	Draft Technical Report
Body composition	Complete	Database prepared
Gut contents	-	Archived ¹
Liver sample	-	Archived ^{1,2}
Feather samples	-	Archived ^{1,2}
Breast muscle sample	-	Archived ^{1,2}
Kidney sample	-	Archived ^{1,2}
Parasite samples	-	Archived ³

1. Archived at CWS Atlantic.
2. Archived at Canadian National Tissue Bank.
3. Representative samples archived at Canada's National Museum of Civilization and US National Parasite Collection.

Parasites. Three hundred and twenty nine specimens of Acanthocephalans, Digeneans, Eucestodes and nematodes, representing 17 taxa, were collected from the 36 Surf Scoters (Table 6). Three species of Acanthocephalans in 2 genera, 3 species of digeneans, and several species of Hymenolepis (*Eucestoda: Hymenolepididae*), 3 species of nematodes were represented in the collections. *Tristriata elegans* (Digenea: Notocotylidae) was the most abundant parasite collected, occurring mostly in the cecae and occasionally in the posterior part of the intestine. *Gymnophallus deliciosus* (Digenea: Gymnophallidae) was the second most common taxon that were recovered only from the gall bladders. Among the nematodes, *Tetrameres fissispinus* was the most abundant. Acanthocephalans were also common, in terms of prevalence, but were lower in terms of intensity. All other parasites were relatively uncommon. All abundant and some uncommon parasites had a negative binomial distribution with many individuals (i.e. heavy infections) occurring in very few birds and moderate or no infections occurring in most birds. Thirteen of the 36 Surf Scoters collected were immatures and had a greater abundance of parasites than adults (Table 7). All the adults had a much higher intensity, range and prevalence of the abundant taxa of parasites.

Three Acanthocephalans recorded in this study, namely *Polymorphus minutus*, *Polymorphus cucullatus* and *Corynosoma clavatum*, constitute new host records for the species and specimens have been submitted to the US National Parasite Collection. *Corynosoma constrictum* was the most abundant Acanthocephalan, and this is widespread parasite of water birds in North America.

Contaminants. Median and ranges for each metal, separated by age, are shown in Table 8. Cadmium was the only metal that showed a significant difference in median concentration between the immature and adult birds. For reference, the toxic thresholds for birds in general, and a sample of other sea duck populations, from the literature are included in Table 8. The only metal where concentrations are near the toxic threshold was selenium, and there literature indicates that sea ducks are resistant to selenium toxicity. Our general conclusions are there are no concerns about the metal concentrations having any adverse effects on the health of the scoters. The laboratory results for organic contaminants are expected in October 2006.

Molt Chronology--. We used development of the ninth primary as a measure of the progression of wing molt. There was a difference in molt chronology among years (ANCOVA, $F=19.49$, $df=2$, $p\leq 0.0001$, $n=742$). When we accounted for variability in capture date, ninth primaries averaged 14.1 ± 3.0 mm ($\pm SE$) longer in 2006 than 2004 (Post Hoc test $p<0.000$) and 18.9 ± 3.1 mm longer in 2006 than 2004 (Post Hoc test $p<0.000$). There was no difference in molt chronology between 2004 and 2005 (Post Hoc test $p=0.17$). The rate of increase of the ninth primary in the population was similar across years (2.9 ± 0.1 mm per day; ANCOVA, $F=360.5$, $df=1$, $p\leq 0.0001$, $n=742$) between 20 July and 22 August. Assuming the growth rate of the ninth primary of Surf Scoters was similar to male Barrows Goldeneye (4.04 ± 0.05 mm per day; van de Wetering and Cooke 2000), molt may have been initiated an average of 3.5 d and 4.8 d earlier in 2006 than in 2004 and 2005, respectively.

Table 6. The taxa of endoparasites collected from all the Surf Scoters and their relative abundance

	Intensity ¹	Range	Prevalence ²
Acanthocephala	1.20	(1-2)	13.9
<i>Corynosoma constrictum</i>	2.00	(1-5)	38.9
<i>Corynosoma clavatum</i>	1.00	1	5.6
<i>Corynosoma</i> sp.	1.83	(1-5)	16.7
<i>Polymorphus cucullatus</i>	1.00	1	5.6
<i>Polymorphus minutus</i>	1.00	1	2.8
<i>Polymorphus</i> sp.	1.00	(1-3)	8.3
Eucestoda	6.00	(1-17)	13.9
<i>Hymenolepis</i> sp.	1.00	1	5.6
Digenea	1.67	(1-2)	8.3
<i>Tristriata elegans</i>	3.53	(1-8)	52.8
<i>Gymnophallus deliciosus</i>	8.23	(1-20)	36.1
<i>Renicola</i> sp.	11.33	(1-28)	8.3
Nematode	1.00	1	2.8
<i>Tetrameres fissispinus</i>	4.00	(1-18)	16.7
<i>Eucoleus anatis</i>	1.33	(1-2)	8.3
<i>Amidostomum acutum</i>	1.00	1	5.6

1. Intensity: mean number of parasites per infected host.
2. Prevalence: percentage of hosts infected.

Body mass was stable during the molt over the three years of study (ANCOVA, $p=0.12$, $n=648$; Fig.2). However, birds averaged 27 ± 7 g heavier in 2004 than 2005 (Post Hoc test $p>0.000$) and 33 ± 7 g heavier in 2004 than 2006 (Post Hoc test $p>0.000$, ANCOVA, $p>0.000$). There was no difference in body mass between 2005 and 2006 (Post Hoc test $p=0.75$).

Table 7. Variation in the abundance of key taxa in adult and juvenile Surf Scoters

	Juveniles			Adults		
	Intensity ¹	Range	Prevalence ²	Intensity ¹	Range	Prevalence ²
Acanthocephala	1.00	1	23.08	1.50	(1-2)	8.70
<i>Corynosoma constrictum</i>	1.78	(1-3)	69.23	2.40	(1-5)	21.74
Eucestoda	7.25	(1-17)	30.77	1.00	1	4.35
<i>Tristriata elegans</i>	4.14	(1-8)	53.85	3.17	(1-6)	52.17
<i>Gymnophallus deliciosus</i>	10.56	(1-20)	69.23	3.00	(2-6)	17.39
<i>Renicola</i> sp.	11.33	(1-28)	23.08	0.00	0	0.00
<i>Tetrameres fissispinus</i>	6.67	(1-18)	23.08	1.33	(1-2)	13.04

1. Intensity: mean number of parasites per infected host.
2. Prevalence: percentage of hosts infected.

Table 8. Concentrations elements (ug/g, dry wt.) in male Surf Scoters molting near Nain, Labrador, 2005. Metal levels in other populations are listed for comparison.

	Immature (n=9)	Adult (n=11)	Toxic threshold in avian liver (ug/g dry wt)					
	Median (min-max)	Median (min-max)		WWSC ¹	WWSC ²	Scoters ³	COEI ⁴	COEI ⁵
Calcium	177.64 (133.03-265.54)	157.64 (92.92-318.66)						
Chromium	0.53 (0.35-3.96)	0.44 (0.33-1.56)			0.51			
Iron	2531 (1749-5080)	2609 (1475-4229)		8320	6570			
Cobalt	0.11 (0.09-0.12)	0.12 (0.09-0.64)						
Nickel	0.15 (0.01-2.59)	0.11 (0.01-0.77)			0.21			
Copper	38.26 (14.53-46.62)	30.90 (22.96-56.16)		85	60.8	20-155		82-2051
Zinc	113.86 (95.35-124.31)	116.89 (86.48-126.48)	1100-1600	205	108	70-190		120-168
Arsenic	1.75 (1.23-2.31)	1.98 (0.95-4.75)						
Selenium	33.21 (24.53-37.18)	35.29 (27.51-54.14)	32	22	54		17	10 - 48
Cadmium ^a	1.24 (0.58-1.59)	2.47 (1.44-4.09)	128	19.6	7	3.4-247	164	10 - 16
Lead	0.10 (0.04-0.24)	0.07 (0.05-0.18)	19-48		1.5			nd - 7
Mercury	0.69 (0.45-2.03)	0.77 (0.47-2.59)	64-96	2.4	0.99		3.5	0.24-5.8
Organic Hg	0.43 (0.24-0.55)	0.33 (0.24-0.80)						

1 Molting, White-winged Scoters; Henny et al. 1995.

2 Nesting, White-winged Scoters; Henny et al. 1995.

3 Fall, scoter spp.; Barjaktarovic et al. 2002.

3 Nesting, female Common Eiders; Wayland et al. 2005.

4 Nesting, female Common Eiders; Mallory et al. 2004.

a Significant difference between ages (p<0.001).

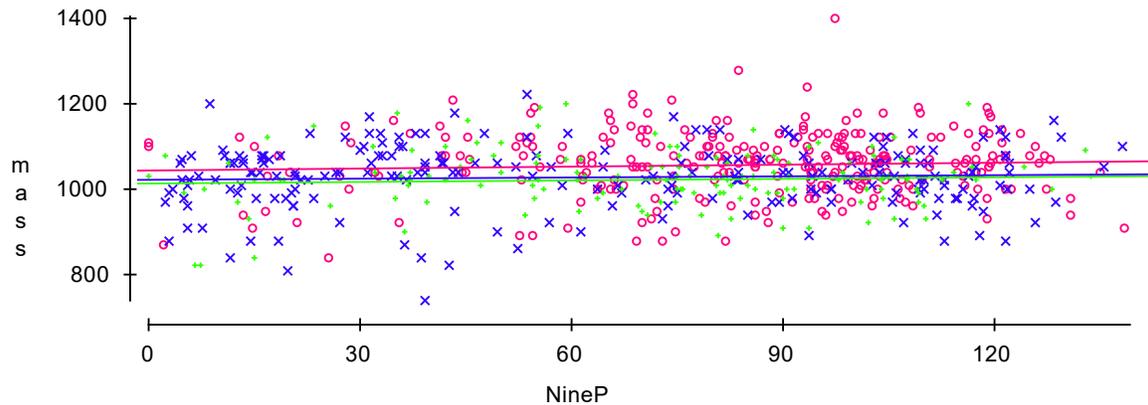


Figure 2. Body mass (g) vs. ninth primary length (mm) of male surf scoters in 2004, 2005 and 2006. Red circles 2004, blue Xs 2005, green crosses 2006.

Movements and Habitat Use--. The effectiveness of the PTTs in identifying movements on a daily basis, or on a broader scale, has yet to be determined. On the intensive duty-cycle, we received an average of 13 locations per bird per day, or about 2,250 locations for the eight birds alive during molt. This data has not yet been analyzed. It appears that birds, while flightless, show site fidelity. To date, no estimates of home range size or maximum daily movements have been estimated. A quick examination of the data suggests a pattern of daily movement from the inshore at dawn, and possibly in the early morning, moving off shore at mid-day and returning to the shoreline in late afternoon. An example of a daily movement of a single bird from the PTT data is shown in Fig. 3.

A current Google Earth® *.KMZ file is maintained at the following FTP site: (ftp://brouillard.wul.qc.ec.gc.ca/depot/ARGOS_CWS/) and can be downloaded to view the data with Google Earth®.

Behavior--. Between 22 July and 19 August 2006, we conducted 236 observation periods for a total of 118 hours of activity budgets. In addition to this, we compiled about 125 hours of afternoon observation obtaining information about whether or not birds were foraging. Hence, we accumulated nearly 250 hours of observation time. During these observations group sizes were routinely larger than 500 and it was not uncommon to see flocks up to 2000 birds (especially in the earlier stages of molt). Rarely did we encounter groups of less than 100, although small flocks were more common toward the end of the season.



Figure 3. Example of movement of a single Surf Scoter on 15 August 2006 from PTT data.

Data analysis for this component has not been completed. However, some patterns were obvious. Birds foraged from dawn until mid-morning (roughly 10:00-11:00 AM), at which time they moved offshore and rested for the remainder of the day. After several hours of resting, the birds moved back inshore (~15:00-16:00) where they eventually resumed foraging until darkness settled and they moved back offshore. This pattern was apparent for most of the molt, and it was not until the final week or so that it changed. Near the end of molt, their behaviors appeared more random (e.g. some groups were moving inshore by 12:00, while the rest remained offshore). It also appeared that synchrony of flock behaviors decreased as the molt was completed. Despite this, flocks engaged in foraging bouts were quite synchronous throughout (Beauchamp 1992).

Although it only comprises a small portion of the time budget (~3%), it appeared that disturbance may greatly affect behavior of molting Surf Scoters. Regardless of the activity they were involved in, the ducks became alert and fled the area, moving offshore, whenever the sound of an engine became audible. It did not matter whether the sound came from a boat, a plane or a helicopter nor did it matter how far away the sound was being generated; as long as it was audible the birds quickly moved offshore. In fact, birds were disturbed by ships when they were as far as 3-4 km away. If involved in feeding at the time, they rarely returned to the island before late afternoon as they normally would.

Communications:

Our project is centered in the community of Nain, Labrador. The project has a high visibility in town and we make efforts to keep residents informed about the study by conducting 2-3 interviews per season on the community radio. During 2005, a local film crew filmed our banding operation for the show *Labradorimiuit*. This show has aired several times on the Aboriginal Peoples Network since April 2006. The Inuktitut version is scheduled to play four times in November 2006.

Planned publications for 2007:

- NAWAMP Canada is producing a special 20th Anniversary publication promoting

corporate involvement in the program. This project will be featured in one of the 13 articles in the publication.

- MSc Thesis on the molting behavior of Surf Scoters.
- Canadian Wildlife Service Technical Report documenting parasite loadings in molting Surf Scoters.
- Prepare a manuscript on parasite loadings in molting scoters.
- Prepare a manuscript relating contaminants, parasites and body condition of molting Surf Scoters.

Additional Funding:

In 2006, the Canadian Wildlife Service made significant additional contributions to this project. A portion of these investments were upgrades of our equipment and costs were not tracked.

Additional Expenditures:

- 3 bear fences, 2 wall tents and materials:	5,900
- 3 Personal Locater Beckons and 2 Sat. Phones	3,700
- 15, 43 g Microwave PTTs	36,500
- PTT FY06-07Argos Access fees	11,000
- Deployment Costs (Vet travel etc.)	7,200
- In kind salary from USGS for PTT deployment	6,500
- Proximate Body Composition Analyses	6,400
- Universal Helicopters donation	3,200
- Additional costs for field assistant	3,600

Contaminant Analyses:

- Laboratory preparation of 20 samples & 2 composites	750
- 20 ICP-MS analysis of metals	1,800
- 20 Hg and organic Hg analyses	1,600
- 2 OC/PCB composite analyses	650

Total: 85,200 USD

Project Status:

In the first two years of the project, we have successfully addressed objectives 1, 2, 4, 5, 7, 8, 9, 10, 11 and 12. In the final year, we will focus on the banding operation. In 2006, we conducted an exploratory aerial survey and located three previously unknown concentrations of molting scoters in archipelagos adjacent to our study site. In 2007, we will visit these areas to maximize our banding efforts. We will also make a presentation to the Atlantic Flyway in winter 2007 to attempt to acquire additional resources to run a second banding site. Although we have not met our initial banding goals, and the recovery and recapture matrices are sparse, we will be able to produce survival estimates with an additional year of banding (E. Reed and G.J. Robertson pers. comm.). The quality of these estimates will improve significantly with each additional year of marking.

We are also making separate proposal to the SDJV for a pilot project to explore the use stable isotopes and fatty-acid structures in various tissues to describe aspects of Surf Scoter diet. To address objectives 7 and 13, we will also process stable isotope levels in growing primaries as part of this study. The feather samples will be analyzed regardless of our success in funding the

diet study.

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2006 Project Funding Sources:

SDJV (USFWS) Contribution	Other U.S. Federal Contributions	U.S. Non-federal Contributions	Canadian Federal Contributions	Canadian Non-federal Contributions	Source of funding (agency or organization)
27,200	6,500 ¹		141,850 ²	3,000 18,000 11,850	CWS NSTP INCO USGS McGill

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¹ USFWS: an additional funding 6.5K in kind contribution for 2 weeks salary for Matt Perry and Glenn Olsen.

² CWS: additional funding for PTT and Argos time, field equipment and various laboratory analyses (see Additional Funding for detailed information.) .

2006 Total Expenditures:

Activity	Breeding	Molting	Migration	Wintering	Total
Banding		64,100			64,100
Surveys					
Research		114,700	30,600		144,300
Communication					
Coordination					

