

## **Sea Duck Joint Venture Progress Report – November 2011**

**Project Title:** Ecology and Population Affiliations of Molting and Fall Staging Barrow's Goldeneye at Cardinal Lake, Alberta (SDJV Project # 116).

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### **Additional Partners:**

Alberta North America Waterfowl Management Plan Partnership, Alberta Conservation Association, National Science and Engineering Research Council

### **Project Description:**

As a result of recent post-breeding waterfowl surveys and satellite telemetry research, several sites used intensively by molting and fall staging Barrow's Goldeneye (BAGO) were discovered in the Peace Parklands of northern Alberta. Most post-breeding BAGO were found on Cardinal Lake where fall numbers exceeded 4000 birds, placing this lake among the most important post-breeding sites currently recognized for this species. As a result of our work in 2009, a nearby site, Leddy Lake, was discovered to be hosting nearly 2000 post-breeding BAGO. The discovery of these significant post-breeding sites provides an important and readily accessible opportunity to investigate the poorly understood molting and fall staging ecology of this species. Furthermore, the ability to capture and mark large numbers of BAGO will help advance recent efforts to develop a better understanding of population structure and cross-seasonal habitat affiliations within the Pacific population of BAGO. Finally, it is also important to recognize that Bruce Power is considering several sites in the Cardinal Lake area as potential locations for western Canada's first nuclear power plant. It is essential to better understand the ecology of post-breeding BAGO in the Peace Parklands to accurately predict or assess the impacts of this proposed development on this species.

Through a combination of surveys, captures, an array of weights and measures, VHF telemetry, and satellite telemetry, we are addressing a suite of objectives related to the ecology of the remigial molt and fall staging periods, the importance of Cardinal Lake, and the remigial molt

stage in the context of population delineation and population dynamics throughout the annual cycle.

### **Objectives:**

Our research is addressing the following objectives:

- 1) Determine the sex and age composition of molting and staging BAGO at Cardinal Lake.
- 2) Determine the timing of arrival, phenology and duration of remigial molt, and timing of fall migration for BAGO age and sex cohorts using Cardinal Lake.
- 3) Determine habitat use and movement patterns of molting and staging BAGO at Cardinal Lake.
- 4) Determine season-specific survival rates of BAGO molting at Cardinal Lake and investigate whether survival rates vary between years.
- 5) Determine breeding and wintering population affiliations of BAGO molting at Cardinal Lake.
- 6) Determine fidelity of BAGO to molting and staging habitats at Cardinal Lake and potentially locate other key molting and staging areas that have yet to be recognized.
- 7) Quantify body mass variation of BAGO through wing molt.
- 8) Document foraging effort of BAGO during wing molt.

### **Preliminary Results:**

The second year of field work for the project was completed in November 2010 and during 2011 activities primarily focused on data analysis and collection of ARGOS data for satellite birds. The project has been an enormous success. We describe, in brief, activities and results thus far.

While Cardinal Lake was the core study area for this project, we conducted weekly surveys of BAGO use at both Cardinal and Leddy Lakes in 2009-2010 to support a number of our objectives. These surveys were used to index BAGO abundance and determine sex ratios of molting and staging birds, as well as timing of components of molt and migration. Single ground surveys were also conducted at each lake during remigial molt and fall staging in 2011. The peak count of molting Barrow's Goldeneyes during the study was 6060 birds on Cardinal Lake and 1855 on Leddy Lake (Table 1). Peak fall staging count on Cardinal and Leddy Lake during the study was 5238 and 820 birds, respectively. These estimates should be considered conservative, particularly on Cardinal Lake where survey areas do not cover the entire lake area.

The primary cohort using both Cardinal and Leddy Lakes during remigial molt was adult (ASY) males (Table 2). However, proportions of females increased as the season progressed on both lakes. BAGO arrived on post-breeding habitats in the Peace Parklands by mid- June and did not

depart until mid-November. This indicates that post-breeding habitats are used by BAGO for at least five months, or over one third of their annual cycle.

We conducted drive trapping of flightless BAGO from the last week in July through early September in 2009 and 2010. The modified Harlequin Duck molt trap was a successful method of trapping BAGO on Cardinal and Leddy Lakes. Overall, our two year banding total was 1194 BAGO. To our knowledge, this represents the second largest sample of BAGO ever banded during a specific project. We also recaptured 106 banded birds. We took an array of morphometric measurements and body mass for each captured individual.

Average body mass ( $\pm$ SE) of each age and sex cohort on Cardinal and Leddy Lakes in 2009 and 2010 is summarized in Table 3. Multiple linear regression models were used to investigate variation in mass as a function of the explanatory variables age, lake, year, emergence date (date that feather erupted from skin), and molt stage. An information-theoretic approach to data analysis was used to evaluate support from the data for a suite of candidate models and model averaging was used to evaluate the importance of each model parameter. The global model including all variables and their interactions was best supported for males. Leddy Lake males were  $47\pm 18$  g heavier than Cardinal Lake males (Table 3). Males gained an average of  $1.09\pm 0.92$ g/day during remigial molt (Figure 1). The model containing all main effects was best supported for females. Leddy Lake females were an average of  $39\pm 12$  g heavier than Cardinal females (Table 2). Females gained an average of  $1.41\pm 1.08$ g/day during molt (Figure 2).

As part of captures, we deployed 100 subcutaneous-prong mounted VHF radios on molting male BAGO to monitor local movements, survival and foraging effort. We decided to mark 50 BAGO with VHF radios on Leddy Lake (25/year) as well as 50 on Cardinal Lake (25/year). Movement and survival of VHF radio-marked birds was monitored on approximately a weekly basis. Preliminary assessment of the movement data suggest most areas of both Cardinal and Leddy Lakes are used by post-breeding BAGO, with particularly concentrated use occurring in the major northern and western bays at Cardinal. Cumulative survival (%) of radioed individuals on each lake was high during remigial molt. Cumulative survival was lower during fall staging than remigial molt. At least seven of 14 mortalities on Cardinal Lake were hunting related. There is no evidence that the seven mortalities on Leddy Lake were hunting related.

Overall, birds foraged relatively little during remigial molt. Leddy Lake birds foraged primarily nocturnally and Cardinal Lake birds foraged primarily diurnally (Figure 4). A basic invertebrate sampling program was developed in 2010 to investigate this difference in foraging habits. Preliminary results suggest that the difference could be food related, as large numbers of amphipods tended to aggregate along the shoreline of Leddy Lake at night. This phenomenon was not observed on Cardinal Lake. Foraging data for fall staging BAGO has yet to be analyzed.

In addition to VHF radios, we deployed 20 satellite transmitters on molting male BAGO at Cardinal Lake in 2009 and 18 in 2010 to monitor larger-scale movements and breeding/wintering sub-population affiliations of these birds. Satellite transmitters were implanted by wildlife veterinarian, Dr. Malcolm McAdie, during the third week of August each year. Of the 20 birds marked in 2009, three birds died within 2 weeks of surgery, possibly due to surgery-related complications, 4 birds are suspected to have died due to hunting activities, 8 died due to

unknown causes, and 2 stopped transmitting due to transmitter failure or for unknown reasons. We were able to identify migration routes and wintering areas for 11 birds in 2010, the majority of which wintered on the coasts of SW British Columbia and Washington. Four birds returned to Cardinal Lake to molt in 2010 (Figure 5). Two of these birds currently continue to transmit, both of which molted at Cardinal Lake in 2011.

Of the 18 birds marked in 2010, 9 continue to transmit data. Seven of these birds molted at Cardinal Lake in 2011, 1 molted in SW British Columbia, and 1 molted near Great Bear Lake, NWT. We will continue to post locations and fates of satellite marked birds on our website (see below) as ARGOS data are analyzed.

### **Project Status:**

All field seasons have been successfully completed and data are now being analyzed. The completion of a MSc thesis at SFU is scheduled for January 2012. One manuscript has been published in the September issue of *Waterbirds* (Hogan *et al.* 2011). Several other manuscripts are currently being prepared and will be submitted for publishing in respected scientific journals. We are confident that the objectives of this study are being met and that the data collected provide numerous new insights into the molting and fall staging ecology of BAGO.

### **Websites and Published Articles:**

Hogan, D.H., J.E. Thompson, D.E. Esler and W.S. Boyd. 2011. Identification of postbreeding sites for Barrow's Goldeneye in the Boreal Transition Zone of Alberta. *Waterbirds* 34: 261-268.

<http://www.sfu.ca/biology/wildberg/CWESeaducksfolder/BAGOwebpage/BAGOMigrationHome.html>

**Table 1:** Annual peak ground survey counts of Barrow's Goldeneyes using Cardinal and Leddy Lakes, AB during remigial molt and fall staging in 2009-2011.

Lake	Year	Remigial Molt	Fall Staging
Cardinal	2009	2323	1224
	2010	6060	5238
	2011	3307	3716
Leddy	2009	1855	820
	2010	730	220
	2011	480	416

**Table 2:** Proportion (%) of captured molting Barrow's Goldeneyes (*Bucephala islandica*) in each age and sex cohort on Cardinal Lake and Leddy Lake, AB in 2009 and 2010.

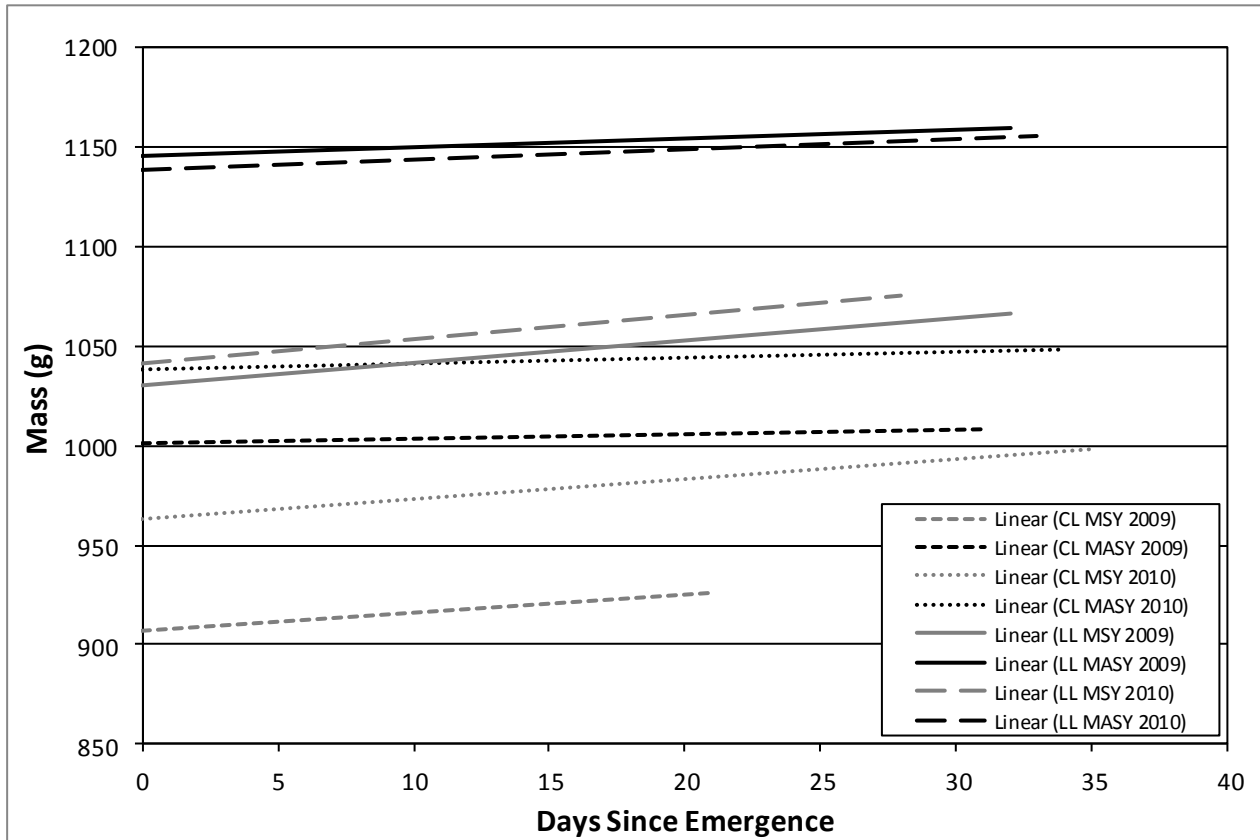
Year	Lake	Total Captured	Males (%)	Females (%)	Males		Females	
					SY(%)	ASY(%)	SY(%)	ASY(%)
2009	Cardinal	277	257 (93)	20 (7)	23 (9)	234 (91)	11* (58)	8* (42)
	Leddy	305	286 (94)	19 (6)	26 (9)	260 (91)	6 (32)	13 (68)
2010	Cardinal	464	417 (90)	47 (10)	55 (13)	362 (87)	20 (43)	27 (57)
	Leddy	182	162 (89)	20 (11)	10 (6)	152 (94)	7 (35)	13 (65)

\*Percentages calculated from 19 females due to unknown age class of one individual.

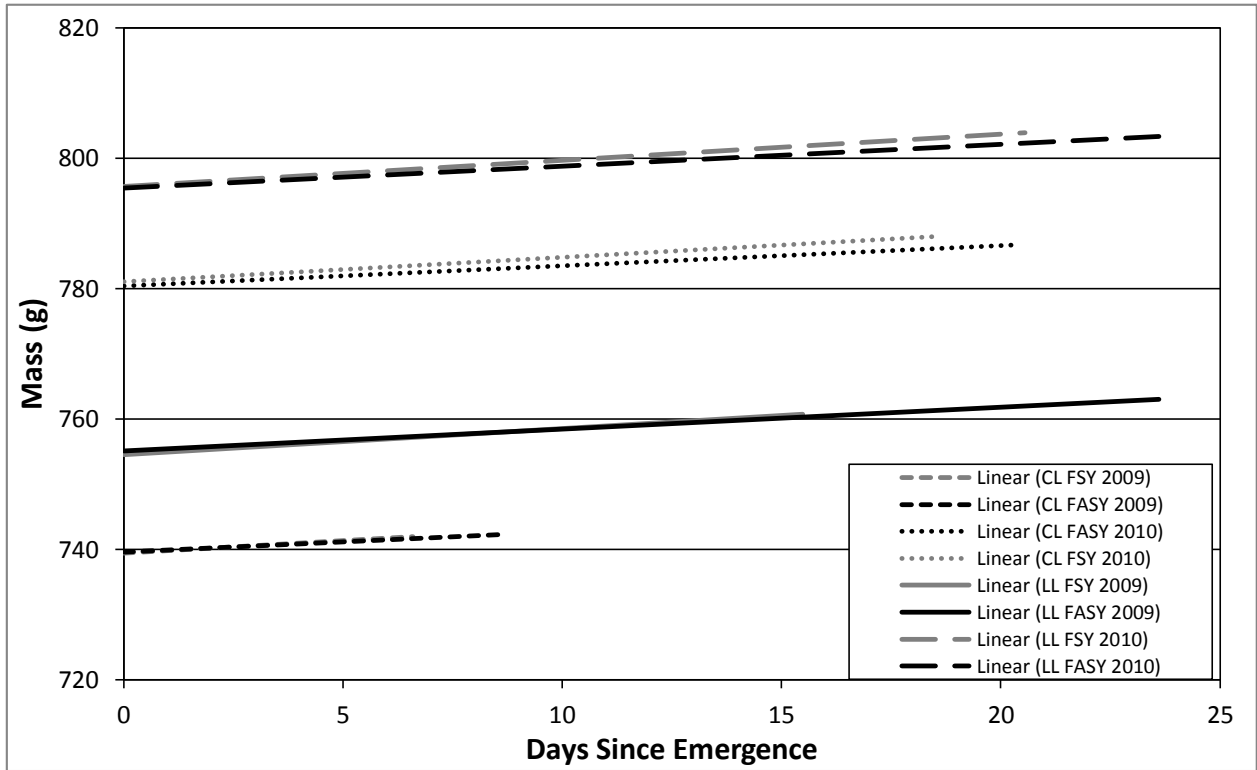
**Table 3:** Average mass (g) of Barrow's Goldeneye sex and age cohorts molting on Cardinal and Leddy Lakes, AB in 2009 and 2010.

Cohort	Mass $\pm$ SE (g)							
	CL 2009	n	CL 2010	n	LL 2009	n	LL 2010	n
M ASY	1006 $\pm$ 4	205	1050 $\pm$ 3	347	1113 $\pm$ 4	244	1106 $\pm$ 5	149
M SY	999 $\pm$ 11	22	1058 $\pm$ 8	55	1058 $\pm$ 18	23	1116 $\pm$ 16	10
F ASY	753 $\pm$ 26	5	770 $\pm$ 7	25	787 $\pm$ 12	13	805 $\pm$ 8	13
F SY	729 $\pm$ 21	9	753 $\pm$ 9	19	827 $\pm$ 24	6	787 $\pm$ 28	6

**Figure 1:** Relationship between predicted mass (g) and stage of molt (days since 9<sup>th</sup> primary emergence) for male Barrow's Goldeneyes molting on Cardinal and Leddy Lakes, AB in 2009 and 2010. Predicted mass was calculated using the model averaged parameter estimates and holding emergence date constant at the average value.

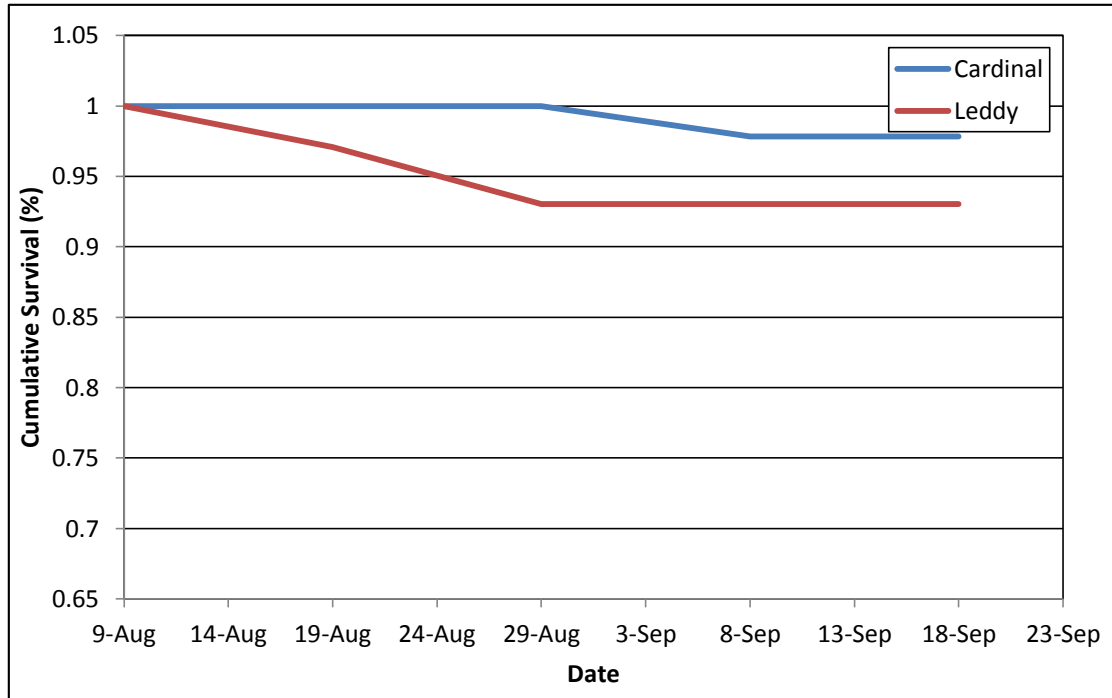


**Figure 2:** Relationship between predicted mass (g) and stage of molt (days since 9<sup>th</sup> primary emergence) for female Barrow's Goldeneyes molting on Cardinal and Leddy Lakes, AB in 2009 and 2010. Predicted mass was calculated using the model averaged parameter estimates and holding emergence date constant at the average value.

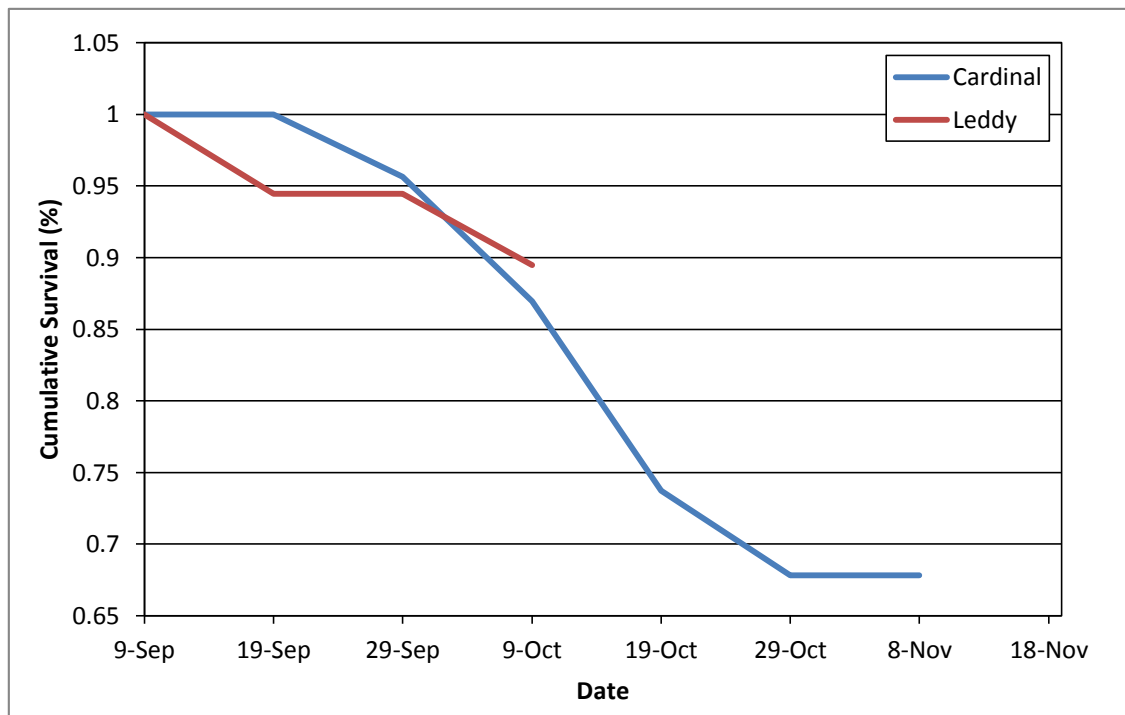


**Figure 3:** Cumulative Survival (%) of adult (ASY) male Barrow's Goldeneye marked with VHF radio transmitter on Cardinal and Leddy Lakes in 2009 and 2010. A) Remigial Molt, B) Fall Staging.

A)

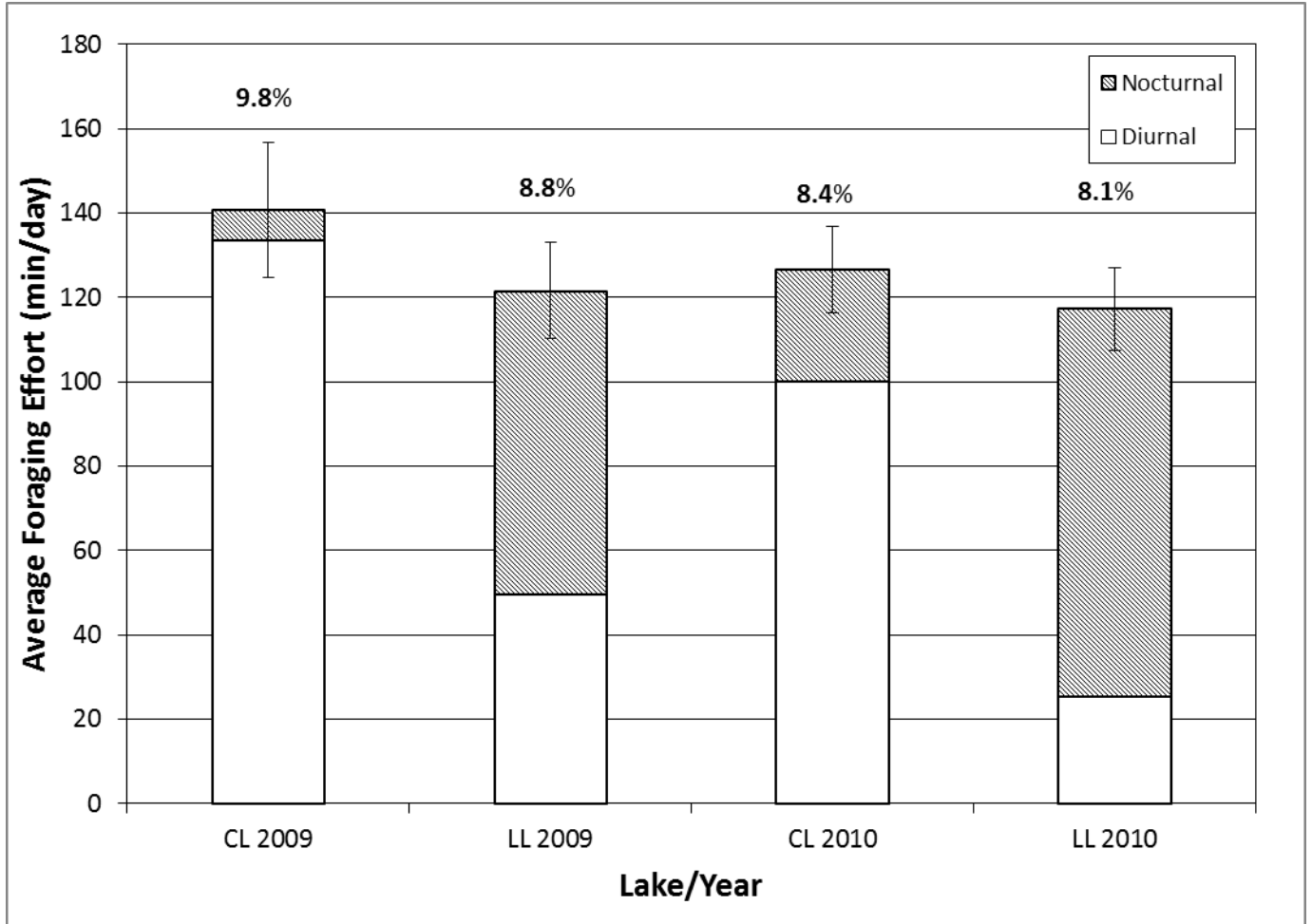


B)





**Figure 4:** Average foraging effort (min/day  $\pm$  SE) of ASY male Barrow's Goldeneyes molting on Cardinal (CL) and Leddy Lakes (LL), AB in 2009 and 2010. Averages were estimated by multiplying nocturnal and diurnal hourly foraging rates by the number of nocturnal and diurnal hours in a day. Filled portions of bars represent the amount of daily foraging effort conducted nocturnally. Percentages above each bar indicate the proportion of total time spent foraging per day.



**Figure 5:** 2010 winter/breeding and molt sites of adult male Barrow's Goldeneyes marked with satellite transmitters on Cardinal Lake, AB in 2009.

