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

Project Title (SDJV Project #72): Seasonal Habitat Requirements of Surf and White-winged Scoters in Puget Sound

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Project Description

Like many sea ducks, scoters have experienced population declines both on breeding areas in Canada and Alaska and on primary wintering areas, including a 57% decline since the late 1970s for all three species combined in Puget Sound (Hodges et al. 1996, Nysewander et al. 2002). It is unclear whether the limiting factors are exerted mainly on wintering, migration, or breeding areas.

Our study is a substantial response to the SDJV priority to **identify and inventory important sea duck coastal habitats** because few studies have considered coastal habitat needs beyond food habits (Brown and Fredrickson 1997, Savard et al. 1998). Padilla Bay in northern Puget Sound contains one of the largest contiguous eelgrass beds on the Pacific Coast (Bulthuis 1995). Past monitoring, mainly in mid-winter, had indicated that numbers of scoters in Padilla Bay were only modest. However, our surveys indicate that over 8,000 SUSC use Padilla Bay during both spring staging and molting periods. Such aggregations could represent as much as 15% of scoters wintering in Puget Sound (D. R. Nysewander, unpubl. data), though the winter origins of these scoters is unknown. The value of eelgrass to many sea ducks is currently viewed in terms of its support of herring spawning events in spring. However, for many eelgrass beds in Puget Sound there are no spawning events (including Padilla Bay) or spawning events have recently collapsed for reasons unknown (Lemberg et al. 1997). An alternative benefit of eelgrass beds to scoters may be the diverse epifaunal prey, which our preliminary analyses indicate become dramatically abundant in spring. To help explain scoter declines and develop appropriate protections, our study will define the seasonal value of eelgrass vs. unvegetated coastal habitats for scoters.

Study area Our local-scale study sites (Fig. 1) include: (1) Padilla Bay which has contiguous eelgrass beds with fine-grained sediments in most areas; (2) Penn Cove which largely lacks vegetation and has extensive mussel beds over mixed sand and gravel, and (3) Birch Bay which has patchy eelgrass beds overlying a sandy substrate.

Objectives

To *better understand declines* and *infer future trends* in scoter populations, we have developed local and regional scale objectives to evaluate the seasonal habitat roles of eelgrass versus unvegetated habitats. All project objectives emphasize comparison between SUSC and WWSC.

Objectives – Local Scale

For bays dominated by alternative benthic habitat types:

1. Evaluate seasonal changes in scoter diet and body composition (both critical inputs to Objective 2).
2. Characterize and contrast fine-scale, seasonal habitat use by scoters. Specifically, we will model the ability of scoters to meet their energy needs based on our field studies of prey availability and foraging effort, as well as lab studies of functional response and the metabolic costs of activities.

Objectives – Regional Scale

3. Relate seasonal changes in scoter movements and distributions to nearshore habitat types.
4. Synthesize scoter and nearshore habitat studies to develop a *model of regional scoter habitat requirements*.

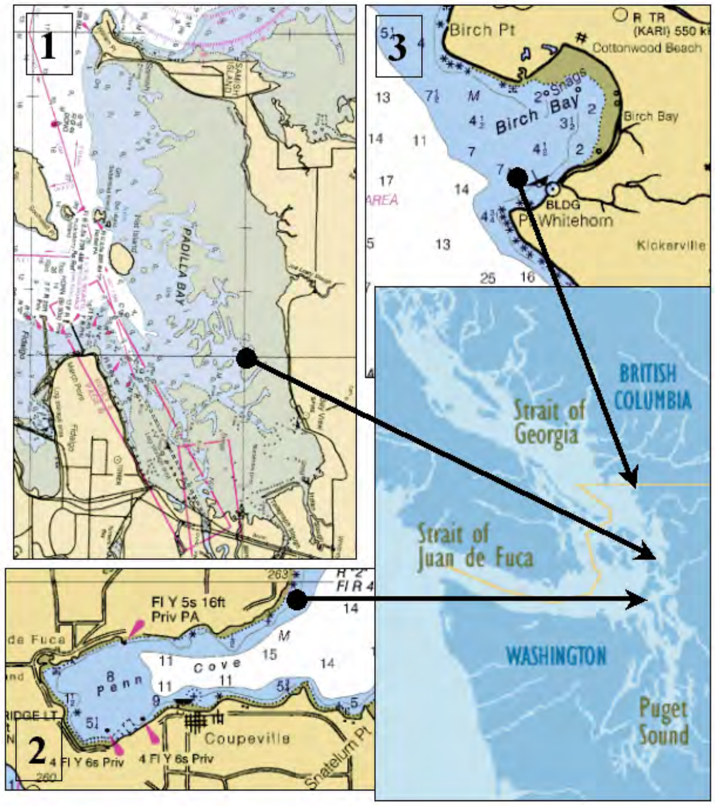


Figure 1. Study sites in northern Puget Sound: (1) Padilla Bay, (2) Penn Cove, and (3) Birch Bay.

Preliminary Results

Seasonal censuses Though large numbers of scoters occur at each site, the seasonal timing of use is unique (Fig. 2). Large numbers of SUSC occurred in Penn Cove in early winter and declined through spring. Conversely, SUSC aggregated during spring in Padilla Bay and Birch Bay. Only Padilla Bay hosted large numbers of SUSC in summer. Moreover, only Birch Bay hosted substantial numbers of WWSC, with little change occurring in their overwinter numbers there.

Scoter foraging behavior For SUSC in both Penn Cove and Birch Bay, time spent underwater increases as winter progresses (Fig. 3). Alternatively, over winter the time spent underwater for WWSC increases in Penn Cove (where WWSC are rare) and does not change in Birch Bay (where WWSC are relatively abundant). Seasonal activity budgets support this result and suggest increases in foraging time for SUSC contribute to reductions in time allocated mainly to sleeping and comfort movements.

Scoter body composition and diet In 2005-06, 60 adult male SUSC were collected in the three study sites combined and 17 adult male WWSC were collected in Birch Bay. Both species of scoter generally lost mass between December and March (Fig. 4). However, this pattern was only significant for SUSC in Penn Cove, while modest for SUSC elsewhere and for WWSC in Birch Bay. Gut contents from scoters combined from all three sites indicate a much greater diversity of prey items consumed by SUSC vs. WWSC (Fig. 5). In particular, SUSC relied to a greater extent on prey that is soft-bodied, and often located in the epibenthos (e.g., Crustacea) and at greater depths (e.g., Ophiuroidea, Polychaeta). Isotopic analyses of breast muscle suggest very little seasonal change in the diet of WWSC (Fig. 6). Alternatively, the overwinter enrichment in $\delta^{15}N$ for SUSC in all three sites suggests (1) they alter their diet seasonally and/or (2) they experience a seasonal increase in nutritional stress (Hobson et al. 1993).

Benthic prey surveys We conducted benthic sampling of scoter invertebrate food items during December, March, and August of 2003-04 and 2004-05 in Padilla Bay, Birch Bay, and Penn Cove. We have recently completed identification of all invertebrate taxa in benthic prey surveys. Thus, detailed comparisons of prey availability among sites and across seasons are not yet available. However, preliminary comparisons suggest that a primary contrast is the much greater abundance and diversity of epifaunal prey items in Padilla Bay and secondarily Birch Bay relative to Penn Cove (Fig. 7).

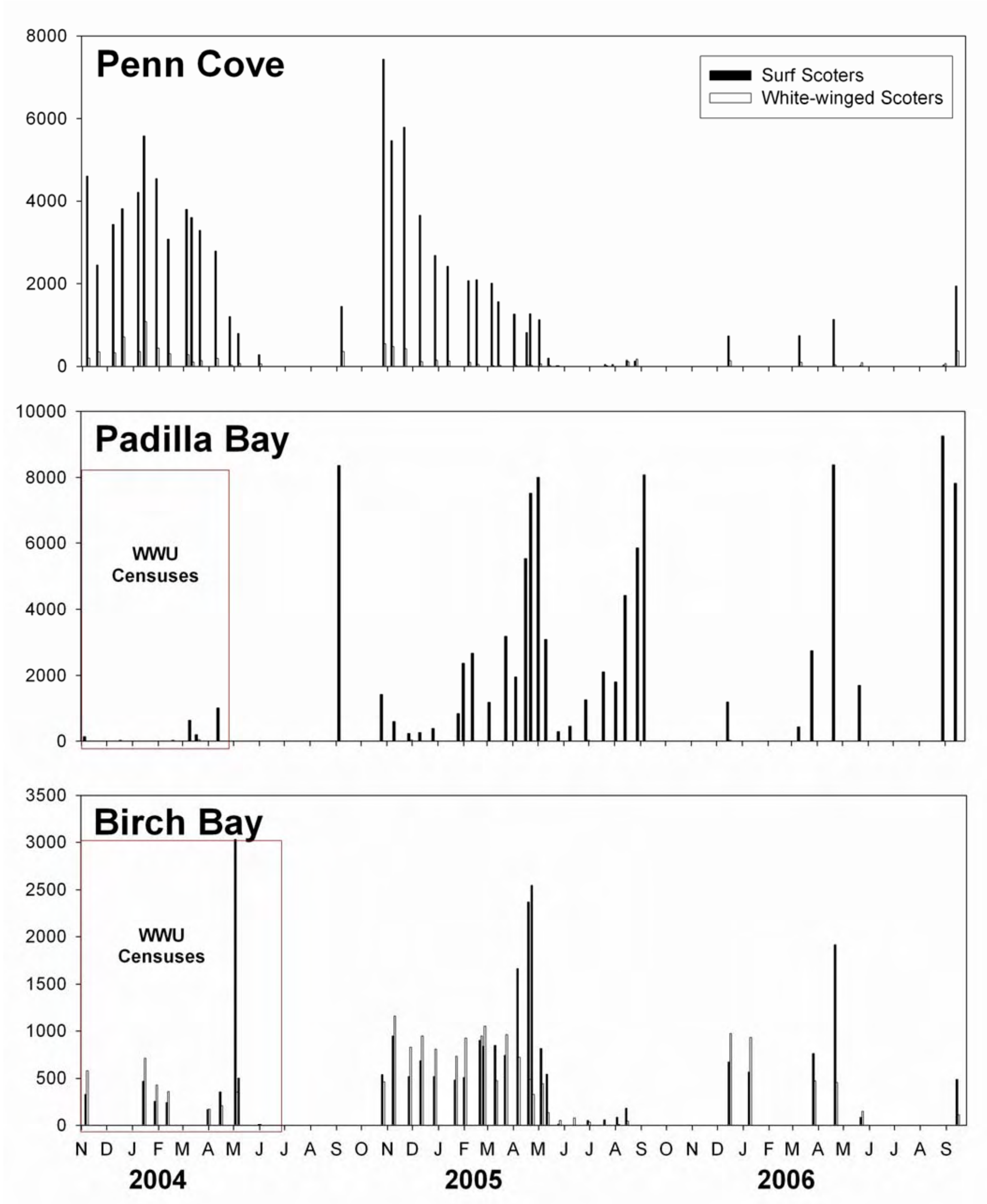


Figure 2. Censuses of scoters in our three study sites. Only Birch Bay had substantial numbers of WWSC. Note the unique patterns of use by SUSC among the three sites: Penn Cove is used mainly during early winter, Birch Bay is used during spring staging (when herring spawn is available), and Padilla Bay is used during both spring staging (though spawn is not available) and molting in late summer.

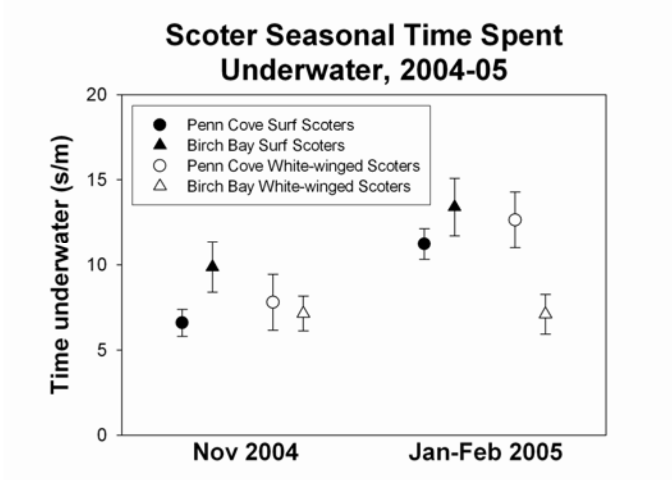


Figure 3. Seasonal time spent underwater (i.e., foraging) of scoters in Penn Cove and Birch Bay. Scoters in Padilla Bay were located very distant from shorelines and thus diving observations were not possible.

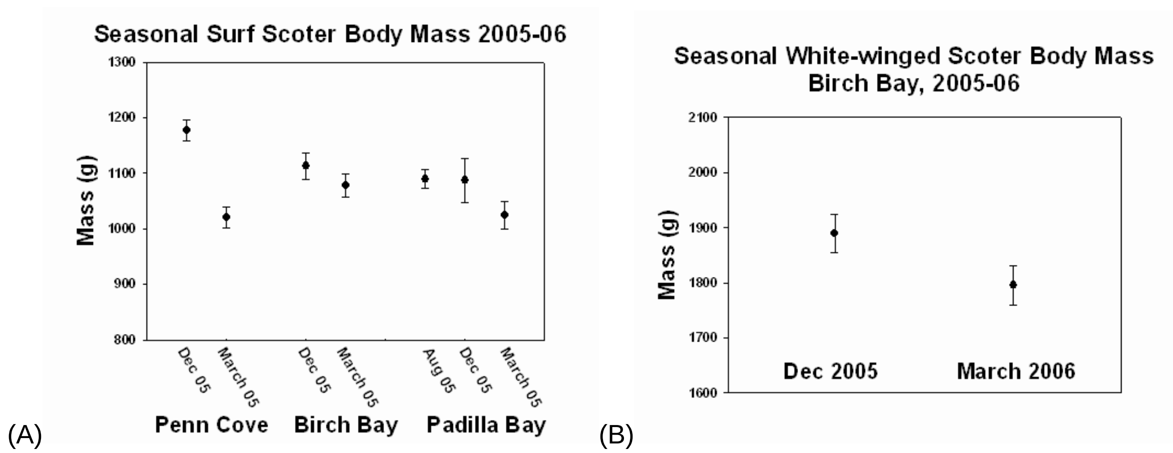


Figure 4. Seasonal fresh body mass of scoters collected in our three study sites. (A) The overwinter decline in SUSC mass is far greater in Penn Cove than in Birch Bay or Padilla Bay. (B) The overwinter decline in WWSC mass is modest in Birch Bay.

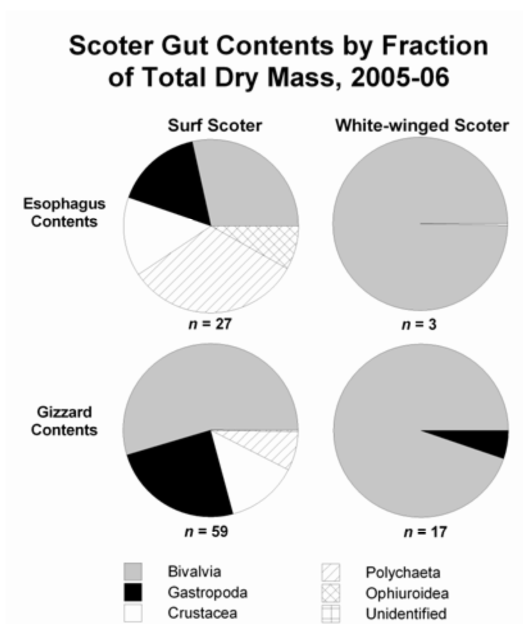


Figure 5. Adult male SUSC and WWSC gut contents (by prey class and as a fraction of total dry mass) for all three sites combined. SUSC consumed prey from a greater diversity of classes.

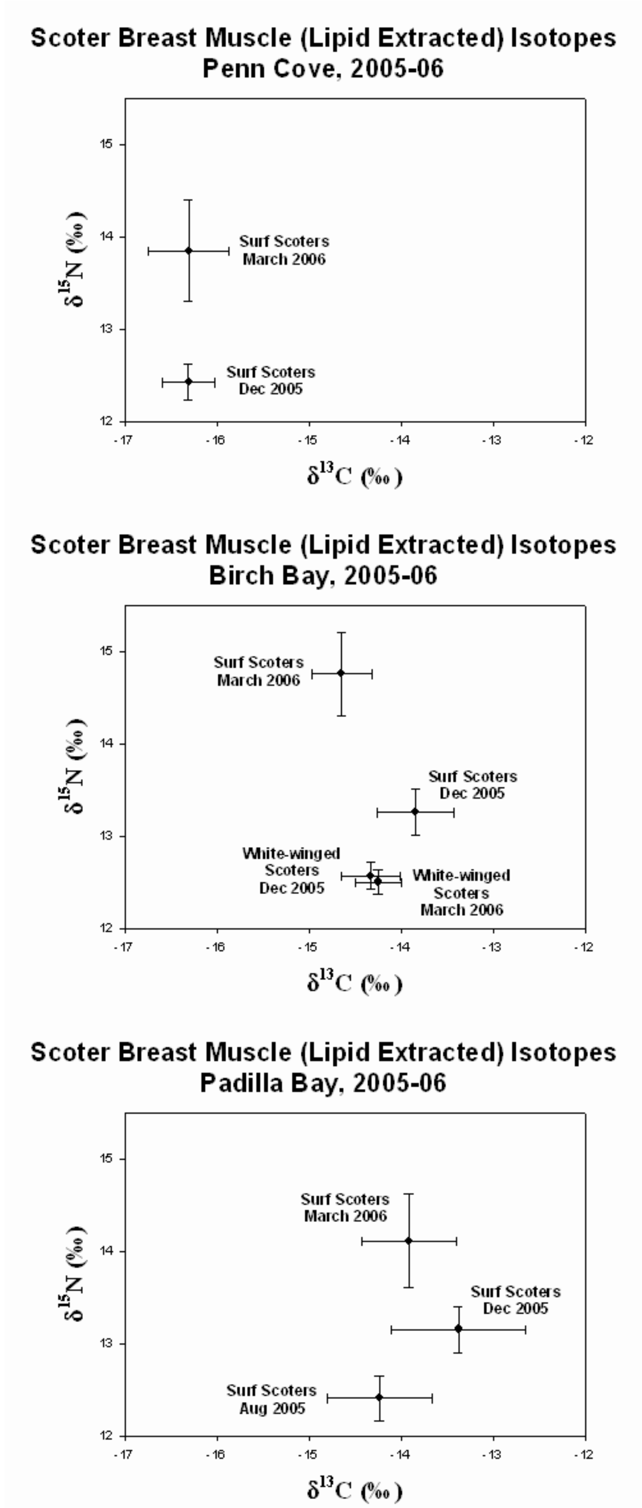


Figure 6. Seasonal $\delta^{13}C$ vs. $\delta^{15}N$ in breast muscle of scoters in our three study sites. Note that the isotopic signature for WWSC does not change overwinter, suggesting their diet does not change seasonally. Conversely, the overwinter enrichment in $\delta^{15}N$ for SUSC suggests (1) they alter their diet seasonally and/or (2) they experience a seasonal increase in nutritional stress.

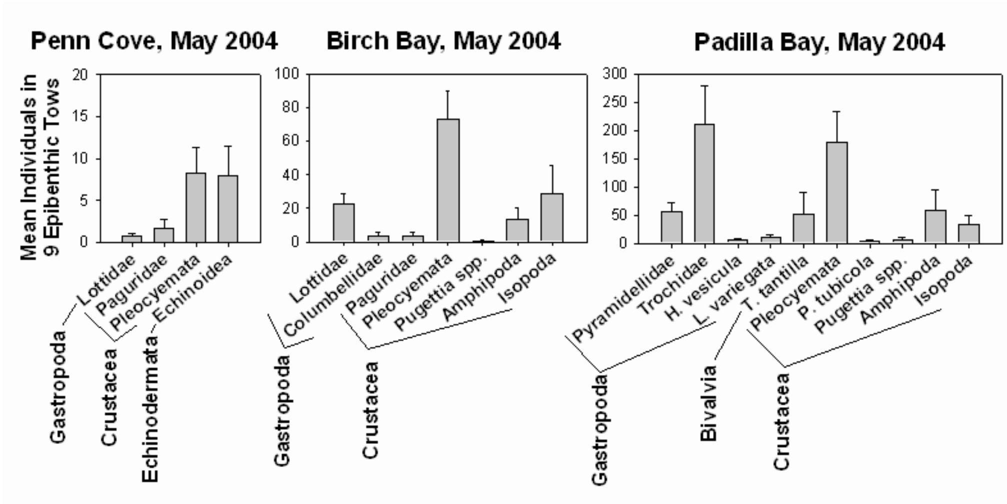


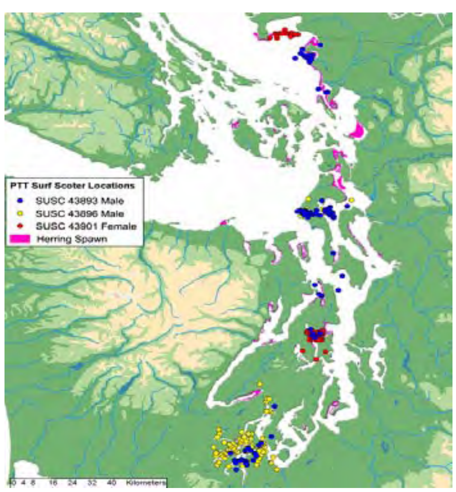
Figure 7. Abundance of dominant epifaunal prey items in our three study sites. Padilla Bay and Birch Bay host extensive and patchy eelgrass beds respectively. Note the greater diversity and abundance of epifaunal prey observed in these sites relative to the largely-unvegetated Penn Cove.

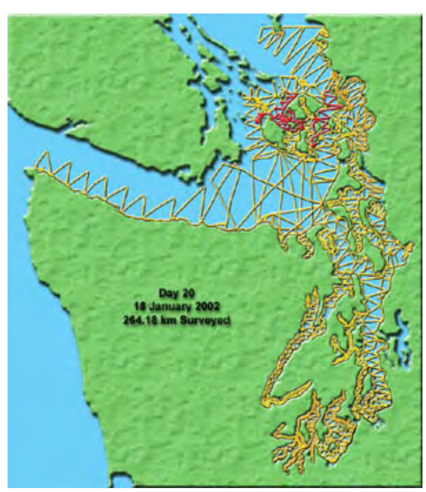
Project Status

We have recently begun analyzing the biomass, nutrient content, and stable isotope and fatty acid signatures for benthic prey items. Once complete, these analyses will enable detailed estimates of seasonal prey availability. Further, comparisons of stable isotopes and fatty acids among scoters and multiple prey items will provide needed support for differences in diet between scoter species (as well as seasonal shifts in diet for SUSC; Fig. 6). Finally, detailed estimates of prey availability, nutrient content, and scoter diets will contribute to energetics models needed to compare the seasonal value of alternative habitats to scoters.

Data on regional distributions and movements of scoters are now being summarized, enabling comparisons with habitat factors (Fig 8). Seasonal associations of scoters with habitat factors at the regional scale will subsequently be compared with our detailed local-scale analyses. Analyses at both scales will enable development of meaningful protection strategies for coastal resources critical to scoters.

We plan to complete all laboratory analyses in December 2006. Analyses and manuscript preparation will begin in January 2007 and will be completed by about May 2008.

(A) 

(B) 

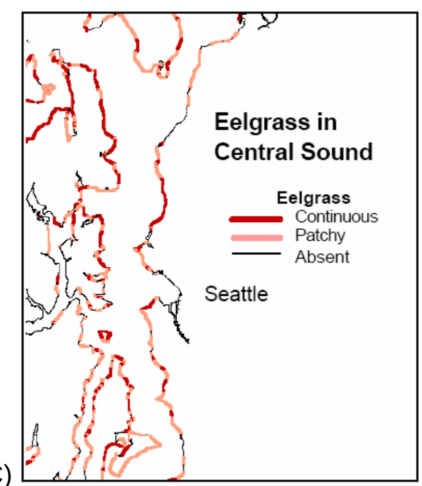
(C) 

Figure 8. Examples of regional-scale data. (A) Satellite-derived movements of three surf scoters in Puget Sound (*courtesy* WDFW). (B) WDFW aerial census route for scoters and other coastal birds in Puget Sound (*courtesy* WDFW). (C) Satellite-derived movements and aerially-documented distributions of scoters will be related to remotely-sensed habitat data, such as this eelgrass coverage defined using aerial videography (*courtesy* WDNR).

Literature Cited

Brown, P. W., and L. H. Fredrickson. 1997. White-winged Scoter (*Melanitta fusca*). *In* A. Poole and F. Gill, editors. The birds of North America, No. 274. The Academy of Natural Sciences, Philadelphia, Pennsylvania, Washington, D.C., USA.

Bulthuis, D. A. 1995. Distribution of seagrasses in a north Puget Sound estuary: Padilla Bay, Washington, USA. Aquatic Botany 50:99-105.

Hobson, K. A., R. T. Alisauskas, and R. G. Clark. 1993. Stable-nitrogen isotope enrichment in avian tissues due to fasting and nutritional stress: implications for isotopic analyses of diet. Condor 95:388-394.

Hodges, J. I., J. G. King, B. Conant, and H. A. Hanson. 1996. Aerial surveys of waterbirds in Alaska 1957-94: population trends and observer variability. U.S. Department of the Interior, National Biological Service Information and Technology Report 4.

Lemberg, N. A., M. F. O'Toole, D. E. Penttila, and K. C. Stick. 1997. 1996 forage fish stock status report. Washington Dep. of Fish and Wildlife, Stock Status Report No.98-1.

Nysewander, D. R., J. R. Evenson, B. L. Murphie, and T. A. Cyra. 2002. Report of the marine bird and marine mammal component, Puget Sound Ambient Monitoring Program, for July 1992 to December 1999 period. Agency Report, WDFW, Olympia, WA.

Savard, J.-P. L., D. Bordage, and A. Reed. 1998. Surf Scoter (*Melanitta perspicillata*). *In* A. Poole and F. Gill, editors. The birds of North America, No. 363. The Academy of Natural Sciences, Philadelphia, Pennsylvania, Washington, D.C., USA.