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Distribution, habitat characteristics, prey abundance and diet of surf scoters (Melanitta perspicillata) and long-tailed ducks (Clangula hyemalis) in polyhaline wintering habitats in the mid-Atlantic region: a comparison of shallow coastal lagoons and Chesapeake Bay environs

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FINAL REPORT

Distribution, habitat characteristics, prey abundance and diet of surf scoters (*Melanitta perspicillata*) and long-tailed ducks (*Clangula hyemalis*) in polyhaline wintering habitats in the mid-Atlantic region: a comparison of shallow coastal lagoons and Chesapeake Bay environs

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Executive Summary

To the best of our knowledge there are no published data on sea duck winter habitat use in the higher salinity portion of the lower Chesapeake Bay or in adjacent coastal bays along the Atlantic margin of the Delmarva (Delaware, Maryland, Virginia) peninsula. Within these regions both SUSC and LTDU have been observed in shallow water environments (Ross, *pers. obs.*), yet little is known about their habitat use or feeding habits in these areas. Importantly, these two adjacent areas, which are separated by as little as 20 km, differ in several key environmental components.

In this study we documented the distribution, habitat use and diet for both surf scoters and long-tailed ducks in these adjacent regions during the winter of 2008-2009. Additionally, we characterized the sediment and quantified infaunal and epifaunal prey species composition and abundances in the shallow water environments used by sea ducks in these areas.

Several aspects of sea duck conservation are suggested by our data. Both the lower Chesapeake Bay and seaward coastal lagoons are important to both LTDU and SUSC, but species-specific habitat needs are at least partially different in both time and space. This suggests individual management perspectives for each species and our data support using spatial analyses of prey availability, duck foraging sites and diet composition to better understand foraging ecology and inform such conservation strategies.

This study implies that the relationships between sea ducks and soft and hard bottom habitats in the mid-Atlantic are complex. In the face of continued habitat degradation and shoreline development, this type of detailed habitat data will be very meaningful and have practical impacts on sea duck conservation.

Acknowledgements

This project was funded by the Sea Duck Joint Venture (FY08 # 104). Portions of this research utilized protocols approved by the College of William and Mary's Institutional Animal Care and Use Committee (#IACUC-2008-03-17-5206) and Institutional Biosafety Committee (#IBC-2008-06-12-5395). Feedback from both committees was very helpful. Sea ducks were collected under permits issued by the U.S. Fish and Wildlife Service (#MB184289-0) and the Virginia Department of Game and Inland Fisheries (#034193).

We would like to thank Edward Smith, Alan Birch, Al Curry and Sean Fate for substantial field and/or laboratory contributions to this study. Gary Costanza provided helpful comments on study design, especially regarding surveys and duck collections. Reade Bonniwell and James Powell fabricated sampling gear. Will Hart, Zack Mallete, Paige Smith, Trisha Wagner and Linda Ward helped process laboratory samples. We would also like to thank Carter Crabbe for his expertise and patience during aerial surveys.

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Introduction

North American population trends for breeding surf scoters (SUSC) and long-tailed ducks (LTDU) appear to be decreasing, while wintering populations along the Atlantic coast are suspected to be decreasing and unknown, respectively (Sea Duck Joint Venture [SDJV] 2006). These trends have led to SDJV assigning a "High" relative conservation priority to both species.

The Chesapeake Bay region has been cited by the SDJV as an important wintering area for several scoter species and LTDU (SDJV 2004). Unfortunately, there are limited quantitative data on habitat use by these species in Chesapeake Bay. Research from mesohaline (salinity <18 psu) portions of Chesapeake Bay and other regions of the U.S. suggest that SUSC preferentially forage in subtidal (> 6 m depth) sandy, soft-sediment habitats, although hard-substrate bottoms are also utilized (Perry et al. 2004, Stott and Olson 1973, Lewis et al. 2007). LTDU have been shown to utilize both hard- and soft-substrate habitats in New Hampshire, with a preference for the former (Stott and Olson 1973). In contrast, long-tailed duck diets in the upper Chesapeake Bay are dominated by infaunal bivalves (Perry et al. 2004), suggesting that they are feeding primarily in soft-sediment habitats (e.g. see Zydelis and Ruskyte 2005). Perry et al. (2004) found that in the mesohaline region of Chesapeake Bay surf scoter diet consisted primarily of infaunal (~54%) and epifaunal (~37%) bivalves, while LTDU feed primarily on infaunal bivalves (>70%). It is likely that the limited availability of hard substrate bottom in the Chesapeake Bay, which is primarily represented by gravels beds and remnant, degraded oyster reefs, accounts for the differences in habitat utilization in the upper Chesapeake compared to other regions. However, the methods utilized in many of the fore mentioned studies may underestimate the importance of soft-bodied prey, such as polychaete worms (Anderson et al. 2008).

To the best of our knowledge there are no published data on sea duck winter habitat use in the higher salinity portion of the lower Chesapeake Bay or in adjacent coastal bays along the Atlantic margin of the Delmarva (Delaware, Maryland, Virginia) peninsula. Within this region both SUSC and LTDU have been observed in shallow water environments in both the southeastern portion of Chesapeake Bay and the coastal bays (Ross, *pers. obs.*), yet little is known about their habitat use or feeding habits in these areas. Importantly, these two adjacent areas, which are separated by as little as 20 km (see Fig. 1) differ in several key environmental components. First, Chesapeake Bay, the largest estuary in North America, has suffered significant declines in water quality and abundances of many living resources over the past 50 years. Sedimentation and excess nutrient loading, leading to eutrophication and oxygen depletion, have affected large areas of the Bay bottom (Chesapeake Bay Program 2007). In addition, the well documented decline in oyster abundance related to over fishing, pollution and disease (Rothschild et al. 1994, Hargis and Haven 1999) has dramatically reduced the availability of hard-substrate bottom habitat in the Bay. Seagrass beds have also declined dramatically in the Chesapeake Bay; however, beds composed of eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*) can still be found along its shallow margins, particularly in the southeastern region of the lower Bay. In contrast, the coastal bays on the eastern side of the peninsula have more pristine water quality and offer a higher diversity of habitats, including intertidal flats, deeper channels and an abundance of intertidal oyster reefs, which provide significant hard-substrate habitat. However, seagrass beds have been locally extinct since the 1930's and are only recently being restored (Orth et al. 2006). Seagrass habitats have been shown to have higher densities of infaunal bivalves relative to unvegetated bottom, owing largely to reduced foraging efficiency by invertebrate predators (Peterson 1982, Peterson et al. 1984).

Nothing is known about the potential importance of seagrass beds to wintering SUSC and LTDU in this region.

In this study we documented the distribution, habitat use and diet for both SUSC and LTDU in these adjacent regions during the winter of 2008-2009. Additionally, we characterized the sediment and quantified infaunal and epifaunal prey species composition and abundances in the shallow water environments used by sea ducks in these areas.

Our objectives were to: 1) compare the distribution, fine-scale habitat characteristics and diet of SUSC and LTDU in two discrete mid-Atlantic environs; 2) qualitatively compare these results to previous studies in the fresher mesohaline portion of Chesapeake Bay; and 3) investigate the proximity of winter foraging habitat to oyster reefs, seagrass beds and emergent shorelines for both species.

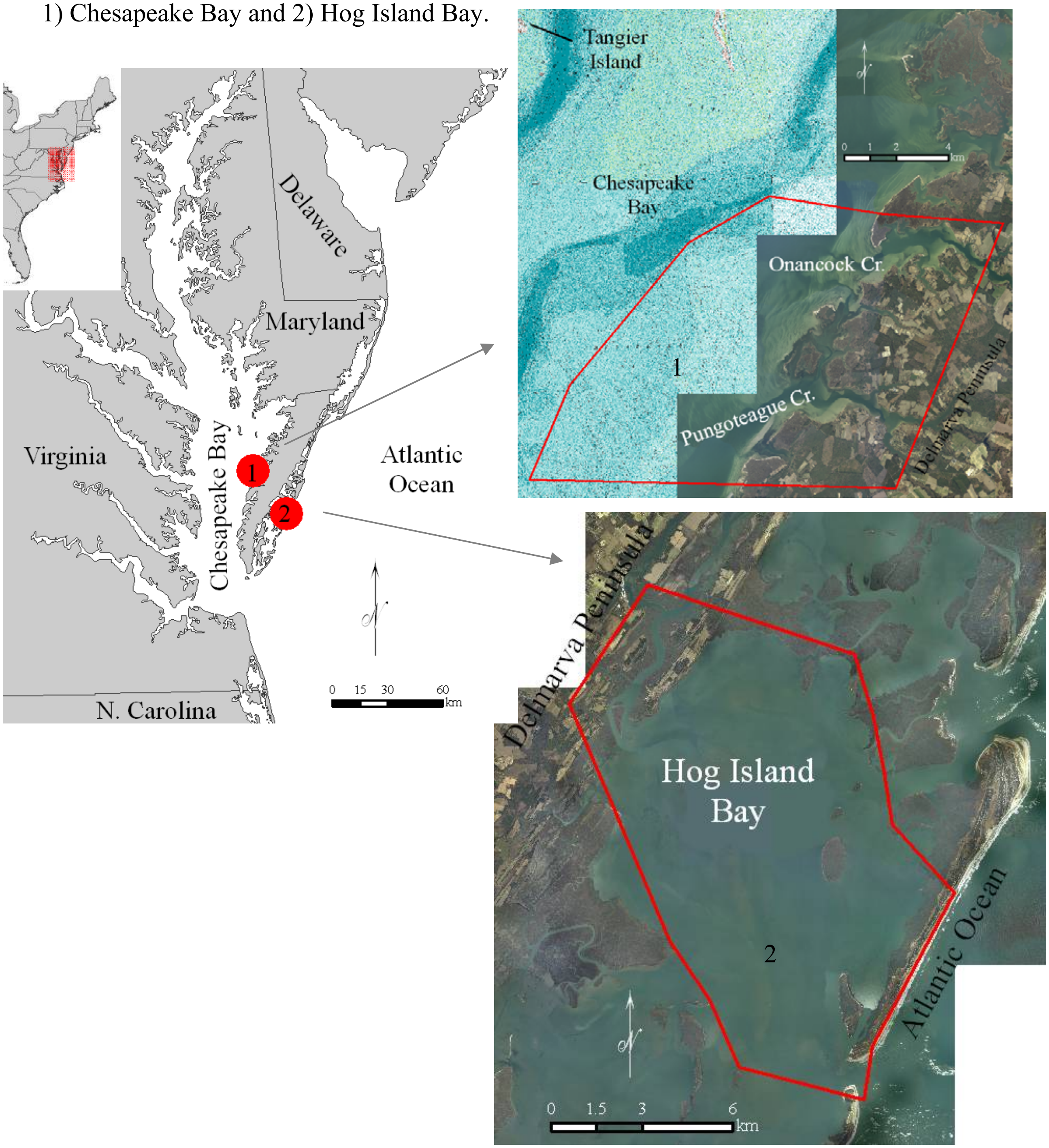
Methods

Study Areas

While large concentrations of sea ducks have been documented in the upper Chesapeake Bay, distribution data from satellite telemetry suggest interchange between mesohaline and polyhaline areas, as well as some movement to seaward coastal lagoons (Perry et al. 2004; e.g. see 2002 SUSC tracks for 49436, 49439, 40775, 49434 & 40773). To logistically focus on fine-scale data collection, we concentrated on two discrete study areas.

Study Area 1 (Pungoteague/Onancock Flats) – The Chesapeake Bay is a large shallow estuary dominated by soft-sediment seabed with limited areas of hard substrates in the form of oyster reefs in various degrees of degradation. It exhibits a south to north salinity gradient in the mainstem portion utilized by sea ducks that ranges from 30 psu at its mouth to <10 psu in the upper reaches. We collected data from a well defined polyhaline (salinity ranging from 18-22

Figure 1. Study areas in Virginia, USA:
1) Chesapeake Bay and 2) Hog Island Bay.



psu) area encompassing water depths ranging from 1-10 m that had discrete regions of muddy and sandy sediments (Fig. 1). This area encompassed 102 km^2 in the vicinity of Onancock, Pungoteague and Nandua creeks. An extensive seagrass bed, composed of eelgrass and widgeon grass, was also found within this area. For the past several years, SUSC and LTDU have been observed using portions of this area for most of the winter (P. Ross *pers. obs.*).

Study Area 2 (Hog Island Bay) - Coastal bays seaward of the Delmarva Peninsula are shallow, partially intertidal bays which lie between barrier islands to the east and the mainland to the west. Extensive *Spartina alterniflora* salt marsh habitat partially separates individual bays. We collected data from one such bay with ~30 psu salinity and a diversity of fine scale habitats ranging from intertidal flats and oyster reefs to deeper channels (Fig 1). This area encompassed Machipongo Creek to Great Machipongo Inlet and North Channel, just south of Quinby Inlet. Hog Island formed the eastern border of the study area. A diversity of discrete sediment types were also encountered. For the past several years, SUSC and LTDU have been observed using portions of this area for portions of the winter (P. Ross *pers. obs.*).

<u>Sea Duck Distribution</u>

Vessel-based and aerial surveys in open water have been shown to be comparable for marine birds (Henkel et al. 2007), although those from boats may be better at inventorying rare species or low densities (Briggs et al. 1985). Therefore, study areas were surveyed by vessel starting in early October 2008 and by fixed-wing aircraft in early November 2009 once sea ducks started arriving in numbers. Aerial surveys continued on a 2-4 week interval until the end of April 2009 (Table 1). Initially, bi-weekly surveys were planned, but weather intermittently dictated longer intervals between surveys. Surveys were conducted at 90 m altitude at 60-90 knots ground speed, using techniques similar to those described by Perry et al. (2004) and Dean et al. (2003). Each individual study area was surveyed completely within a 4-hr period and within 48 hrs of each other. Surveys were completed within 3 hrs of high tide to assure that intertidal habitats in Hog Island Bay, which are only inundated at higher tides, were available to birds. Locations of individuals, pairs and discrete aggregations were recorded using a global positioning system (GPS) and flock diameter estimated to the nearest 50 m (a minimum polygon diameter of 50 m was adopted for individuals and pairs as well). If loose aggregations of sea ducks were present, the outer perimeters were marked accordingly.

Several weather criteria limited when surveys were performed. We did not undertake surveys unless visibility was greater than 1 km and sea state was less than 0.75 m. Occasionally we were obliged to postpone surveys because of these constraints. This resulted in survey intervals ranging from two to four weeks.

Abundance of SUSC and LTDU was enumerated for each aggregation. LTDU were more difficult to see; however, species identification was straight forward. SUSC were much easier to see, however, distinguishing between scoter species was difficult. In most cases, when adult male SUSC were observed, we considered that aggregation to be mainly SUSC. In several cases, we could distinguish white-winged scoters. There were undoubtedly several species of scoters in some large aggregations; however, these groups were dominated by SUSC and labeled as such.

We were specifically interested in foraging aggregations and initially planned to only map and sample groups actively foraging. Two variables impacted our ability to do this. First, during vessel surveys, we observed no aggregations where at least a portion of the ducks were not actively diving and, therefore, presumably foraging or investigating opportunities, even when other portions of the aggregation appeared to be resting or, in several cases, sleeping. This mix of behaviors within aggregations was most apparent within the larger groups and we decided to classify them as foraging aggregations even when a portion of individuals did not appear to be doing so. Second, during aerial surveys, sometimes ducks would dive in response to the aircraft before we could observe the aggregation. Anecdotally, this was less apparent as the aggregation size increased, but it could lead to a false judgment regarding the active behaviors within a flock. However, nearly every aggregation we encountered appeared to be actively diving to some degree not in response to the airplane (e.g. flying over two ducks not diving and having a third one pop up as we passed over).

GPS coordinates and flock diameter estimates for each aggregation were used to create GIS polygons (ArcGIS 9.1) that were then used to direct further sampling as described below. The smallest aggregation polygon was a 50 m diameter circle centered on GPS coordinates. This minimum dimension was based on estimates of cumulative GPS marking errors consisting of: 1) inherent GPS error with Wide-Angle Augmentation Signal (WAAS) correction of 5-10 m; 2) positional change error when traveling at 80 kts (with GPS only updating every several seconds); and 3) observer error. In an earlier aerial survey of clam dredging activities, we determined that these cumulative errors using fixed-wing aircraft and the same equipment under similar circumstances of this study were on the order of 50 m by repeatedly marking a fixed object of known position (x=48.6 m, range=11-70 m; P. Ross, unpublished data). Thus, by using a minimum polygon dimension of 50 m, we were fairly certain that the observed aggregation was within the polygon created in GIS. Details of shapefiles and other GIS specifications can be found below and in the metadata for the companion GIS products accompanying this final report.

Habitat Characteristics

Benthic Grab Samples – Based on the locations of sea duck aggregations within each study area, we collected temporally-replicated, quantitative benthic samples to characterize prey species composition and the physical characteristics of foraging areas. Fifteen and 16 stations were randomly selected from the Chesapeake Bay (CB) and Hog Island Bay (HIB) areas, respectively, for benthic sampling during 10/27/2008 to 12/6/2008. All but one station in each study area were based on SUSC aggregations during this early sampling because very few LTDU were observed until benthic sampling was already completed (Table 1). Seventeen stations were randomly selected from each study area for benthic sampling during 2/25/2009 to 4/13/2009. During this later sampling, HIB stations consisted almost exclusively of LTDU foraging sites since SUSC aggregations significantly diminished by mid-December 2008. CB stations were allocated to both randomly selected LTDU and SUSC foraging areas.

Replicate bottom samples within each station were collected using a Smith-McIntyre grab (Fig. 2). This device sampled 0.0841 m^2 of seabed to a depth of 10-15 cm, depending on sediment characteristics. For each targeted station, 3-12 points were randomly selected within the associated GIS polygon (e.g. see Fig 3), proportional to its size (based on ~3 samples per 0.01 km^2) using Hawth's Tools (Beyer 2004). This resulted in 63 and 69 grabs in CB and HIB, respectively, during the early sample period and 53 and 51, respectively, during the late sample period (Fig. 4).

Figure 2. Smith-McIntyre grab sampler.

Figure 3. Example of benthic sample locations randomly allocated within a polygon based on location of a sea duck aggregation.

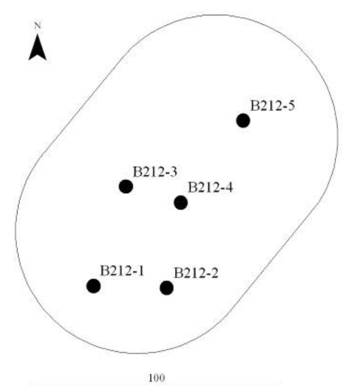


Table 1. Aerial survey results (# aggregations, total # individual ducks and # ducks standardized by area[a]) for both duck species during winter 2008/2009 in: A) Chesapeake Bay and B) Hog Island Bay study areas.

(A) *Chesapeake Bay*

Date	Species	# Groups	# Ducks	# · km^{-2}	Species	# Groups	# Ducks	# · km^{-2}
10/8[b]	Long-tailed Duck	0	0	0.00	Surf Scoters	0	0	0.00
10/24[b]		0	0	0.00		20	5,426	52.99
11/7		1	7	0.07		16	2,372	23.16
11/20		0	0	0.00		61	1,744	17.03
12/8		14	190	1.86		46	943	9.21
12/23		23	63	0.62		31	331	3.23
1/17		9	73	0.71		27	330	3.22
2/10		8	35	0.34		26	225	2.20
3/5		21	71	0.69		12	95	0.93
4/2		0	0	0.00		9	116	1.13
4/27		0	0	0.00		0	0	0.00

(B) *Hog Island Bay*

Date	Species	# Groups	# Ducks	# · km^{-2}	Species	# Groups	# Ducks	# · km^{-2}
10/7[b]	Long-tailed Duck	0	0	0.00	Surf Scoters	1	3	0.02
10/20[b]		0	0	0.00		29	1,709	13.70
11/7		1	1	0.01		9	116	0.93
11/20		2	4	0.03		13	112	0.90
12/8		16	117	0.94		7	71	0.57
12/23		12	35	0.28		2	9	0.07
1/17		26	139	1.11		0	0	0.00
2/10		11	56	0.45		2	16	0.13
3/5		28	162	1.30		1	1	0.01
4/2		0	0	0.00		5	66	0.53
4/27		0	0	0.00		0	0	0.00

[a] Study area footprints for standardizing counts were: Chesapeake Bay=102 km^2; Hog Island Bay=125 km^2
[b] Vessel surveys instead of aerial surveys

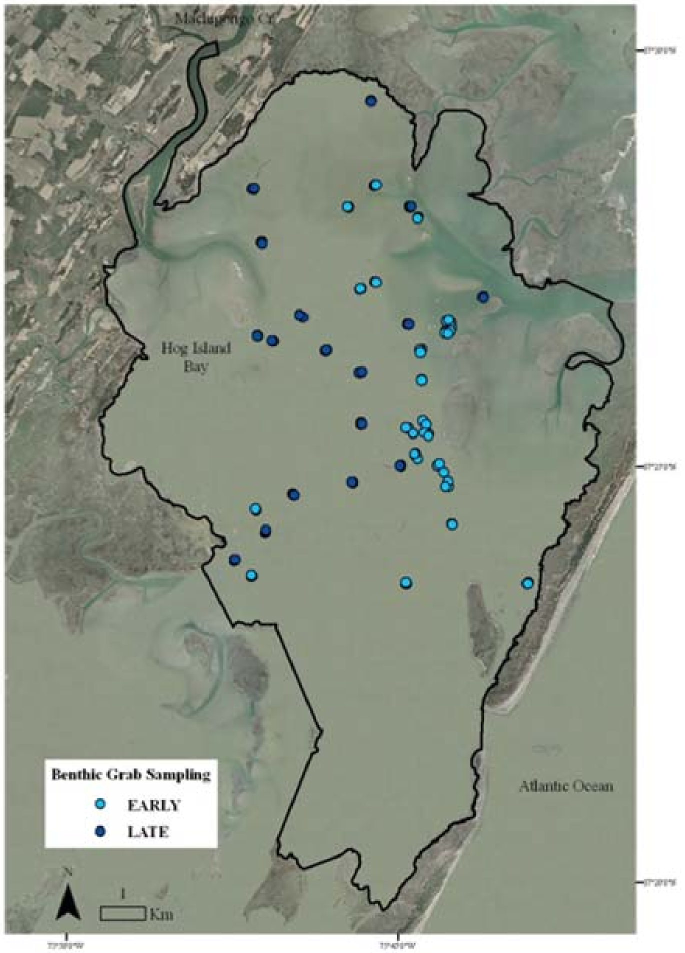
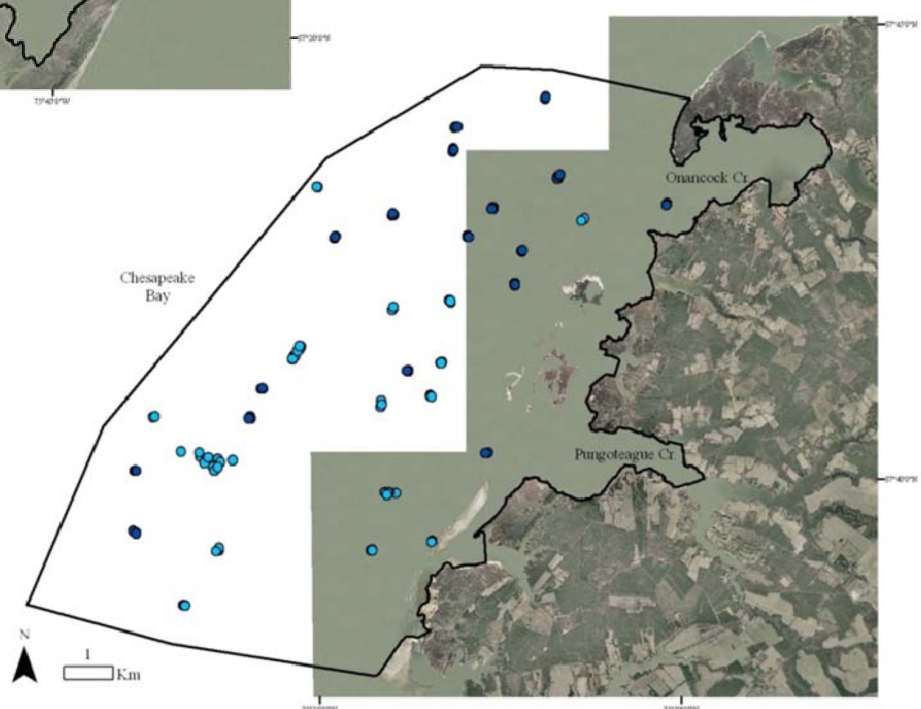


Figure 4. Benthic sampling locations in early (light blue) and late (dark blue) winter 2008/2009. Locations based on sea duck foraging aggregations observed during surveys.



Water depth was measured at the approximate centroid of each station using a 200 kHz fathometer. Bathymetry was manually corrected to mean higher high water (MHHW) based on predicted vs. observed tides at appropriate reference stations. Additionally, water temperature (ºC), salinity (psu), turbidity (ntu) and dissolved oxygen ($mg \cdot L^{-1}$) were collected at each centroid using an *in situ* YSI multi-parameter probe (YSI 6600 V2 Sonde). If water depth was >3 m, these water quality parameters were measured within 1 m of the surface and within 1 m of the bottom. Otherwise, only surface measurements were taken. Thus, if three grabs were to be conducted within one station, only one set of bathymetry/water quality data was collected, since grab locations were typically within 50 to 100 meters of each other.

Exact grab sample locations were navigated to using a Trimble sub-meter accuracy surveying GPS. Once on site, the Smith-McIntyre grab was deployed and recovered via a boom and winch arrangement. Once the unit was back on board, the depth of sediment in the grab was immediately measured. Grabs containing at least 10 cm of sediment were placed in a 1 mm mesh lined container to allow free water to drain out. Those with <10 cm were rejected and another adjacent grab sample was collected (there were two instances where <10 cm grabs were accepted after several re-tries as the sediment contained substantial relic oyster shell and we could penetrate the sea bed no more than ~ 7 cm). A 2.5 cm diameter x ~ 10 cm deep core was extracted from the grab sample for subsequent sediment organic matter and grain size analysis (details below). The remaining sample was transferred to land where it was washed on a 1mm mesh sieve. Benthic macrofauna and macroflora retained on this sieve were preserved in 10% buffered formalin and then transferred to 70% ethanol until further processing could occur (details below). Additionally, shell or gravel particles too large to be sampled with the 2.5 cm corer were set aside a dried.

Sediment Analysis – Samples collected with the 2.5 cm corer, described above, were combined by station. These samples were dried to a constant weight at 90 ºC for at least 5 days and clumps were gently broken up with a mortar and pestle with care given to not destroy the integrity of individual grains. Samples were then homogenized and ~15 cm^3 placed in a pre-weighed aluminum pan and weighed to the nearest 0.001 g. Samples were then placed in a muffle furnace at ~550º C for at least 5 hrs, allowed to cool and then re-weighed to the nearest 0.001 g. We could then calculate the % organic matter in the sediment, by weight, based on the difference of these measurements.

Additionally, grain size analysis was determined for ~50 g of sediment (each sample measured to the nearest 0.01 g) using a standard dry sieve series technique. Dry sediment was agitated through a stacked sieve array of the following standard mesh sizes: #5 (4 mm), #10 (2 mm), #60 (250 µm) and #230 (63 µm). After manual agitation, a nylon brush was used to gently expose all grains to mesh openings in each sieve. The fractions retained on each sieve and the residual passing through the #230 were recovered and individually weighed to the nearest 0.01 g. The proportion of each fraction, by weight, could then be calculated. Grain size categories were then developed partially based on Wentworth (1922) as follows: retained on #5 and #10, *Coarse Substrate* (shell fragments and small pebbles); retained on #60, *Medium-Coarse Sand*; retained on #230, *Very Fine-Fine Sand*; and the residual passing through the #230, *Silt-Clay*.

Also, the large shell and gravel particles set aside during the original sieving process (see above section) were dried and weighed to the nearest g. These represented particles too large to be sampled by the 2.5 cm corer and identified foraging sites containing remnant oyster reefs or shell beds. In all instances where these larger particles were present, coarse particles were also retained on the #5 and/or #10 sieves during grain size analysis. The larger shells and gravel were not included in the grain size analysis since they are reported separately in the Results section.

Benthic Organisms – Flora and fauna retained on a 1 mm mesh sieve (see above) were identified to the lowest practical taxonomic level for each individual grab (Table 2). Bivalves, gastropods, fish and amphioxus (up to 50 per grab) were measured to the nearest mm in the organisms' longest dimension. All specimens within broad taxa (see Table 2) were then pooled by station (i.e. foraging aggregation) and placed in pre-weighed aluminum pans. These samples were dried to a constant weight at 90 ºC for at least 48 hrs and then weighed to the nearest 0.001 g. Samples were then placed in a muffle furnace at ~550º C for at least 5 hrs, allowed to cool and then re-weighed to the nearest 0.001 g. Ash-free dry weight was determined from these results by subtraction (referred to as dry tissue biomass, or simply biomass, henceforth).

Community metrics were measured using the broad taxa described above (see Table 2). Species richness and the Shannon Index were calculated to evaluate diversity (Downing 1980, Zar 1984).

Landscape Relationships – While we were interested in quantifying the micro-scale habitat characteristics of observed sea duck aggregations as described above, we also wanted to investigate the distribution of aggregations within the landscape, especially with regard to three habitat types: emergent shoreline (including marsh islands and sand bars fully exposed on normal high tides), submerged aquatic vegetation patches and intertidal oyster reefs.

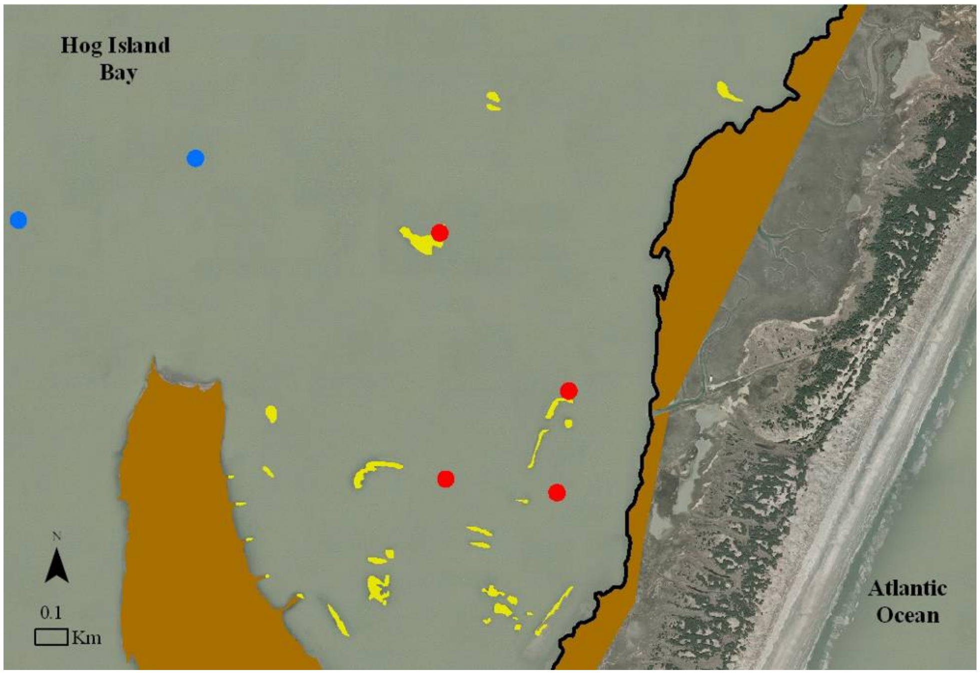
Special "sea duck zones" are designated in Virginia for harvest outside of the general waterfowl season and are generally 800 yds (730 m) from emergent shoreline. Therefore, for each aggregation mapped, we determined whether the nearest polygon perimeter was within 730 m of emergent shoreline, which may have management implications (e.g. see Fig. 5).

Table 2. General description of the targeted level of identification of the main taxa encountered in benthic and stomach samples.

Broad Taxa	Level for ID	Level for Biomass
Mollusca		
Bivalvia	Species	Genus
Gastropoda	Family (species in many cases)	Order (Gastropoda)
Crustacea		
Brachyura	Species	Infraorder (Brachyura)
Anomura	Species	Infraorder (Anomura)
Caridea	Species	Infraorder (Caridea)
Cumacea	Infraorder (Cumacea)	Infraorder (Cumacea)
Amphipoda	Family (Genus in many cases)	Order (Amphipoda)
Isopoda	Family (Genus in many cases)	Order (Isopoda)
Thalassinidea	Species	Order (Thalassinidea)
Polychaeta	Family (Genus in many cases)	Class (Polychaeta)
Ascidiacea	Genus	Family
Echinodermata	Genus	Order
Chordata		
Amphioxiformes	Genus	Genus
Teleostei	Species	Species
Macroalgae	Phylum	Phylum
Vascular plant[a]	Genus	Vascular plant

[a] Primarily consisted of pieces of submerged aquatic vegetation in the genera *Zostera* and *Ruppia* or *Spartina alterniflora* debris

Figure 5. Example of emergent shoreline (brown) and intertidal oyster reefs (yellow) mapped in GIS relative to georeferenced aerial images and sea duck foraging locations (LTDU=blue and SUSC=red). Note that the black line is the study area boundary.

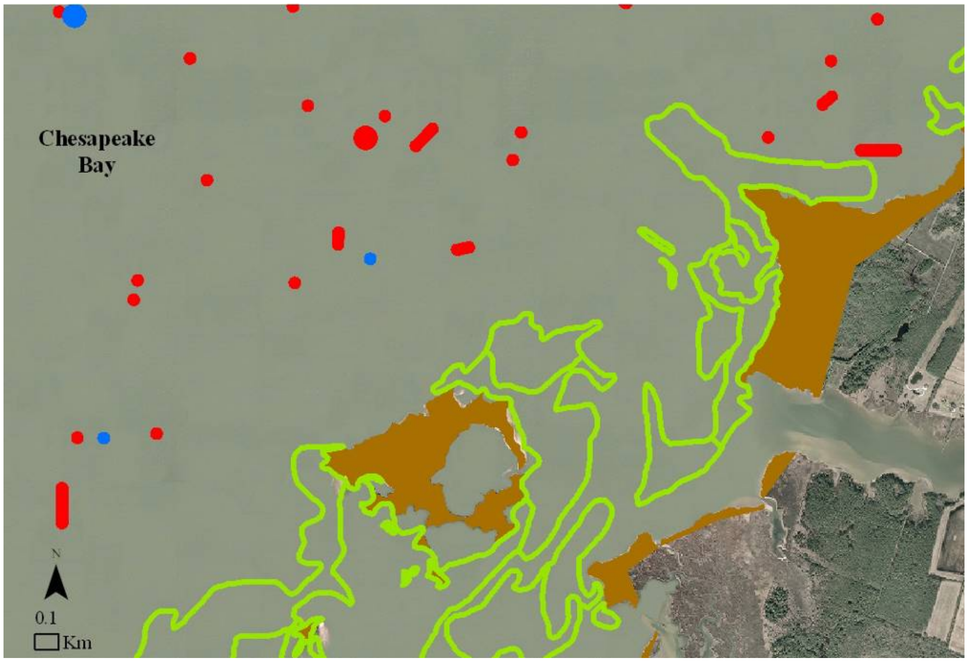


Although SAV has experienced dramatic declines in Chesapeake Bay in previous decades and has almost been extirpated from the coastal bays in the vicinity of our HIB study area, prey densities can be dramatically impacted by the presence of SAV and SUSC forage in such areas in other regions (e.g. see Anderson et al, 2008). Therefore, we determined whether the nearest perimeter of each aggregation was > 50 m, 1-50 m or overlapping the most recent SAV plots (VIMS 2008; e.g. see Fig. 6). As of the development of this report, the most recent SAV plots were from late 2007 imagery.

It has been suggested that both LTDU and SUSC may forage on degraded and remnant subtidal oyster reefs in Chesapeake Bay. While we know of no current maps for this type of habitat in our CB study area, we have recently mapped all of the intertidal oyster reefs within the

HIB study area as part of another study. Therefore we categorized the distance of the nearest perimeter of each aggregation as > 50 m, 1-50 m or overlapping these reefs (e.g. see Fig. 5).

Figure 6. Example of emergent shoreline (brown) and submerged aquatic vegetation (green) mapped in GIS relative to georeferenced aerial images and sea duck foraging locations (LTDU=blue and SUSC=red).



Diet

We recognized the negative impacts of destructively sampling individuals of these potentially declining species. Nevertheless, such information would enhance the other data collected during this study and result in a better description of the wintering ecology of sea ducks. Therefore, a limited number of LTDU and SUSC were haphazardly collected (using a 12-gauge shotgun) from groups observed to be foraging in each study area during two time periods: November/December 2008 and January 2009. Although we initially planned to observe foraging individuals for 15-30 min before collecting them, unpublished data cited in Anderson et al. (2008) suggested observing foraging ducks for this long did not necessarily yield better stomach content data. Therefore, we collected individuals shortly after ascertaining that they were actively foraging (or at least actively diving) by observations for ~5 min. We attempted to collect a cross-section of the population by targeting both males and females and adults and juveniles when possible.

Collection locations were marked using a GPS and subsequently plotted in GIS. Bathymetry and water quality parameters were measured using the same techniques and criteria as described above for benthic grab sampling. Upon retrieval, ducks were photographed and their sex and age estimated based on plumage characteristics (see Iverson et al. 2003). Both were subsequently confirmed by gonad examination (type for sex and development for age). Several anatomical measurements were then taken, including: wet mass, wing notch-tip length, tarsus length, culmen-fore feather length, culmen-nostril length, maximum bill height and bill width at gape.

Field necropsies were performed within ~30 min of collection. For individual birds, the esophagus from the bill to the gizzard (including the proventriculus) was removed with contents intact and preserved in 10% formalin. The gizzard was then removed and preserved separately. Several other tissue samples were also collected for collaborators (see Appendix I): lower intestine from the gizzard to near the cloaca, heart tissue and the outer three primary feathers. Additional tissue samples (~ 1 cm^3) were collected and archived at -80 ºC at our lab: liver, brain, wing muscle, breast muscle, thigh muscle and reproductive organs. The first primary and ~ 10 back feathers were also archived.

Flora and fauna from esophagus/proventriculus and gizzard samples were identified to the lowest practical taxonomic level for each bird (Table 2). All bivalves, gastropods, fish and amphioxus were measured to the nearest mm in the organisms' longest dimension. Organisms were pooled into broad taxonomic groupings (see Table 2) and placed in pre-weighed aluminum pans. These samples were dried to a constant weight at 90 ºC for at least 48 hrs and then weighed to the nearest 0.001 g. Samples were then placed in a muffle furnace at ~550º C for at least 5 hrs, allowed to cool and then re-weighed to the nearest 0.001 g. Ash-free dry weight was determined from these results by subtraction to characterize dry tissue biomass.

Community metrics were measured using the broad taxa described in Table 2. Species richness and the Shannon Index were calculated to evaluate diversity (Downing 1980, Zar 1984).

Geographic Information System (GIS)

Sea duck distribution and abundance, habitat data and prey species composition and density were integrated into layers of a GIS project (ArcGIS 9.1). All spatial data were measured using GIS. Additionally, benthic and bird collection locations were plotted with pertinent data included. Please see the metadata developed for GIS layers submitted with this report.

Statistical Analysis

All benthic and diet data were pooled with regard to sample dates (i.e. no comparisons were made between early and late winter). We wanted to capture any seasonality in these data, but within the scope of this study, we did not plan to formulate any temporal hypotheses.

Differences between species and study areas were generally analyzed using unbalanced ANOVA (General Linear Models Procedure, SAS). This fairly robust parametric test was used where appropriate unless statistical assumptions were violated, in which cases equivalent non-parametric tests were used (e.g. Kruskal-Wallis tests). Proportion data were arcsine transformed prior to analysis (Sokal and Rohlf 1997).

Because these datasets contained numerous variables we utilized principal components analysis (PCA) to identify those groups of factors (e.g., bathymetry, numerous habitat characteristics, prey composition and abundance) which explained most of the variation in the habitat and diets of both LTDU and SUSC in both study areas. Components with eigenvalues >1 (or if only one met this criteria then the next highest was included) were used to determine axes. The largest eigenvector coefficients were then selected to describe the most important factors within each axis. Graphs of these results are reported to help visualize potential differences for the most important factors. Percent data were arcsine transformed prior to analysis.

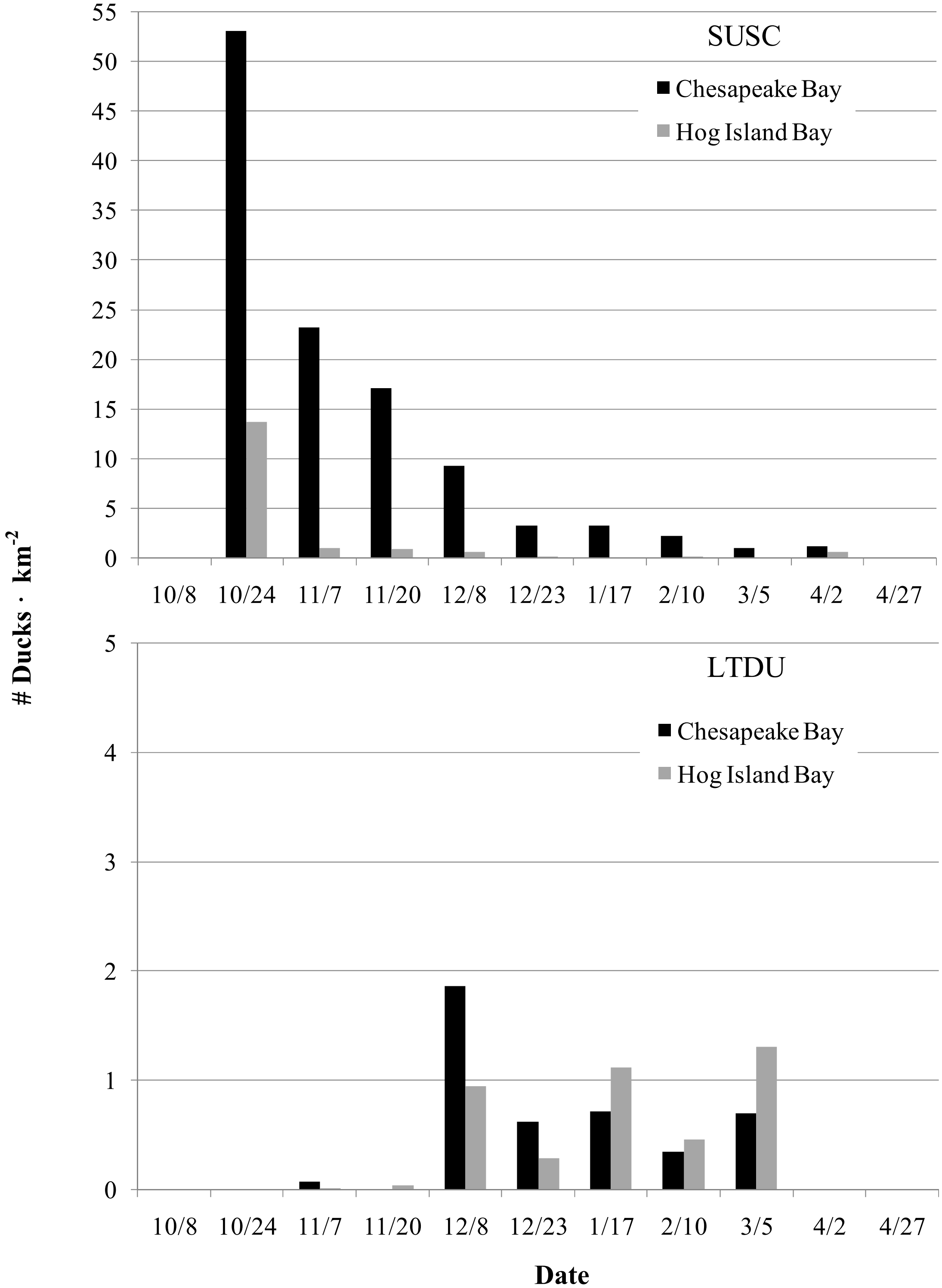
Results

<u>Distribution and Aggregation Descriptions</u>

Overall, 489 aggregations (including singles) containing 14,638 LTDU and SUSC were observed during this study. Just over 12,000 and 2,600 were found in CB and HIB study areas, respectively. SUSC were the dominant species accounting for 13,685 (93%) of sea ducks counted during surveys in 317 aggregations. However, it is important to note that 40% of these were counted in one survey during peak concentrations. LTDU in 172 aggregations accounted for 953 (7%) of the ducks counted. The relative abundance of the two species was expected given their life histories and will be addressed in the discussion. Data, including flock centroid coordinates and raw counts, are reported for all aggregations observed during surveys in Appendix II.

SUSC arrived in both study areas well before LTDU (Table 1 and Fig. 7). Only one group of three SUSC was observed during the first survey, however; a substantial migration occurred during the second and third weeks of October. SUSC counts in both areas peaked during the 10/24 survey at 53 ducks$\cdot$km^{-2} and 14 ducks$\cdot$km^{-2} for CB and HIB, respectively. They

Figure 7. Sea duck abundance ($\#\cdot km^{-2}$) observed during vessel/aerial surveys during winter 2008/2009 in both study areas for SUSC and LTDU. Note that abundance axis scales are different for the two duck species.



dropped to relatively more moderate levels through the beginning of December in CB and slowly diminished to below 1 duck·km^{-2} by the beginning of March. In contrast, SUSC in HIB quickly fell to below 1 duck·km^{-2} in early November and were basically absent for the remainder of the study with the exception of a short period in early April. In one survey conducted on December 8, 2008, we estimated upwards of 10,000 SUSC (possibly mixed with other scoter species) in an area approximately 65 km^2 in the ocean just east of Hog Island and outside of the HIB study area. Densities were generally much higher in the CB study area, sometimes by more than an order of magnitude.

LTDU arrived to both study areas later than SUSC, not showing up in numbers until the beginning of December (see Table 1 and Fig. 7). Similar trends were observed in both study areas with numbers slowly diminishing through February, but with slight increases during early March. Densities were generally similar in scale throughout the study in both study areas.

Both LTDU and SUSC aggregations tended to be found outside of tidal creeks in CB, although some SUSC were observed in Onancock Creek and one group of each species was observed in Pungoteague Creek (Fig. 8). Cumulative plots show flocks of both species scattered throughout this bayside study area, but it is apparent that larger groups were well offshore for both (Fig. 8). A different pattern emerged in HIB. While LTDU tended to be scattered throughout the study area, SUSC were concentrated in a relatively narrow band along a shoal area just west of High Shoal Marsh (Fig. 9).

Most of the sea duck aggregations observed during surveys were comprised of only SUSC (although some large flocks likely contained multiple scoter species) or LTDU. Only 11 mixed-species aggregations (2.2%) were observed with LTDU and SUSC actively foraging together. These contained from 3 to 55 individual ducks (Table 3) and no statistical tests were pursued because of their scarcity and small sample size.

There was no significant difference in the mean number of sea ducks comprising aggregations between the two study areas (p=0.44). However, overall, LTDU aggregation size was significantly smaller than that of SUSC and this same pattern held within both study areas

Figure 8. Cumulative GIS plots of sea duck foraging aggregations observed during vessel/aerial surveys in winter 2008/2009 in the Chesapeake Bay study area.

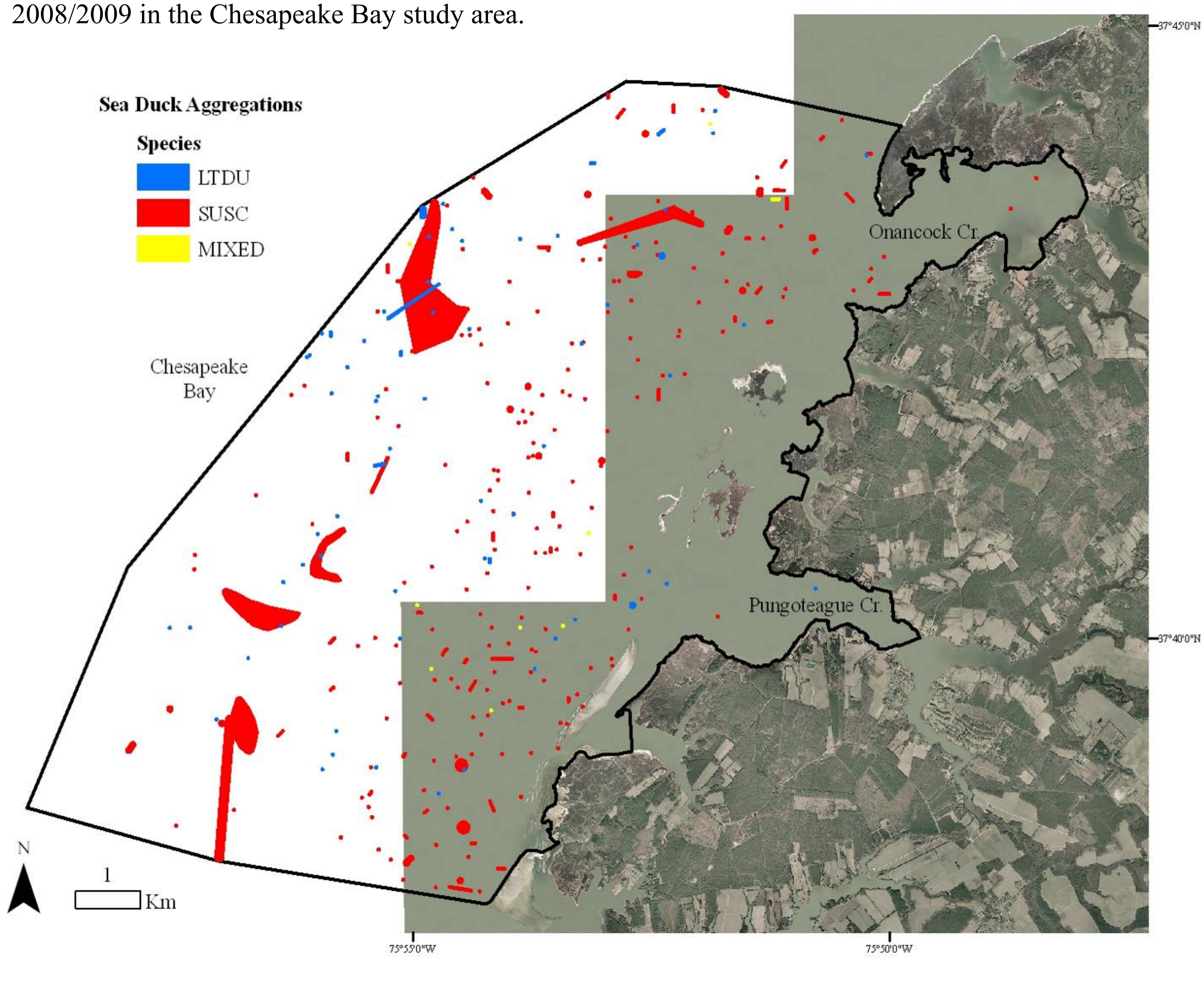


Figure 9. Cumulative GIS plots of sea duck foraging aggregations observed during vessel/aerial surveys in winter 2008/2009 in the Hog Island Bay study area.

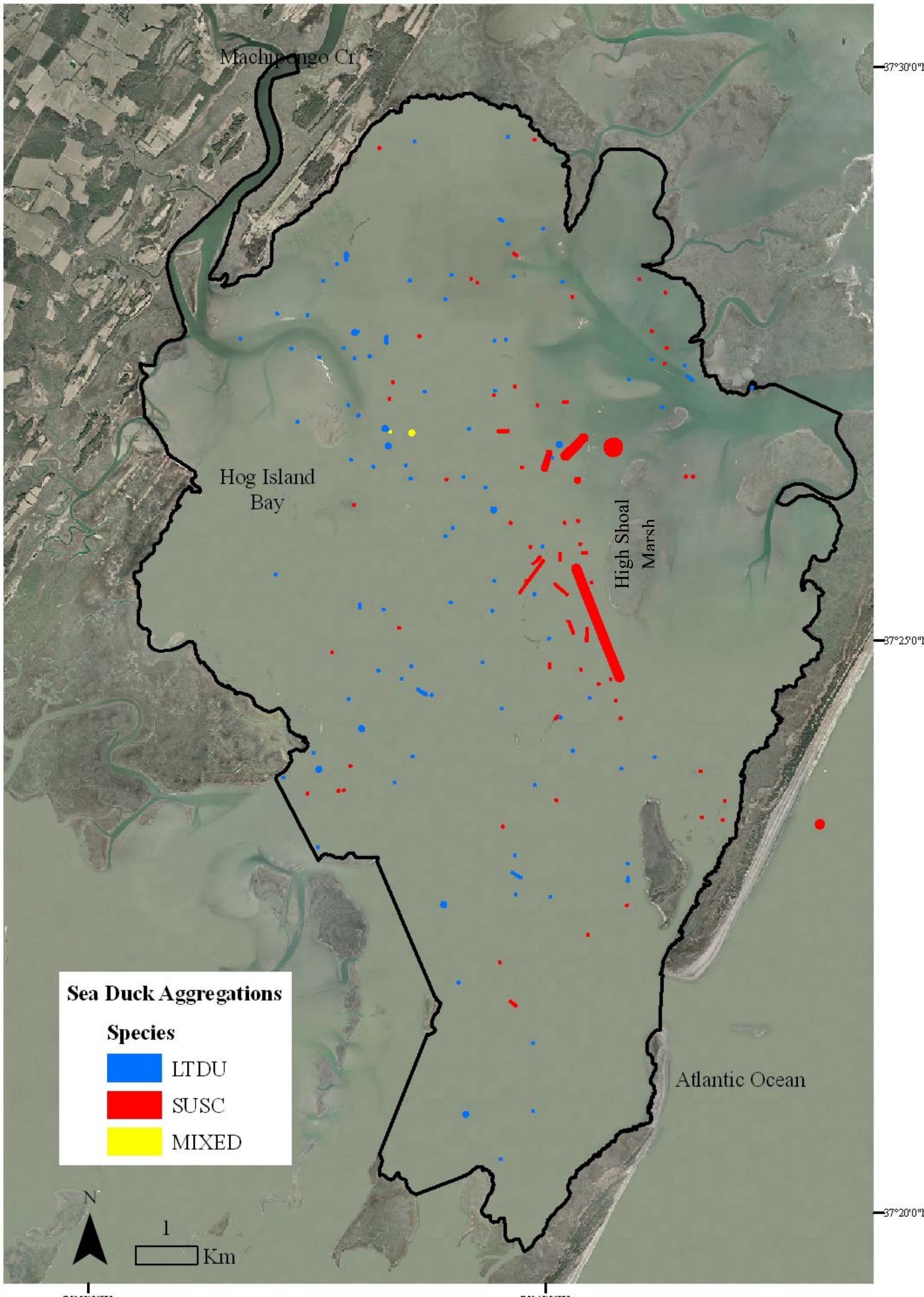


Table 3. Sea duck abundance (mean, SE, min and max) for individual aggregations (n) observed during aerial/vessel surveys for: A) single species aggregations and B) mixed species aggregations.

A) *Single species aggregations (97.8%)*

Study Area	Species	n	Mean	SE	Min	Max
Chesapeake Bay	LTDU	76	6**	1.4	1	77
	SUSC	248	48	9.6	1	1,170
Hog Island Bay	LTDU	96	5**	0.6	1	37
	SUSC	69	31	8.3	1	425
Overall	LTDU	172	6**	0.7	1	77
	SUSC	317	44	7.7	1	1,170

B) *Mixed species aggregations (2.2%)*

Study Area	Dominant Species (%)	n	Mean	SE	Min	Max
Chesapeake Bay	SUSC (64)	9	15	5	3	55
Hog Island Bay	LTDU (74)	2	17	6	11	23

** Means significantly different between species ($p<0.01$)

(Table 3). Accordingly, the mean aerial footprint of aggregations also appeared larger for SUSC than LTDU (Table 4), although no statistical tests were applied to this data because of the way we estimated polygon size (i.e. visual estimates in 50 m increments in each polygon dimension).

Overall, 15% and 18% of LTDU and SUSC aggregations, respectively, were within 730 m of emergent shoreline. More were within this distance in HIB than CB (Table 5) mainly because of the layout of the two study areas (see Fig. 1). Only several small patches of SAV were in the HIB whereas a fairly extensive bed was located in CB. However, <1% of aggregations were within 50 m of these patches and none were overlapping them in CB (Table 5). Conversely, although there were no intertidal oyster reefs in CB, many were scattered throughout HIB (Fig. 10). Within HIB, 1% and 9% of LTDU and SUSC aggregations, respectively, were within 50 m of reefs while 2% and 6% of each species aggregations, respectively, overlapped them (Table 5).

Table 4. Estimated aerial footprints (m^2) of individual sea duck aggregations (n, mean, SE, min and max) observed during aerial/vessel surveys for: A) single species aggregations and B) mixed species aggregations.

A) *Single species aggregations (97.8%)*

Study Area	Species	n	Mean	SE	Min[a]	Max
Chesapeake Bay	LTDU	76	3,386	731	1,963	47,477
	SUSC	248	14,148	5,198	1,963	1,084,069
Hog Island Bay	LTDU	96	2,924	222	1,963	9,590
	SUSC	69	10,650	4,669	1,963	299,027
Overall	LTDU	172	3,116	330	1,963	47,477
	SUSC	317	13,382	4,184	1,963	1,084,069

B) *Mixed species aggregations (2.2%)*

Study Area	Dominant Species (%)	n	Mean	SE	Min[a]	Max
Chesapeake Bay	SUSC (64)	9	2,518	556	1,963	6,968
Hog Island Bay	LTDU (74)	2	4,905	2,943	1,963	7,848

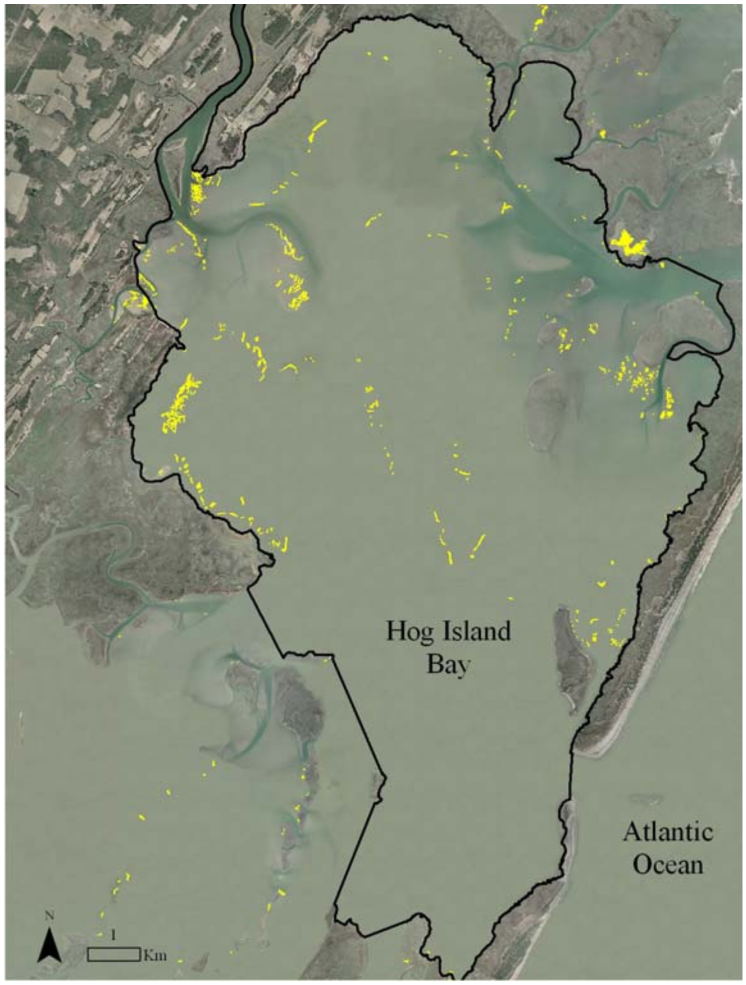
[a] Minimum aerial footprint was 1,963 m^2 which consisted of a 50m diameter circular polygon centered on the location of one or more ducks (see Methodology for details)

Table 5. Distance categories from the edge of single species sea duck aggregations to emergent shoreline[a], submerged aquatic vegetation[b] and known intertidal oyster reefs[c].

		Emergent Shoreline		Submerged Aquatic Vegetation			Oyster Reefs[c]		
Study Area	Species	# Within 730m (%)	Duck Abun. Range	# Within 1-50m (%)	# Overlapping (%)	Duck Abun. Range	# Within 1-50m (%)	# Overlapping (%)	Duck Abun. Range
Chesapeake Bay	LTDU	6 (8)	1-3	1 (1)	0	1	0	0	na
	SUSC	33 (13)	1-510	2 (1)	0	3-22	0	0	na
Hog Island Bay	LTDU	20 (21)	1-12	0	0	na	1 (1)	2 (2)	1-9
	SUSC	25 (36)	1-425	0	0	na	6 (9)	4 (6)	3-334
Overall	LTDU	26 (15)	1-12	1 (1)	0	1	1 (1)	2 (1)	1-9
	SUSC	58 (18)	1-510	2 (1)	0	3-22	6 (2)	4 (1)	3-334

[a] Marsh or high profile sand bars exposed on normal high tides
[b] SAV beds were estimated from 2007 aerial overflights (see Methodology for a discussion of why these were used)
[c] Only oyster reefs that we have previously mapped were accounted for in this metric (see Methodology for further discussion)

Figure 10. Plot of intertidal oyster reefs (yellow) mapped in the Hog Island bay study area (delineated with black line) during a previous project.



Habitat Characteristics

Bathymetry/Water Quality - Water depth (corrected to MHHW) for sea duck aggregations was significantly deeper in CB relative to HIB (Table 6). Overall, there was no significant difference in mean foraging depths between LTDU and SUSC (Table 7). LTDU did tend to be found in slightly deeper water than SUSC on average in CB, although this difference was not significant (Figure 11 and Table 8). Both surface and bottom (where appropriate) water quality measurements are reported for each benthic sampling location in Appendix III.

Table 6. Water depth[a] (m) at sea duck aggregation locations that were randomly selected for benthic grab sampling within the two study areas. *Species* refers to the number of sampling locations with the noted duck species (see Methods section for details).

Study Area	n	Mean	SE	Min	Max	Species
Chesapeake Bay	30	4.9[**]	0.5	1.3	11.2	LTDU=7, SUSC=23
Hog Island Bay	32	2.3	0.2	1.0	8.7	LTDU=16, SUSC=16

[a] Corrected to Mean Higher High Water (MHHW)
[**] Means significantly different ($p<0.01$, GLM)

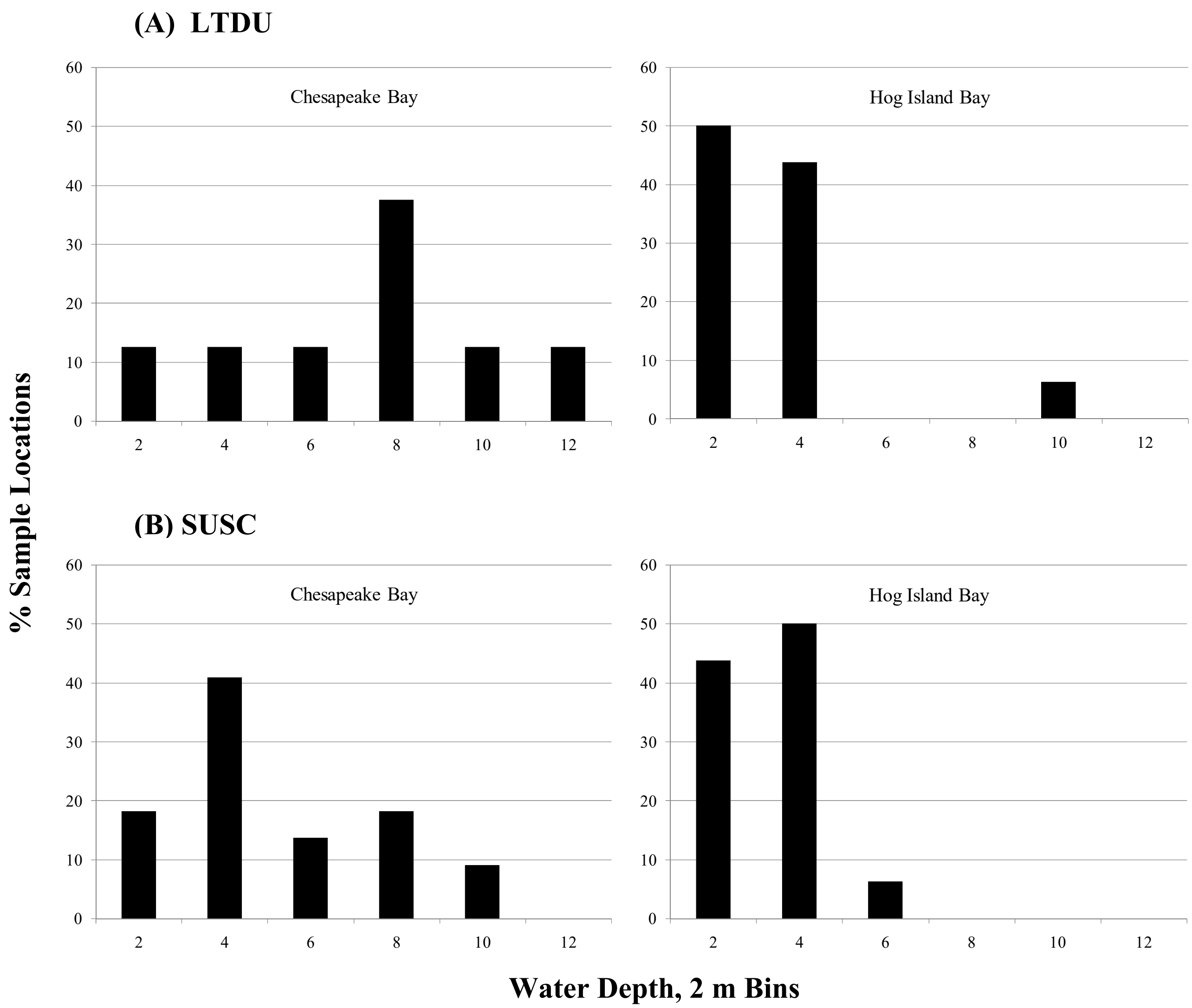
Table 7. Water depth[a] (m) at sea duck aggregation locations that were randomly selected for benthic grab sampling (data for both study areas pooled).

Species	n	Mean	SE	Min	Max
LTDU	24	3.7[NS]	0.6	1.3	11.2
SUSC	38	3.5	0.4	1.0	9.1

[a] Corrected to Mean Higher High Water (MHHW)
[NS] Means not significantly different ($p=0.06$, GLM)

While several water quality parameters were measured during benthic sampling, the value in these data lay in a general characterization of the two study areas rather than quantifying conditions of actively foraging ducks. This sampling was typically done days or weeks after aggregations were mapped. Water quality data more pertinent to actively feeding birds was measured when individual birds were collected and will be discussed below.

Figure 11. Distribution (%) of water depths (m) for sea duck foraging locations where benthic samples were collected in both study areas for: A) LTDU and B) SUSC. Depth is divided into 2 m bins.



Water quality ranges are reported here to compare the two study areas. Water temperature tended to be colder and salinity lower in CB relative to HIB (Table 9). Turbidity and dissolved oxygen tended to be in similar ranges, although bottom turbidity in HIB appeared to be slightly higher (Table 9).

Table 8. Water depth[a] (m) at sea duck aggregation locations that were randomly selected for benthic grab sampling by duck species for each study area.

Study Area	Species	n	Mean	SE	Min	Max
Chesapeake Bay	LTDU	8	6.4[NS]	1.0	1.7	11.2
	SUSC	22	4.4	0.5	1.3	9.1
Hog Island Bay	LTDU	16	2.3[NS]	0.4	1.3	8.7
	SUSC	16	2.2	0.2	1.0	5.1

[a] Corrected to Mean Higher High Water (MHHW)
[NS] Means not significantly different between species (p=0.06 & p=0.80, for Chesapeake and Hog Island bays, respectively; GLM)

Table 9. Range of several water quality parameters measured at benthic sampling locations within 1m of the surface (n~62) and, if depth was >3m, within 1m of the bottom (n~22) in both study areas during winter 2008/2009.

Study Area	Depth	Water Temp. (ºC)	Salinity (PSU)	Turbidity (NTU)	DO ($mg \cdot L^{-1}$)
Chesapeake Bay	Surface	2-8	17-21	1-13	7-10
	Bottom	2-8	18-22	0-12	7-9
Hog Island Bay	Surface	8-16	30-32	2-11	6-10
	Bottom	10	30-32	9-15	6-9

Sediment - Three sediment parameters were characterized from benthic grabs: per cent organic matter (% OM), presence of larger shell/gravel particles and sediment grain size distribution. Overall, in the locations sea ducks foraged, there were significant differences in % OM between study areas and between duck species ($p<0.01$). Mean % OM was significantly higher in HIB (2.0%, SE=0.19) than CB (0.4%, SE=0.04) and in areas within HIB where LTDU were foraging (1.9%, SE=0.3) than where SUSC were foraging (0.9%, SE=0.1). This interspecific pattern was inconsistent within the two study areas with % OM significantly higher in LTDU foraging areas than those of SUSC in HIB, but not in CB (Table 10).

Table 10. Per cent organic matter (by weight) in sediment collected at sea duck foraging locations for both duck species within each study area.

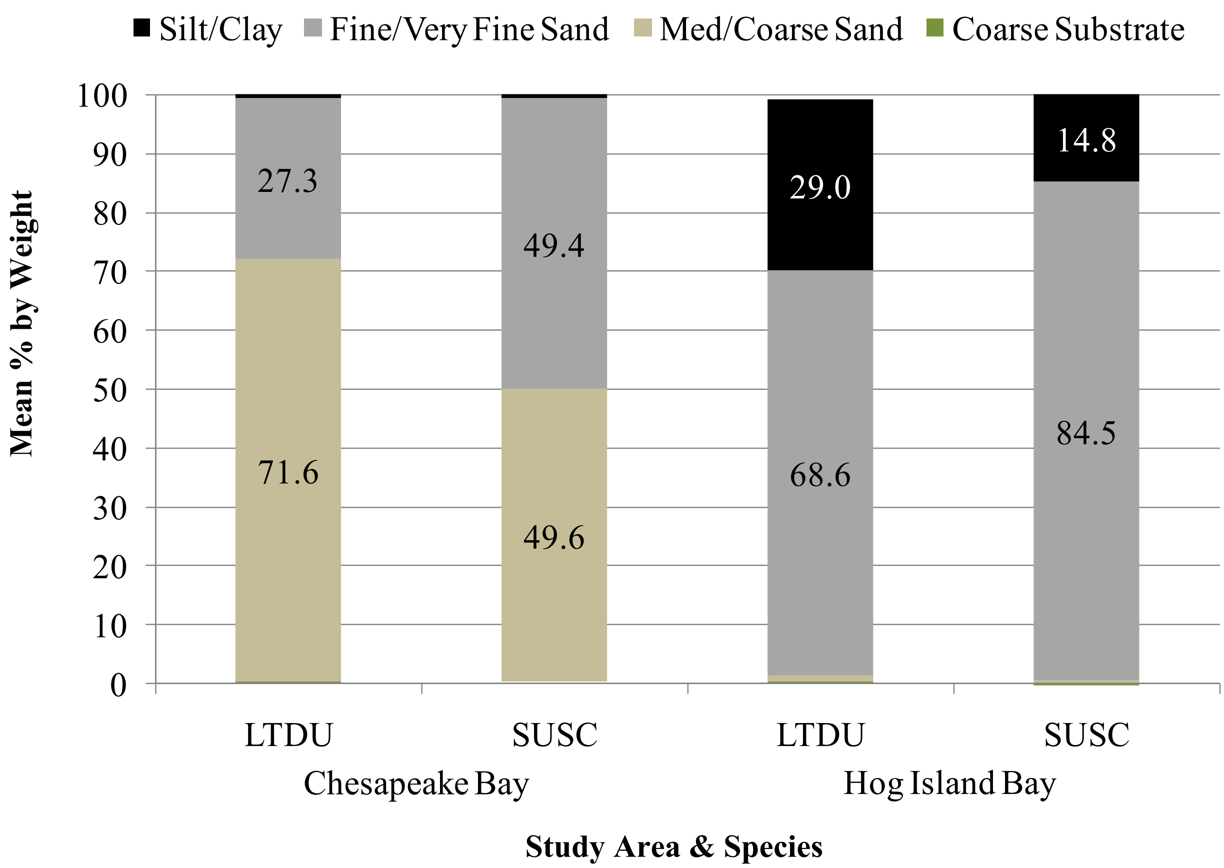
Study Area	Species	n	Mean	SE
Chesapeake Bay	LTDU	8	0.5^{NS}	0.07
	SUSC	21	0.4	0.04
Hog Island Bay	LTDU	16	2.7^{**}	0.3
	SUSC	16	1.4	0.1

^{NS} Means between species not significantly different ($p=0.69$, GLM)
** Means between species significantly different ($p<0.01$, GLM)

More sea duck foraging areas in HIB tended to have the presence of large shell particles than those in CB (44% and 21%, respectively). However, 7% of these areas in CB had gravel present compared to none in HIB. With the limited number of areas exhibiting these qualities, no difference could be discerned between species-specific foraging areas. As noted earlier, in all instances where these large particles were observed, coarse grain fractions in the sediment analysis were also present.

Sediments were fractionated into four size categories and presented as mean percent by weight. CB foraging areas were dominated by *Medium/Coarse Sand* (56%) and *Fine/Very Fine Sand* (43%), whereas HIB tended towards higher *Fine/Very Fine Sand* (77%) and *Silt/Clay* (22%) fractions. Minor differences between species-specific foraging areas were noted within each study area (Figure 12). Sediment metrics for each benthic sampling location are reported in Appendix IV.

Figure 12. Mean % grain size for sediment collected from sea duck foraging areas in both study areas for both duck species (see Methods section for size class definitions).



Benthic Organisms - Organisms in 22 broad taxa were identified from sea duck foraging areas (Table 11). An inclusive list of the 146 species/taxa is reported in Appendix V. Three metrics were used to describe these within study areas and between sea duck species areas: % occurrence, abundance ($\#\cdot m^{-2}$) and dry tissue biomass ($g\cdot m^{-2}$). Although we summarize all three, we report statistical analyses for dry tissue biomass only, since we feel that this is the most important metric. Additionally, sizes of brachiostomes and dominant bivalves and gastropods are reported.

Mean total biomass of benthic organisms was higher in HIB than CB (6.8 and 2.7 $g\cdot m^{-2}$, respectively; $p<0.01$) and higher in LTDU foraging areas compared to those of SUSC (7.6 and 3.2 $g\cdot m^{-2}$, respectively; $p<0.01$). However, this overall interspecific difference was not consistent across study areas. LTDU foraging areas had significantly more total biomass than those of SUSC in HIB, but not in CB (Table 12).

Amphipods, bivalves, gastropods and polychaetes were identified in all foraging areas (Table 13) and were the most abundant organisms by far (Table 14 and Fig. 13). Brachiostomes, also called Amphioxus or sand lancets, were only found in foraging areas in CB while hemichordates, one chiton (*Neoloricata*) and one horseshoe crab (*Xiphosura*) were only found in HIB foraging areas.

Dry tissue biomass (henceforth referred to as biomass) of broad taxa is more illuminating and is where we focused our attention for further analysis. Again amphipods, bivalves, gastropods and polychaetes were generally the dominant broad taxa in terms of biomass, although brachyurans, echinoderms and nemerteans were also important in HIB foraging areas (Table 15 and Fig. 14). The higher relative biomass of echinoderms was driven by the presence of a few sea cucumbers in HIB. Even a few small sea cucumbers can contribute substantial biomass to a benthic community. It is also important to note the high biomass of nemerteans in LTDU foraging areas in HIB. Again, even a few of these organisms can add substantial biomass. The significance of these differences will be discussed in light of diet results in the discussion section of this report.

Table 11. General description of broad taxonomic groups collected in benthic samples, including the level of the broad grouping in parentheses.

Broad Taxa	General Taxa Descriptions
Actiniaria	Sea anemones (*Order*)
Algae	Macro algae commonly called seaweeds (*n/a*)
Amphioxiformes	Amphioxus, commonly called sand lancets (*Order*)
Amphipoda	Small crustaceans (*Order*)
Anomura	Decapod crustaceans, eg hermit crabs (*Infraorder*)
Ascidiacea	Sea squirts (*Class*)
Bivalvia	Bivalve mollusks (*Class*)
Brachyura	True crabs (*Infraorder*)
Caridea	Shrimps (*Infraorder*)
Cumacea	Small crustaceans sometimes called hooded shrimp (*Order*)
Echinodermata	Brittle stars and sea cucumbers (*Phylum*)
Gastropoda	Snails (*Class*)
Hemichordata	Hemichordates (*Phylum*)
Hydrozoa	Hydroids (*Class*)
Isopoda	Small crustaceans (*Order*)
Nemertea	Ribbon worms (*Phylum*)
Neoloricata	Chitons (*Order*)
Polychaeta	Segmented worms (*Class*)
SAV	Vascular submerged aquatic vegetation (*n/a*)
Teleostei	Bony fishes (*Infraclass*)
Thalassinidea	Burrowing shrimp (*Infraorder*)
Xiphosura	Horseshoe crabs (*Order*)

Table 12. Total dry tissue biomass ($g \cdot m^{-2}$) of macro flora and fauna in sediment collected at sea duck foraging locations by species for each study area.

Study Area	Species	n	Mean	SE
Chesapeake Bay	LTDU	8	3.1^{NS}	0.7
	SUSC	21	2.6	0.4
Hog Island Bay	LTDU	16	9.5^{**}	1.2
	SUSC	16	4.1	0.4

^{NS} Means between species not significantly different (p=0.58, GLM)
** Means between species significantly different (p<0.01, GLM)

Statistical analyses were performed on the biomass ($g \cdot m^{-2}$) of the four main ubiquitous taxa: amphipods, bivalves, gastropods and polychaetes. Although other taxa occurred in samples, their biomass was either insignificant (e.g. cumaceans) or absent from one or more study area/duck groupings (we will address this information qualitatively in the discussion). Mean amphipod and gastropod biomass did not significantly differ between study areas (p=0.32 and 0.69, respectively) nor between duck species foraging areas (p=0.57 and 0.35, respectively). However, significantly more bivalve biomass was observed in HIB relative to CB (1.3 and 0.3 $g \cdot m^{-2}$, respectively; p<0.01), although there were no differences between LTDU and SUSC (p=0.16). Conversely, polychaete biomass did not differ between study areas (p=0.93), although significantly higher biomass was measured within LTDU foraging areas compared to those of SUSC (4.0 and 1.6 $g \cdot m^{-2}$, respectively; p<0.01). These results are summarized in Table 16.

Table 13. Frequency of occurrence (% of foraging locations) for broad taxonomic groups collected in benthic samples at sea duck foraging locations in both study areas. Number of stations that were sampled for each grouping follows duck abbreviations in parentheses.

	Chesapeake Bay		***Hog Island Bay***	
Broad Taxa	**LTDU (7)**	**SUSC (23)**	**LTDU (16)**	**SUSC (16)**
Actiniaria	14	0	31	19
Algae	0	9	63	63
Amphioxiformes	57	30	0	0
Amphipoda	100	100	100	100
Anomura	0	22	31	38
Ascidiacea	29	9	0	6
Bivalvia	100	100	100	100
Brachyura	43	39	94	88
Caridea	0	9	50	25
Cumacea	43	48	56	50
Echinodermata	0	22	56	50
Gastropoda	100	100	100	100
Hemichordata	0	0	13	0
Hydrozoa	0	9	50	88
Isopoda	29	22	88	50
Nemertea	29	57	56	50
Neoloricata	0	0	6	0
Polychaeta	100	100	100	100
SAV	0	4	6	0
Teleostei	0	4	6	0
Thalassinidea	14	13	0	25
Xiphosura	0	0	0	6

Table 14. Mean (± SE) density (#/m^2) for broad taxonomic groups collected in benthic samples at sea duck foraging locations in both study areas (rare taxa are not included). Number of stations that were sampled for each grouping follows duck abbreviations in parentheses.

	Chesapeake Bay		***Hog Island Bay***	
Broad Taxa	**LTDU (7)**	**SUSC (23)**	**LTDU (16)**	**SUSC (16)**
Actiniaria	1 (1)	0 (0)	4 (2)	3 (2)
Algae	0 (0)	0 (0)	5 (1)	4 (1)
Amphioxiformes	7 (3)	11 (5)	0 (0)	0 (0)
Amphipoda	135 (38)	100 (14)	189 (51)	353 (60)
Anomura	0 (0)	1 (0)	3 (2)	2 (1)
Ascidiacea	7 (6)	3 (2)	0 (0)	0 (0)
Bivalvia	207 (143)	86 (27)	1,788 (580)	103 (59)
Brachyura	5 (3)	3 (1)	12 (2)	10 (3)
Caridea	0 (0)	0 (0)	7 (2)	1 (1)
Cumacea	7 (6)	8 (4)	6 (2)	3 (1)
Echinodermata	0 (0)	1 (0)	5 (2)	3 (1)
Gastropoda	218 (64)	166 (29)	133 (22)	97 (15)
Hydrozoa	0 (0)	0 (0)	4 (1)	5 (1)
Isopoda	3 (2)	2 (1)	20 (5)	9 (4)
Nemertea	2 (1)	4 (1)	6 (2)	2 (0)
Polychaeta	549 (234)	222 (32)	468 (52)	158 (27)
Thalassinidea	1 (1)	0 (0)	0 (0)	1 (1)

Figure 13. Per cent density (pooled data as measured by $\#\cdot m^{-2}$) of dominant broad taxa found in benthic grabs in sea duck foraging areas within both study areas for: A) LTDU and B) SUSC.

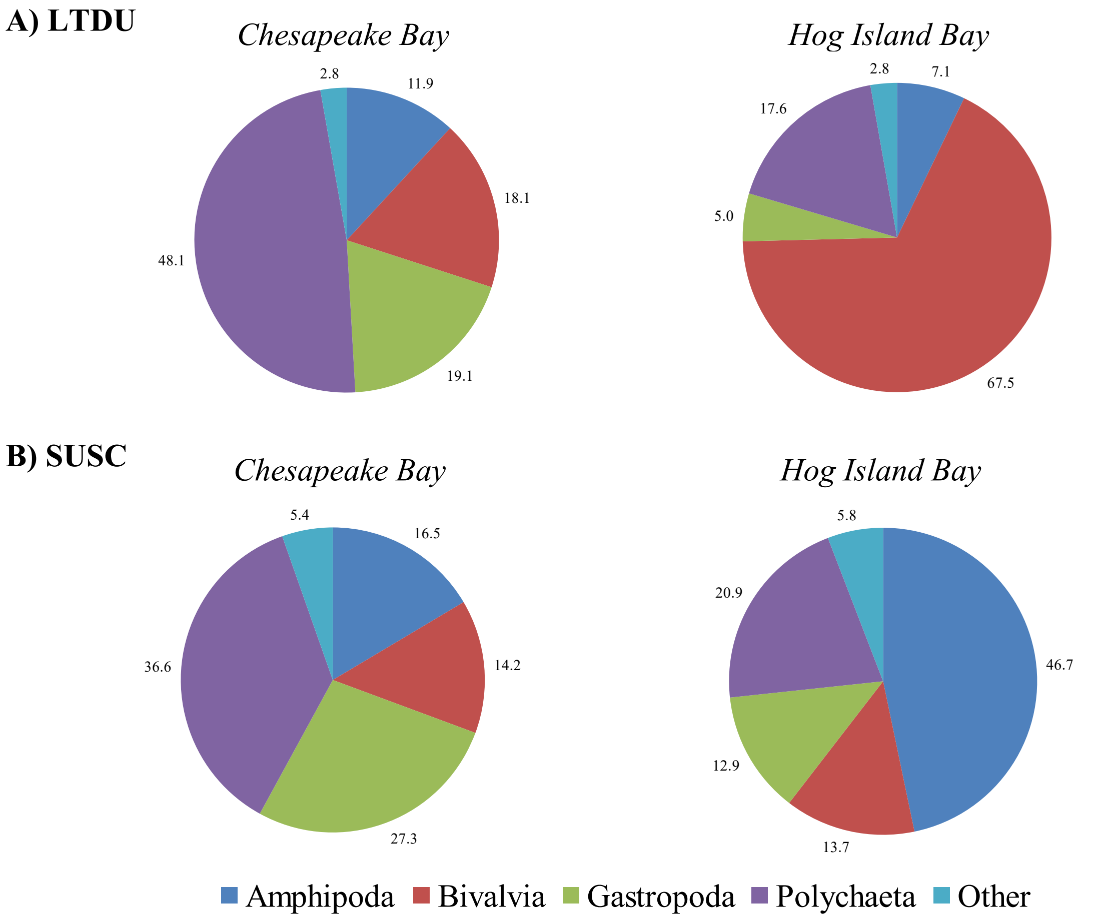


Table 15. Mean (± SE) dry tissue biomass (g/m^2) for broad taxonomic groups collected in benthic samples at sea duck foraging locations in both study areas (rare taxa are not included). Number of stations that were sampled for each grouping follows duck abbreviations in parentheses.

	Chesapeake Bay		*Hog Island Bay*	
Broad Taxa	**LTDU (7)**	**SUSC (23)**	**LTDU (16)**	**SUSC (16)**
Actiniaria	0.007 (0.007)	0.000 (0.000)	0.222 (0.134)	0.016 (0.010)
Algae	0.000 (0.000)	0.000 (0.000)	0.140 (0.072)	0.279 (0.146)
Amphioxiformes	0.061 (0.024)	0.064 (0.031)	0.000 (0.000)	0.000 (0.000)
Amphipoda	0.173 (0.033)	0.121 (0.018)	0.252 (0.132)	0.209 (0.060)
Anomura	0.000 (0.000)	0.013 (0.010)	0.016 (0.012)	0.046 (0.022)
Ascidiacea	0.002 (0.001)	0.074 (0.063)	0.000 (0.000)	0.003 (0.003)
Bivalvia	0.250 (0.099)	0.281 (0.091)	1.868 (0.600)	0.771 (0.216)
Brachyura	0.006 (0.003)	0.017 (0.009)	0.299 (0.161)	0.574 (0.377)
Caridea	0.000 (0.000)	0.000 (0.000)	0.093 (0.062)	0.006 (0.005)
Cumacea	0.003 (0.002)	0.002 (0.001)	0.042 (0.017)	0.009 (0.007)
Echinodermata	0.000 (0.000)	0.002 (0.001)	0.341 (0.186)	0.191 (0.087)
Gastropoda	0.054 (0.016)	0.151 (0.082)	0.099 (0.035)	0.186 (0.120)
Hydrozoa	0.000 (0.000)	0.000 (0.000)	0.009 (0.007)	0.047 (0.017)
Isopoda	0.007 (0.007)	0.003 (0.002)	0.097 (0.052)	0.012 (0.005)
Nemertea	0.095 (0.066)	0.107 (0.040)	1.278 (0.535)	0.281 (0.191)
Polychaeta	2.483 (0.579)	1.699 (0.262)	4.696 (0.706)	1.446 (0.267)
Thalassinidea	0.004 (0.004)	0.025 (0.021)	0.000 (0.000)	0.047 (0.033)

Dominant genera/families within the broad taxa of amphipods, bivalves, gastropods and polychaetes are listed in Table 17. Generally, similar dominant genera were observed in foraging areas of both duck species within each study area. Differences did occur between the two study areas, most notably haustorid amphipods and terebellid polychaetes predominantly in CB and gammarid amphipods and nereid and chaetopterid polychaetes predominantly in HIB.

In addition to addressing dominant taxa, a summary of unique ones between study areas and duck species is also important. Three taxa were mainly found in HIB foraging areas of both duck species: algae, hydrozoans and carideans (mainly *Crangon septemspinosa*). Additionally, hemichordates were only found in SUSC foraging areas within HIB (although not very prevalent). Branchiostomes (Amphioxiformes) were only found in the foraging areas of both duck species in CB. Ascidians (*Molgula manhattensis*) were rare in foraging areas except those of LTDU in CB.

Figure 14. Per cent dry tissue biomass (as measured by g·m^{-2}) of dominant broad taxa found in benthic grabs in sea duck foraging areas within both study areas for: A) LTDU and B) SUSC.

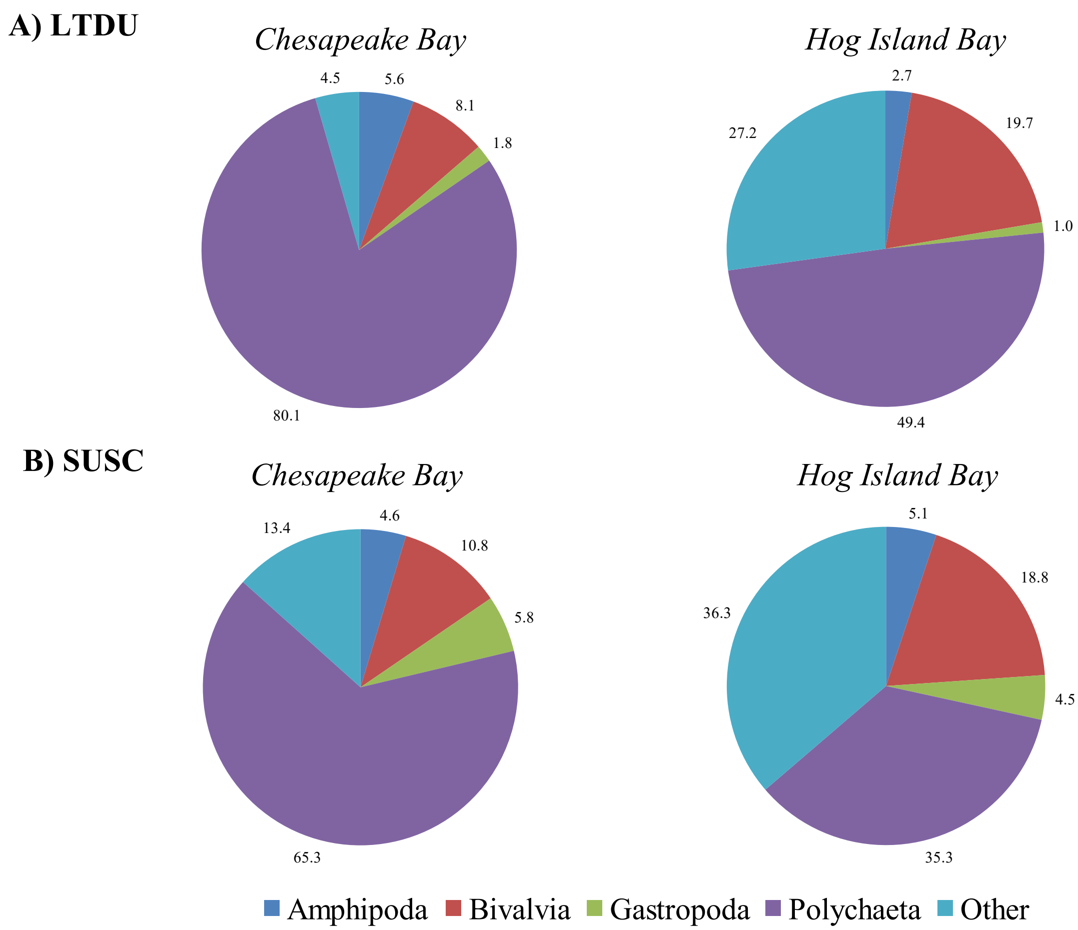


Table 16. Results of Kruskal-Wallis tests[a] for the dry tissue biomass density ($g \cdot m^{-2}$) of the four dominant taxa found in benthic samples from foraging areas of both duck species in both study areas (Chesapeake Bay=CB and Hog Island Bay=HIB).

Broad Taxa	Study Area	Duck Species
Amphipoda	HIB=CB	LTDU=SUSC
Bivalvia	HIB>>CB	LTDU=SUSC
Gastropoda	HIB=CB	SUSC=LTDU
Polychaeta	HIB=CB	LTDU>>SUSC

[a] Relationships are noted as "=" (no significant difference between means) or ">>" (means significantly different, p<0.01) and listed in descending order.

We also measured the total length of amphioxus, bivalves and gastropods collected in benthic samples. Sizes are summarized for genera in these taxa in Table 18 by study area. Most of the gastropods collected were very small (<13 mm). Most bivalves were small, as well (< 20 mm), with the exception of a few *Anadara* and *Ensis* (Table 18). Amphioxus was only collected in CB and ranged from 15-46 mm in size.

Two community metrics were used to compare foraging areas at the broad taxonomic levels described above: richness and the Shannon Index. Overall, mean taxa richness was higher in HIB than CB (9.8 and 6.9, respectively; $p<0.01$), but did not differ between LTDU and SUSC foraging areas (9.0 and 8.0, respectively; $p=0.79$). Community diversity, as measured by the mean Shannon Index, was similar between HIB and CB (1.18 and 1.25, respectively; $p=0.50$), but was significantly higher in SUSC foraging areas relative to those of LTDU (1.29 and 1.08, respectively; $p<0.05$). There was not a significant interaction between the effects of study area and duck species for taxa richness or Shannon Index (p=0.53 and p=0.10, respectively).

Table 17. Dominant genera (italics) or families for the dominant broad taxonomic groups collected in benthic samples at sea duck foraging locations in both study areas. Taxa in bold were much more dominant that others within individual groupings.

	Chesapeake Bay		***Hog Island Bay***	
Broad Taxa	**LTDU**	**SUSC**	**LTDU**	**SUSC**
Amphipoda	Ampeliscidae	**Ampeliscidae**	**Ampeliscidae**	**Ampeliscidae**
	Haustoridae	Haustoridae	Gammaridae	Gammaridae
	Liljeborgiidae	Liljeborgiidae	Liljeborgiidae	Melitidae
Bivalvia	***Gemma***	*Macoma*	***Ensis***	***Ensis***
	Macoma	*Dosinia*	*Macoma*	*Macoma*
	Dosinia	*Gemma*	*Mercenaria*	*Mercenaria*
	Anadara	*Mulinia*	*Mulinia*	*Mya*
Gastropoda	***Acteocina***	***Acteocina***	*Acteocina*	*Acteocina*
	Turbonilla	*Odostomia*	*Turbonilla*	*Turbonilla*
Polychaeta	**Orbiniidae**	Maldanidae	Nereidae	Maldanidae
	Maldanidae	Orbiniidae	Orbiniidae	Chaetopteridae
	Terebellidae	Terebellidae	Maldanidae	Nereidae

Table 18. Total length (mm) of the longest dimension of Amphioxus and the dominant genera of bivalves and gastropods collected in benthic samples at sea duck foraging locations from both study areas (data pooled for both duck species).

		Chesapeake Bay					***Hog Island Bay***				
Broad Taxa	**Genus**	**n**	**Mean**	**SE**	**Min**	**Max**	**n**	**Mean**	**SE**	**Min**	**Max**
Amphioxiformes	*Branchiostoma*	77	32.1	0.7	15	46			*none collected*		
Bivalvia	*Anadara*	18	4.1	1.2	1	23	10	9.5	4.4	2	48
	Dosinia	254	4.4	0.1	1	7			*none collected*		
	Ensis			*none collected*			1,880	8.3	0.1	1	70
	Gemma	215	2.2	0.1	1	4	1	2.0	na	na	na
	Macoma	340	3.6	0.1	1	14	278	6.8	0.3	1	20
	Mercenaria	12	7.0	1.4	2	19	74	3.6	0.3	1	18
	Mulinia	24	9.6	0.8	3	15	34	3.6	0.3	1	8
	Mya	2	5.0	0.0	5	5	43	2.8	0.3	1	15
Gastropoda	*Acteocina*	1,634	2.5	0.01	1	5	620	2.6	0.02	1	4
	Astyris	3	3.3	0.7	2	4	110	4.2	0.2	2	13
	Odostomia	164	3.0	0.04	2	4	3	4.0	1.5	2	7
	Turbonilla	103	4.7	0.1	2	7	407	4.7	0.1	2	9

Table 19. Number of ducks collected by species, sex[a] and age[a] for each study area and in total for this project during winter 2008/2009.

Study Area	Species	Total	Female	Male	After Hatch Year	Hatch Year
Chesapeake Bay	LTDU	30	14	16	23	7
	SUSC	31	10	21	27	4
Hog Island Bay	LTDU	30	6	24	23	7
	SUSC	13	4	9	13	0
Total	LTDU	60	20	40	46	14
	SUSC	44	14	30	40	4

[a] Sex and age determined initially by plumage characteristics and supplemented by gonad examination (*type* for sex and *development* for age).

Diet

Sixty LTDU and 44 SUSC were haphazardly collected for esophagus and gizzard contents to evaluate diet. Both sexes and two age classes were represented for both species collected in CB and for LTDU collected in HIB (Table 19). However, only After-Hatch Year (AHY) SUSC were collected in HIB. Collections were spread throughout much of both study areas (Fig. 15), mainly dictated by the location of actively foraging birds on days suitable for collection. Two SUSC collected in January 2009 from the CB study area were banded in Labrador, Canada; one in 2004 and one in 2007 (Fig. 16). Copies of return information are in Appendix VI.

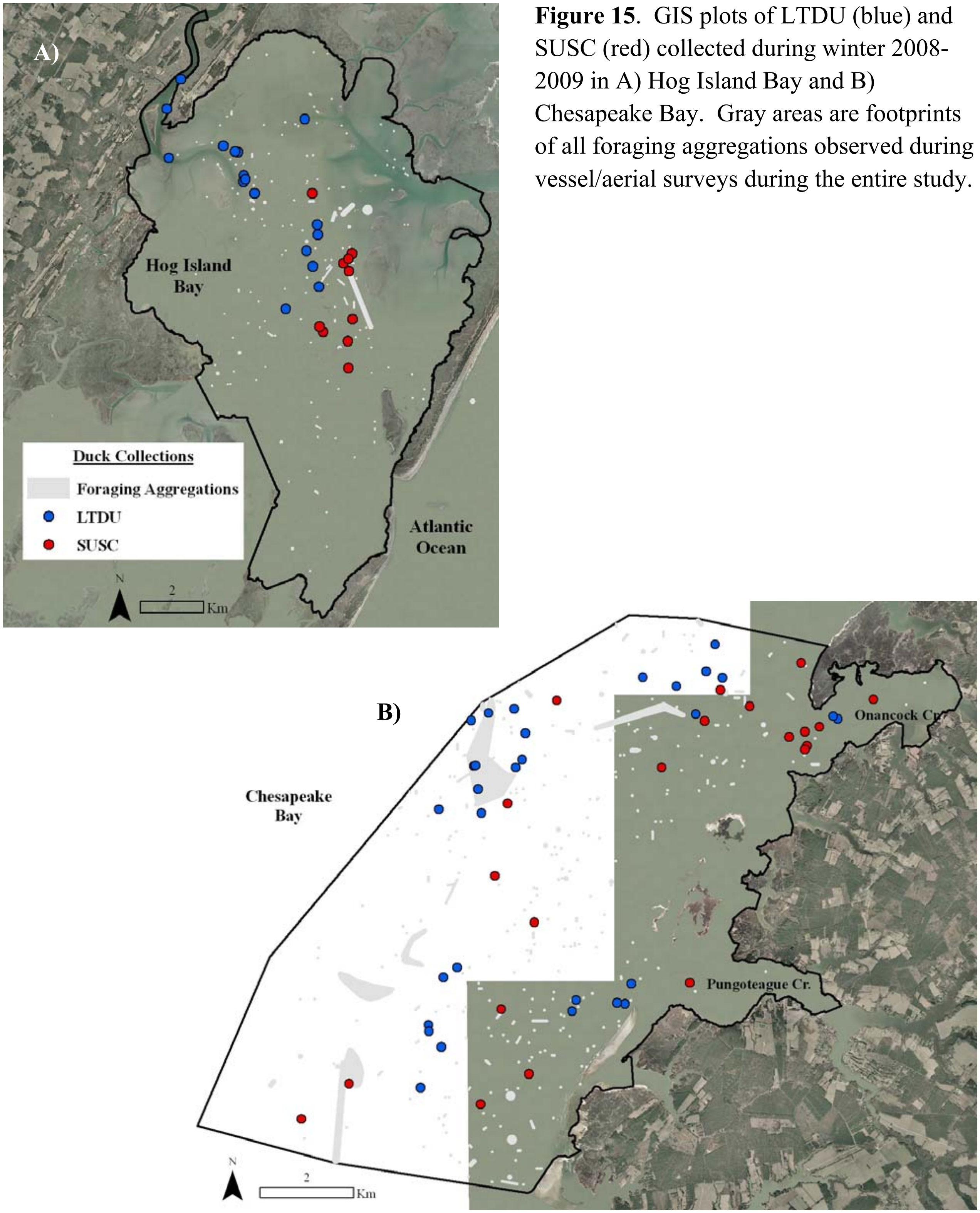
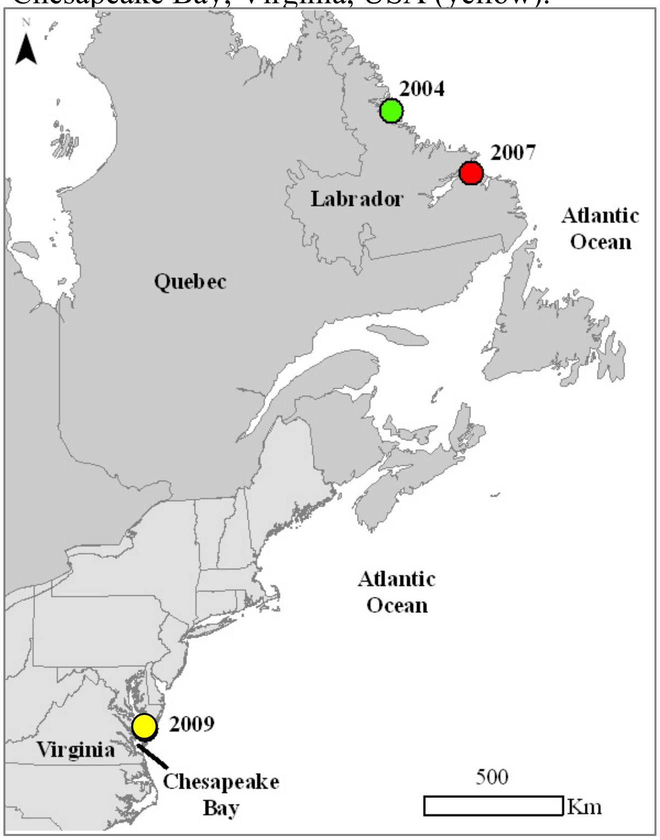


Figure 15. GIS plots of LTDU (blue) and SUSC (red) collected during winter 2008-2009 in A) Hog Island Bay and B) Chesapeake Bay. Gray areas are footprints of all foraging aggregations observed during vessel/aerial surveys during the entire study.

Figure 16. Locations of two SUSC banded during 2004 (green) and 2007 (red) in Labrador, Canada and the subsequent location of both recoveries in 2009 in Chesapeake Bay, Virginia, USA (yellow).



Anatomical Measurements – The anatomical metrics described in the Methods above were collected for all 104 ducks. Measurements for all parameters were lower for LTDU than SUSC (Table 20; $p<0.01$) as was expected. Coordinates for the exact location of each collected duck and its respective physical measurement are reported in Appendix VII.

Physical Habitat Descriptions – Water depth and the suite of water quality parameters measured at each collection site are reported in Appendix VIII. Birds collected in CB were foraging in significantly deeper water than those in HIB (Table 21). Overall, LTDU were foraging in deeper water than SUSC (Table 22) and the same inter-specific pattern was observed in both study areas (Table 23).

Table 20. Anatomical metrics (mean, SE, min and max) sea ducks collected for diet analysis (see methods for further descriptions of metrics).

Metric		LTDU *n=60*	SUSC *n=44*
Wet Mass	Mean	755**	1,036
(g)	SE	12	11
	Min	560	880
	Max	900	1,220
Wing Length	Mean	219**	236
(mm)	SE	1	2
	Min	193	180
	Max	235	250
Tarsus Length	Mean	34.4**	42.6
(mm)	SE	0.2	0.3
	Min	32.2	35.6
	Max	38.7	46.4
Culmen1	Mean	26.3**	36.9
(mm)	SE	0.2	0.3
	Min	23.9	32.2
	Max	28.9	42.4
Culmen2	Mean	17.7**	24.5
(mm)	SE	0.1	0.3
	Min	15.1	20.7
	Max	21.3	27.4
Bill Height	Mean	16.4**	22.6
(mm)	SE	0.2	0.2
	Min	14	19.7
	Max	20.7	25.7
Bill Width	Mean	18.5**	24.3
(mm)	SE	0.1	0.3
	Min	15.7	19.8
	Max	20.6	28.2

** Means significantly different between LTDU and SUSC (P<0.01, multiple T-tests)

Table 21. Water depth[a] (m) at sea duck collection locations (data for both species pooled).

Study Area	n	Mean	SE	Min	Max
Chesapeake Bay	61	5.1**	0.3	1.4	9.4
Hog Island Bay	43	3.7	0.4	1.5	8.2

[a] Corrected to Mean Higher High Water (MHHW)
** Means significantly different ($p<0.01$, GLM)

Table 22. Water depth[a] (m) at sea duck collection locations (data for both study areas pooled).

Species	n	Mean	SE	Min	Max
LTDU	60	5.2**	0.3	1.5	9.4
SUSC	44	3.6	0.3	1.4	9.3

[a] Corrected to Mean Higher High Water (MHHW)
** Means significantly different ($p<0.01$, GLM)

Table 23. Water depth[a] (m) at sea duck collection locations by species for each study area.

Study Area	Species	n	Mean	SE	Min	Max
Chesapeake Bay	LTDU	30	6.0**	0.3	2.3	9.4
	SUSC	31	4.1	0.4	1.4	9.3
Hog Island Bay	LTDU	30	4.3**	0.5	1.5	8.2
	SUSC	13	2.3	0.1	1.8	2.8

[a] Corrected to Mean Higher High Water (MHHW)
** Means significantly different between duck species ($p<0.01$, GLM)

The range of water quality parameters reported here is likely more relevant than those reported above for benthic sampling, since they were measured in real time when ducks were actively foraging. However, since both species were typically foraging near each other (within several hundred m of open water) and both study areas appeared to have well mixed water columns, our main interest was again using these data to help describe and differentiate the two study areas. HIB had a broader range of surface temperature and a consistently higher salinity than CB (Table 24). Other metrics were not noticeably different.

Table 24. Range of several water quality parameters measured at sea duck collection sites within 1m of the surface (n~100) and, if depth was >3m, within 1m of the bottom (n~46): water temperature, salinity, turbidity and dissolved oxygen (DO).

Study Area	Depth	Water Temp. (°C)	Salinity (PSU)	Turbidity (NTU)	DO ($mg \cdot L^{-1}$)
Chesapeake Bay	Surface	4-8	18-21	1-10	7-9
	Bottom	4-8	19-21	2-15	7-9
Hog Island Bay	Surface	2-14	29-32	3-8	6-10
	Bottom	2-9	29-31	5-9	6-9

Diet – Of the 60 LTDU collected, 55 (92%) had esophageal contents and 59 (98%) had gizzard contents. All 60 (100%) had prey in either their esophagus or gizzard. However, of the 44 SUSC collected, only 26 (59%) and 40 (91%) had esophageal or gizzard contents, respectively. Overall, 40 (91%) had prey in either their esophagus or gizzard.

As a result, we report four metrics for total stomach contents (i.e. all taxa pooled) and by broad taxa: *esophageal abundance* ($\# \cdot duck^{-1}$), *esophageal dry tissue biomass* ($g \cdot duck^{-1}$), *gizzard* *abundance* (#·duck^{-1}), and *esophageal + gizzard abundance* (#·duck^{-1}). Additionally, these metrics were each computed as a mean proportion (e.g. mean % of the total *esophageal abundance*) for broad taxa. Below we provide descriptive statistics for each of these metrics, but conducted hypothesis testing for *dry tissue biomass* only, since those data are the most robust and relevant.

We analyzed these abundance and biomass variables in two ways: 1) by including all ducks that were collected and 2) excluding those without any esophagus and/or gizzard contents. We included ducks without any contents because our methods of collecting birds, selected for those ducks that were actively foraging. Ducks with empty esophagi and/or gizzards were either unsuccessful foragers (i.e. searching unproductive areas) or had been foraging for too short a time to encounter prey. By observing individuals to be collected for a period of time to confirm diving/foraging activity, we theoretically eliminated the latter scenario. Therefore, for comparative purposes, we felt that including and excluding those with empty guts in separate analyses had value.

LTDU esophagi and gizzards had significantly higher total abundance and biomass of prey items than those of SUSC across study areas for all metrics with no overall significant differences between study areas (Tables 25-27). This pattern was similar between both species within each study area, with the exception of *esophageal dry tissue biomass* in CB (Table 26). Although no statistical differences were observed between overall study areas, it is important to note that stomach contents were quite variable and species-specific differences across study areas was muddled when including empty stomach contents, but became slightly clearer when excluding them (Table 27). Though no statistical differences were encountered for some metrics (e.g. esophageal biomass in some cases; see Table 27), practical differences can be arguably inferred and we consider these further in the Discussion section.

Table 25. Mean (+/- SE) esophagus prey abundance ($\# \cdot duck^{-1}$), esophagus prey dry tissue biomass ($g \cdot duck^{-1}$), gizzard prey abundance ($\# \cdot duck^{-1}$) and esophagus+gizzard prey abundance ($\# \cdot duck^{-1}$) for duck species comparisons (pooled for study areas) and study area comparisons (pooled for duck species) for the following data: (A) all ducks collected, including those with empty contents and (B) excluding ducks with empty contents. See Table 27 for a summary of Kruskal-Wallis tests for each grouping.

(A) Data for all ducks

	n	**E Abun.**	**E Biomass**	**G Abun.**	**E+G Abun**
LTDU	60	32 (8.4)	0.263 (0.092)	278 (64)	309 (66)
SUSC	44	1 (0.3)	0.049 (0.015)	5 (1)	6 (1)
Chesapeake Bay	61	12 (3.3)	0.054 (0.013)	220 (65)	232 (67)
Hog Island Bay	43	29 (11.2)	0.340 (0.126)	80 (16)	109 (21)

(B) Data for all ducks except those with empty esophagi and/or gizzard contents

	n[a]	**E Abun.**	**E Biomass**	**G Abun.**	**E+G Abun**
LTDU	54-60	35 (9.1)	0.293 (0.101)	282 (65)	309 (66)
SUSC	25-40	2 (0.4)	0.086 (0.024)	5 (1)	6 (1)
Chesapeake Bay	45-60	16 (4.3)	0.073 (0.016)	224 (66)	236 (68)
Hog Island Bay	34-40	37 (14.0)	0.431 (0.156)	88 (17)	117 (22)

[a] A range of sample sizes are reported since they varied with the different metrics (e.g. some ducks had no esophagus contents, but did have gizzard contents etc.)

Table 26. Mean (+/- SE) esophagus prey abundance ($\# \cdot duck^{-1}$), esophagus prey dry tissue biomass ($g \cdot duck^{-1}$), gizzard prey abundance ($\# \cdot duck^{-1}$) and esophagus+gizzard prey abundance ($\# \cdot duck^{-1}$) for LTDU and SUSC comparisons within each study area for the following data: (A) all ducks collected, including those with empty contents and (B) excluding ducks with empty contents. See Table 27 for a summary of Kruskal-Wallis tests for each grouping.

(A) Data for all ducks

		n	E Abun.	E Biomass	G Abun.	E+G Abun
Chesapeake Bay	LTDU	30	22 (6.2)	0.050 (0.018)	443 (120)	465 (124)
	SUSC	31	2 (0.4)	0.059 (0.018)	4 (1)	6 (1)
Hog Island Bay	LTDU	30	41 (15.7)	0.477 (0.175)	113 (19)	154 (26)
	SUSC	13	1 (0.2)	0.025 (0.024)	5 (1)	5 (1)

(B) Data for all ducks except those with empty esophagi and/or gizzard contents

		n[a]	E Abun.	E Biomass	G Abun.	E+G Abun
Chesapeake Bay	LTDU	24-30	27 (7.1)	0.062 (0.022)	443 (120)	465 (124)
	SUSC	21-30	2 (0.4)	0.087 (0.025)	5 (1)	6 (2)
Hog Island Bay	LTDU	29-30	41 (15.7)	0.477 (0.175)	117 (20)	154 (26)
	SUSC	4-10	2 (0.3)	0.082 (0.080)	6 (2)	7 (2)

[a] A range of sample sizes are reported since they varied with the different metrics (e.g. some ducks had no esophagus contents, but did have gizzard contents etc.)

Table 27. Results of Kruskal-Wallis tests[a] grouped by various effects[b] for (A) all ducks collected, including those with empty contents and (B) excluding ducks with empty contents for the following diet metrics: esophagus prey abundance ($\# \cdot duck^{-1}$), esophagus prey dry tissue biomass ($g \cdot duck^{-1}$), gizzard prey abundance ($\# \cdot duck^{-1}$) and esophagus+gizzard prey abundance ($\# \cdot duck^{-1}$). See Tables 25-26 for means (SE) for these groupings.

(A) Data for all ducks

	Esoph. Abun.	**Esoph. Biomass**	**Gizzard Abun.**	**Esoph.+Gizzard Abun.**
Duck Species	LTDU>>SUSC	LTDU>>SUSC	LTDU>>SUSC	LTDU>>SUSC
LTDU	HIB>CB	HIB>>CB	CB=HIB	CB=HIB
SUSC	CB>HIB	CB>HIB	HIB=CB	CB=HIB
Study Area	HIB=CB	HIB=CB	CB=HIB	CB=HIB
Bayside	LTDU>>SUSC	LTDU=SUSC	LTDU>>SUSC	LTDU>>SUSC
Seaside	LTDU>>SUSC	LTDU>>SUSC	LTDU>>SUSC	LTDU>>SUSC

(B) Data for all ducks except those with empty esophagi and/or gizzard contents

	Esoph. Abun.	**Esoph. Biomass**	**Gizzard Abun.**	**Esoph.+Gizzard Abun.**
Duck Species	LTDU>>SUSC	LTDU>>SUSC	LTDU>>SUSC	LTDU>>SUSC
LTDU	HIB=CB	HIB>>CB	CB=HIB	CB=HIB
SUSC	CB=HIB	CB=HIB	HIB=CB	CB=HIB
Study Area	HIB=CB	HIB=CB	CB=HIB	CB=HIB
Bayside	LTDU>>SUSC	LTDU=SUSC	LTDU>>SUSC	LTDU>>SUSC
Seaside	LTDU>>SUSC	LTDU>>SUSC	LTDU>>SUSC	LTDU>>SUSC

[a] Relationships are noted as "=" (no significant difference between means), ">" (means significantly different, $p<0.05$) or ">>" (means significantly different, $p<0.01$) and listed in descending order

[b] Chesapeake Bay=CB and Hog Island Bay=HIB

Organisms in 23 broad taxa were identified from sea duck stomachs (Table 28). An inclusive list of the 96 species/taxa is reported in Appendix IX. Ascidians, bivalves, brachyurans, gastropods and polychaetes were found in esophagi and/or gizzards of both duck species in both study areas (Tables 29-31). Ascidians, mainly *Molgula,* and amphipods were found in high relative abundance in LTDU esophagi in CB and HIB, respectively (Table 32), while their dominance diminished when measured by dry tissue biomass relative to taxa such as polychaetes and bivalves, especially for amphipods (Table 33). SUSC esophagi were dominated by bivalves in both study areas and, additionally, polychaetes and nemerteans in both study areas (Table 33).

Gastropods dominated gizzards of LTDU in HIB and ascidians dominated those collected in CB (Table 34). Bivalves and polychaetes were important items in gizzards of SUSC in both study areas, with gastropods found in high relative proportion in HIB (Table 34).

When combined, *esophageal + gizzard abundance* of duck species were dominated by various combinations of ascidians, bivalves, gastropods and/or polychaetes (Table 35). Ascidians were found almost entirely in the guts of LTDU from CB where their abundance was skewed by several esophagi and/or gizzards containing >1,000 very small individuals (hence, the contrast to *dry tissue biomass*).

With the results of *esophageal biomass* abundance in mind, we limited further statistical analysis to bivalves, gastropods and polychaetes due to their prominence throughout the various duck species and study areas. Again, analysis was limited to *dry tissue biomass*. Overall, sea ducks foraging in HIB contained a higher biomass of gastropods than those in CB (both in terms of mg and %) while other prey items were similar (Tables 36 and 37). Additionally, SUSC esophagi contained a higher biomass of bivalves than LTDU, while LTDU had a higher biomass of gastropods (Tables 36 and 37). Polychaete biomass was statistically similar for both species (Tables 36 and 37) mainly due to very high variation in LTDU foraging in HIB. There is likely a practical difference here that will be discussed later.

Table 28. General description of broad taxonomic groups collected in esophagi and gizzards of sea ducks, including the level of the grouping in parentheses.

Broad Taxa	General Taxa Descriptions
Actiniaria	Sea anemones (*Order*)
Algae	Macro algae commonly called seaweeds (*n/a*)
Amphioxiformes	Amphioxus, commonly called sand lancets (*Order*)
Amphipoda	Small crustaceans (*Order*)
Anomura	Decapod crustaceans, eg hermit crabs (*Infraorder*)
Ascidiacea	Sea squirts (*Class*)
Bivalvia	Bivalve mollusks (*Class*)
Brachyura	True crabs (*Infraorder*)
Caridea	Shrimps (*Infraorder*)
Cumacea	Small crustaceans sometimes called hooded shrimp (*Order*)
Echinodermata	Brittle stars and sea cucumbers (*Phylum*)
Gastropoda	Snails (*Class*)
Hemichordata	Hemichordates (*Phylum*)
Hydrozoa	Hydroids (*Class*)
Isopoda	Small crustaceans (*Order*)
Nemertea	Ribbon worms (*Phylum*)
Polychaeta	Segmented worms (*Class*)
SAV	Vascular submerged aquatic vegetation (*n/a*)
Seed	A single unidentified hard seed
Sessilia	Several barnacles of the genus *Belanus*
Stomatopoda	Crustacean called mantis shrimp
Teleostei	Bony fishes (*Infraclass*)
Thalassinidea	Burrowing shrimp (*Infraorder*)

Table 29. Frequency of occurrence (% of ducks) for broad taxonomic groups identified from LTDU and SUSC *esophagi* in both study areas. Number of ducks that were sampled for each grouping follows duck abbreviations in parentheses. Note that some taxa may be unrepresented in esophagus samples, but are still included in this table for comparisons since they were found in gizzard samples reported in Table 30.

	Chesapeake Bay		***Hog Island Bay***	
Broad Taxa	**LTDU (30)**	**SUSC (31)**	**LTDU (30)**	**SUSC (13)**
Actiniaria	3.3	0.0	3.3	0.0
Algae	0.0	0.0	20.0	0.0
Amphioxiformes	3.3	0.0	0.0	0.0
Amphipoda	26.7	0.0	36.7	0.0
Anomura	0.0	0.0	0.0	0.0
Ascidiacea	53.3	25.8	0.0	7.7
Bivalvia	23.3	9.7	30.0	7.7
Brachyura	13.3	3.2	50.0	7.7
Caridea	10.0	0.0	63.3	0.0
Cumacea	0.0	0.0	13.3	0.0
Echinodermata	3.3	0.0	3.3	0.0
Gastropoda	43.3	12.9	83.3	15.4
Hemichordata	6.7	0.0	0.0	0.0
Hydrozoa	6.7	6.5	6.7	0.0
Isopoda	6.7	0.0	10.0	0.0
Nemertea	0.0	3.2	10.0	0.0
Polychaeta	30.0	41.9	43.3	7.7
SAV	10.0	6.5	3.3	0.0
Seed	0.0	0.0	0.0	0.0
Sessilia	3.3	0.0	0.0	0.0
Stomatopoda	0.0	0.0	0.0	0.0
Teleostei	13.3	0.0	0.0	0.0
Thalassinidea	3.3	0.0	6.7	0.0
Unknown	0.0	3.2	0.0	0.0

Table 30. Frequency of occurrence (% of ducks) for broad taxonomic groups identified from LTDU and SUSC *gizzards* in both study areas. Number of ducks that were sampled for each grouping follows duck abbreviations in parentheses. Note that some taxa may be unrepresented in gizzard samples, but are still included in this table for comparisons since they were found in esophagus samples reported in Table 29.

	Chesapeake Bay		***Hog Island Bay***	
Broad Taxa	**LTDU (30)**	**SUSC (31)**	**LTDU (30)**	**SUSC (13)**
Actiniaria	0.0	0.0	3.3	0.0
Algae	0.0	0.0	3.3	0.0
Amphioxiformes	0.0	0.0	0.0	0.0
Amphipoda	23.3	0.0	30.0	0.0
Anomura	10.0	0.0	0.0	0.0
Ascidiacea	50.0	29.0	3.3	0.0
Bivalvia	56.7	54.8	36.7	53.8
Brachyura	40.0	12.9	60.0	7.7
Caridea	6.7	0.0	46.7	0.0
Cumacea	0.0	0.0	6.7	0.0
Echinodermata	3.3	0.0	3.3	0.0
Gastropoda	86.7	9.7	96.7	53.8
Hemichordata	0.0	0.0	0.0	0.0
Hydrozoa	10.0	12.9	0.0	0.0
Isopoda	3.3	3.2	10.0	0.0
Nemertea	0.0	6.5	0.0	0.0
Polychaeta	23.3	51.6	36.7	38.5
SAV	0.0	0.0	0.0	0.0
Seed	0.0	3.2	0.0	0.0
Sessilia	0.0	0.0	0.0	0.0
Stomatopoda	3.3	0.0	3.3	0.0
Teleostei	6.7	0.0	6.7	0.0
Thalassinidea	6.7	0.0	6.7	0.0
Unknown	0.0	9.7	0.0	0.0

Table 31. Frequency of occurrence (% of ducks) for broad taxonomic groups identified from LTDU and SUSC *esophagi + gizzards* in both study areas. Number of ducks that were sampled for each grouping follows duck abbreviations in parentheses.

	Chesapeake Bay		***Hog Island Bay***	
Broad Taxa	**LTDU (30)**	**SUSC (31)**	**LTDU (30)**	**SUSC (13)**
Actiniaria	3.3	0.0	6.7	0.0
Algae	0.0	0.0	23.3	0.0
Amphioxiformes	3.3	0.0	0.0	0.0
Amphipoda	43.3	0.0	50.0	0.0
Anomura	10.0	0.0	0.0	0.0
Ascidiacea	60.0	41.9	3.3	7.7
Bivalvia	66.7	61.3	40.0	53.8
Brachyura	46.7	16.1	66.7	15.4
Caridea	13.3	0.0	66.7	0.0
Cumacea	0.0	0.0	16.7	0.0
Echinodermata	6.7	0.0	6.7	0.0
Gastropoda	90.0	19.4	96.7	61.5
Hemichordata	6.7	0.0	0.0	0.0
Hydrozoa	13.3	16.1	6.7	0.0
Isopoda	10.0	3.2	13.3	0.0
Nemertea	0.0	9.7	10.0	0.0
Polychaeta	40.0	61.3	50.0	46.2
SAV	10.0	6.5	3.3	0.0
Seed	0.0	3.2	0.0	0.0
Sessilia	3.3	0.0	0.0	0.0
Stomatopoda	3.3	0.0	3.3	0.0
Teleostei	16.7	0.0	6.7	0.0
Thalassinidea	10.0	0.0	10.0	0.0
Unknown	0.0	12.9	0.0	0.0

Table 32. Mean abundance (# · duck^{-1}) and mean % (in parentheses[a]) of broad taxa found in *esophagi* of LTDU and SUSC in both study areas (rare taxa not included). Number of ducks that were sampled for each grouping follows duck abbreviations in parentheses.

	Chesapeake Bay				***Hog Island Bay***			
	LTDU (30)		**SUSC (31)**		**LTDU (30)**		**SUSC (13)**	
Broad Taxa	#	%	#	%	#	%	#	%
Algae	0.0	(0.0)	0.0	(0.0)	0.1	(0.6)	0.0	(0.0)
Amphipoda	2.4	(9.5)	0.0	(0.0)	21.0	(11.9)	0.0	(0.0)
Ascidiacea	15.9	(39.6)	0.6	(17.3)	0.0	(0.0)	0.1	(3.8)
Bivalvia	0.3	(2.4)	0.1	(7.3)	2.0	(5.6)	0.2	(7.7)
Brachyura	0.3	(2.2)	0.0	(1.6)	1.3	(3.3)	0.1	(3.8)
Caridea	0.1	(3.8)	0.0	(0.0)	4.7	(25.1)	0.0	(0.0)
Gastropoda	1.9	(16.1)	0.2	(8.2)	9.0	(41.8)	0.2	(7.7)
Hydrozoa	0.1	(0.2)	0.0	(1.6)	0.1	(0.0)	0.0	(0.0)
Nemertea	0.0	(0.0)	0.0	(3.2)	0.1	(0.2)	0.0	(0.0)
Polychaeta	0.4	(5.8)	0.5	(27.5)	2.5	(10.6)	0.1	(7.7)
Teleostei	0.3	(2.4)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)

[a] % will not sum to 100%; they are means across individual ducks in a grouping vs. an aggregate %

Table 33. Mean dry tissue biomass (mg · duck^{-1}) and mean % (in parentheses[a]) of broad taxa found in *esophagi* of LTDU and SUSC in both study areas (rare taxa not included). Number of ducks that were sampled for each grouping follows duck abbreviations in parentheses.

	Chesapeake Bay				***Hog Island Bay***			
	LTDU (30)		**SUSC (31)**		**LTDU (30)**		**SUSC (13)**	
Broad Taxa	mg	%	mg	%	mg	%	mg	%
Algae	0.0	(0.0)	0.0	(0.0)	5.8	(2.8)	0.0	(0.0)
Amphipoda	1.5	(4.0)	0.0	(0.0)	7.4	(1.1)	0.0	(0.0)
Ascidiacea	12.6	(35.3)	1.9	(8.9)	0.0	(0.0)	0.0	(0.0)
Bivalvia	4.3	(3.6)	11.1	(6.4)	25.1	(6.1)	24.7	(7.7)
Brachyura	1.4	(1.9)	0.1	(2.4)	24.5	(6.9)	0.2	(5.1)
Caridea	1.9	(5.4)	0.0	(0.0)	139.6	(37.2)	0.0	(0.0)
Gastropoda	1.0	(5.9)	0.1	(6.5)	4.4	(21.4)	0.2	(10.3)
Hydrozoa	0.1	(0.6)	3.6	(4.0)	0.0	(0.0)	0.0	(0.0)
Nemertea	0.0	(0.0)	10.4	(3.2)	2.7	(0.3)	0.0	(0.0)
Polychaeta	12.9	(11.0)	31.0	(35.8)	246.7	(23.3)	0.3	(7.7)
Teleostei	5.9	(6.4)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)

[a] % will not sum to 100%; they are means across individual ducks in a grouping vs. an aggregate %

Table 34. Mean abundance ($\# \cdot duck^{-1}$) and mean % (in parentheses[a]) of broad taxa found in *gizzards* of LTDU and SUSC in both study areas (rare taxa are included). Number of ducks that were sampled for each grouping follows duck abbreviations in parentheses.

	Chesapeake Bay				*Hog Island Bay*			
	LTDU (30)		**SUSC (31)**		**LTDU (30)**		**SUSC (13)**	
Broad Taxa	#	%	#	%	#	%	#	%
Algae	0.0	(0.0)	0.0	(0.0)	0.0	(0.1)	0.0	(0.0)
Amphipoda	0.5	(1.1)	0.0	(0.0)	1.4	(1.5)	0.0	(0.0)
Ascidiacea	408.3	(39.3)	1.9	(17.8)	0.1	(0.1)	0.0	(0.0)
Bivalvia	1.7	(4.1)	1.2	(34.3)	1.2	(2.4)	2.0	(30.5)
Brachyura	1.1	(2.5)	0.1	(5.8)	1.4	(3.0)	0.1	(1.3)
Caridea	0.1	(0.1)	0.0	(0.0)	1.3	(5.2)	0.0	(0.0)
Gastropoda	29.8	(48.0)	0.2	(1.9)	106.0	(81.9)	2.5	(35.7)
Hydrozoa	0.1	(0.5)	0.1	(1.8)	0.0	(0.0)	0.0	(0.0)
Nemertea	0.0	(0.0)	0.1	(1.9)	0.0	(0.0)	0.0	(0.0)
Polychaeta	0.2	(3.0)	0.5	(25.5)	0.6	(1.7)	0.4	(9.4)
Teleostei	0.1	(0.6)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)

[a] % will not sum to 100%; they are means across individual ducks in a grouping vs. an aggregate %

Table 35. Mean abundance ($\# \cdot duck^{-1}$) and mean % (in parentheses[a]) of broad taxa found in *esophagus + gizzards* of LTDU and SUSC in both study areas (rare taxa are included). No. of ducks that were sampled for each grouping follows duck abbreviations in parentheses.

	Chesapeake Bay				*Hog Island Bay*			
	LTDU (30)		**SUSC (31)**		**LTDU (30)**		**SUSC (13)**	
Broad Taxa	#	%	#	%	#	%	#	%
Algae	0.0	(0.0)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)
Amphipoda	2.9	(4.2)	0.0	(0.0)	22.4	(7.2)	0.0	(0.0)
Ascidiacea	424.2	(40.6)	2.5	(19.8)	0.1	(0.0)	0.1	(1.9)
Bivalvia	2.1	(3.5)	1.4	(29.5)	3.2	(3.9)	2.2	(29.3)
Brachyura	1.4	(2.7)	0.2	(3.7)	2.7	(2.6)	0.2	(3.7)
Caridea	0.2	(0.3)	0.0	(0.0)	6.0	(13.6)	0.0	(0.0)
Gastropoda	31.8	(40.3)	0.4	(5.5)	115.0	(67.7)	2.6	(34.6)
Hydrozoa	0.2	(0.5)	0.2	(1.8)	0.1	(0.0)	0.0	(0.0)
Nemertea	0.0	(0.0)	0.1	(2.9)	0.1	(0.1)	0.0	(0.0)
Polychaeta	0.7	(2.0)	1.1	(26.4)	3.1	(3.9)	0.5	(7.5)
Teleostei	0.4	(1.1)	0.0	(0.0)	0.1	(0.1)	0.0	(0.0)

[a] % will not sum to 100%; they are means across individual ducks in a grouping vs. an aggregate %

Table 36. Results of Kruskal-Wallis tests[a] for mean *esophageal* dry tissue biomass (g · duck^{-1}) of the three dominant taxa found in duck esophagi by study area (Chesapeake Bay=CB and Hog Island Bay=HIB) and duck species effects.

Broad Taxa	Study Area	Duck Species
Bivalvia	HIB=CB	SUSC>LTDU
Gastropoda	HIB>>CB	LTDU>>SUSC
Polychaeta	HIB=CB	LTDU=SUSC

[a] Relationships are noted as "=" (no significant difference between means), ">" (means significantly different, p<0.05) or ">>" (means significantly different, p<0.01) and listed in descending order.

Table 37. Results of Kruskal-Wallis tests[a] for the mean % *esophageal* dry tissue biomass (% · duck^{-1}) of the three dominant taxa found in duck esophagi by study area (Chesapeake Bay=CB and Hog Island Bay=HIB) and duck species effects.

Broad Taxa	Study Area	Duck Species
Bivalvia	HIB=CB	SUSC>LTDU
Gastropoda	HIB>>CB	LTDU>>SUSC
Polychaeta	CB=HIB	SUSC=LTDU

[a] Relationships are noted as "=" (no significant difference between means), ">" (means significantly different, p<0.05) or ">>" (means significantly different, p<0.01) and listed in descending order.

The suite of genera dominating the three taxa examined above was slightly different between study areas and duck species. In CB, bivalves were mainly composed of *Anadara* and *Tagelus* for LTDU and SUSC, respectively (Table 38). In HIB, LTDU diet included *Macoma* and *Mercenaria* as well, while SUSC were dominated by *Ensis* (Table 38). However, SUSC had few bivalves in their diet; *Tagelus* only in CB and *Ensis* only in HIB. Generally, LTDU had several dominant gastropods, whereas very few were found in SUSC stomachs (Table 38). The family *Nereidae* was the dominant polychaete for both duck species; however, individuals from this taxa were difficult to identify to family in esophagi samples and more so in gizzard samples (although setae and jaws appeared to be quite persistent).

Table 38. Dominant genera (italics) or families for the dominant broad taxonomic groups found in stomach samples (esophagi and/or gizzards) of LTDU and SUSC in both study areas. Taxa in bold were much more dominant than others within individual groupings.

	Chesapeake Bay		***Hog Island Bay***	
Broad Taxa	**LTDU**	**SUSC**	**LTDU**	**SUSC**
Bivalvia	***Anadara***	*Tagelus*	***Macoma*** *Mercenaria* *Anadara*	*Ensis*
Gastropoda	*Astyris* *Mangelina* *Nucella*	very few	***Astyris*** *Turbonilla* *Acteocina*	*Nucella* *Acteocina*
Polychaeta	*Nereidae*	few identifiable	***Nereidae***	few identifiable

From a different perspective, we observed that LTDU had many more unique broad taxa than SUSC and these were not rare (found in > 10% of samples) in many cases (Table 39). Amphipods and carideans were two of the more dominant unique taxa in the case of LTDU. The lone unique one found in SUSC, *Nemertea*, was only found in ducks collected in CB (Table 39).

Two community metrics were analyzed for *esophageal + gizzard abundance*: richness and the Shannon index. Mean taxa richness was higher for LTDU than SUSC (4.6 and 2.4, respectively; $p<0.01$), but did not differ between CB and HIB (3.5 and 4.1, respectively; $p=0.87$). Community diversity, as measured by the mean Shannon Index, was similar between CB and HIB (0.61 and 0.60, respectively; $p=0.92$), and between LTDU and SUSC (0.59 and 0.64, respectively; $p=0.68$). There was not a significant interaction between the effects of study area and duck species for taxa richness or Shannon Index ($p=0.78$ and $p=0.83$, respectively).

Table 39. Unique broad taxa for each seaduck species in each study area. Taxa must have occurred in >1 duck and been absent from the other species within the two separate study areas. Taxa in **bold** were found in >25% of guts for a duck species (indicating dominant taxa) and those in gray were found in <10% guts for a duck species (rare taxa).

Chesapeake Bay		***Hog Island Bay***	
LTDU	**SUSC**	**LTDU**	**SUSC**
Amphipoda	Nemertea	**Amphipoda**	*none*
Caridea		**Caridea**	
Actiniaria		Algae	
Anomura		Cumacea	
Echinodermata		Nemertea	
Hemichordata		Echinodermata	
Thalassinidea		Actiniaria	

Additionally, length of brachiostomes and dominant bivalves and gastropods were measured. Due to a limited number of bivalves and gastropods for comparison, we did not statistically compare them. Therefore we simply report the mean and range of sizes in Table 40. The few *Ensis* and *Tagelus* that were identified were quite large (35-65 mm) and resulted in the higher relative bivalve biomass reported earlier.

Table 40. Total length (mm) of the longest dimension of Amphioxus, teleosts and the dominant genera of bivalves and gastropods collected stomach samples (esophagus and gizzard samples pooled) from both duck species[a].

		LTDU					*SUSC*				
Broad Taxa	**Genus**	**n**	**Mean**	**SE**	**Min**	**Max**	**n**	**Mean**	**SE**	**Min**	**Max**
Amphioxiformes	*Branchiostoma*	3	33.7	2.2	31.0	38.0					
Bivalvia	*Anadara*	61	6.2	0.4	2.0	16.0	5	7.8	1.4	4.0	11.0
	Dosinia	2	6.0	0.0	6.0	6.0					
	Ensis	1	4.0	.	4.0	4.0	4	50.0	7.4	35.0	65.0
	Gemma			*absent*			1	3.0	.	3.0	3.0
	Lyonsia	2	12.5	4.5	8.0	17.0			*absent*		
	Macoma	58	11.9	0.4	6.0	19.0			*absent*		
	Mercenaria	17	4.1	0.4	2.0	7.0	3	7.0	2.6	3.0	12.0
	Mulinia	5	9.6	3.3	3.0	18.0	4	12.3	0.8	10.0	13.0
	Solen	2	23.5	17.5	6.0	41.0			*absent*		
	Tagelus			*absent*			1	43.0	.	43.0	43.0
Gastropoda	*Acteocina*	667	2.7	0.0	1.0	5.0	10	2.6	0.2	2.0	3.0
	Astyris	1,831	3.6	0.0	1.0	6.0	2	3.5	0.5	3.0	4.0
	Boonea	19	3.8	0.3	3.0	7.0			*absent*		
	Caecum	3	4.0	0.0	4.0	4.0			*absent*		
	Costoanachis	102	4.7	0.1	1.0	11.0	1	10.0	.	10.0	10.0
	Crepidula	2	5.0	1.0	4.0	6.0			*absent*		
	Doriopsilla	1	5.0	.	5.0	5.0			*absent*		
	Epitonium	8	5.6	0.8	3.0	10.0			*absent*		
	Mangelina	312	4.9	0.1	2.0	7.0	4	5.5	0.5	5.0	7.0

Continued next page

Table 40 (cont). Total length (mm) of the longest dimension of Amphioxus, teleosts and the dominant genera of bivalves and gastropods collected stomach samples (esophagus and gizzard samples pooled) from both duck species.

		LTDU					***SUSC***				
Broad Taxa	**Genus**	**n**	**Mean**	**SE**	**Min**	**Max**	**n**	**Mean**	**SE**	**Min**	**Max**
Gastropoda (cont.)	*Nassarius*	9	5.1	0.5	3.0	8.0					
	Nucella	366	4.0	0.1	2.0	8.0	15	4.9	0.3	3.0	7.0
	Odostomia	25	3.1	0.3	2.0	8.0	1	7.0	.	7.0	7.0
	Polinices	2	3.5	0.5	3.0	4.0	1	13.0	.	13.0	13.0
	Rissoina	19	6.2	0.2	4.0	8.0	1	7.0	.	7.0	7.0
	Seila	18	5.2	0.5	2.0	9.0			*absent*		
	Trophora	1	2.0	.	2.0	2.0			*absent*		
	Turbonilla	1,016	3.9	0.0	2.0	8.0	6	5.2	0.9	2.0	8.0
	Urosalpinx	3	4.3	1.9	2.0	8.0			*absent*		
	Vitrinella	12	2.6	0.1	2.0	3.0			*absent*		
Teleostei	*Gobiosoma*	9	22.2	1.6	14.0	27.0			*absent*		
	Microgobius	1	37.0	.	37.0	37.0			*absent*		
	Opsanus	1	23.0	.	23.0	23.0			*absent*		

[a] If a genus was not found in either the esophagi or gizzards of a duck species "*absent*" is noted in the appropriate row

Overall Multivariate Analysis

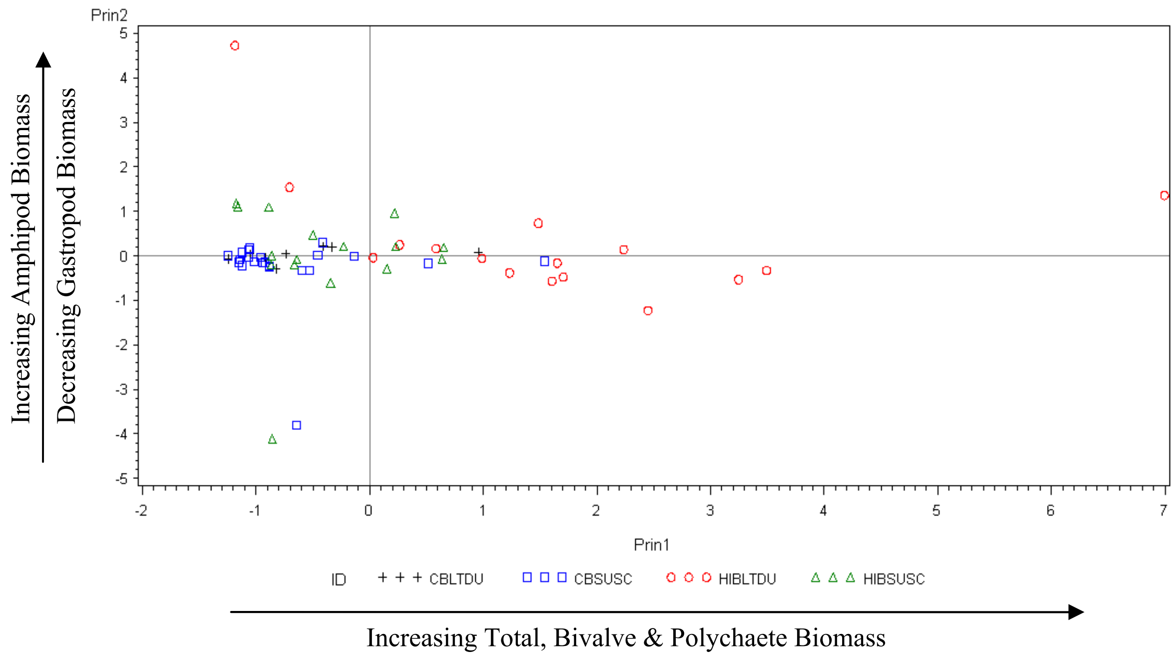
Benthic Data - Principle Components Analysis was performed on multiple variables for benthic samples and diet samples. For benthic samples, biotic factors in the analysis included total biomass, amphipod biomass, bivalve biomass, gastropod biomass and polychaete biomass (all in $g \cdot m^{-2}$). The first principle component (PCI) was composed of positively correlated total biomass, bivalve biomass and polychaete biomass. The second (PCII) was composed of amphipod biomass and gastropod biomass which were positive and negative relationships, respectively. These two components accounted for 65% of the variance in the correlation matrix and several weak patterns were evident. LTDU foraging areas in HIB appeared to separate along PCI from SUSC areas in HIB and, more markedly, from those of both species in CB (Fig. 17). Interestingly, the spread of points was also much greater for foraging areas in HIB compared to those in CB (Fig. 17). Little obvious separation was observed along PCII.

Additionally, a separate analysis was conducted using the abiotic factors water depth (corrected to MHHW), sediment organic matter content (%), medium/coarse sand fraction (%), fine/very fine sand fraction (%) and silt/clay fraction (%) of sediment. PCI was composed of positively correlated organic matter and silt/clay fraction in addition to negatively correlated medium/coarse sand fraction. PCII was composed of positively correlated organic matter and negatively correlated fine/very fine sand fraction. These two components accounted for 90% of the variance in the correlation matrix. Strong separation was evident for foraging areas in the two study areas along PCI, which was expected due to the different physiography of these areas (Fig. 18). There also appears to be separation between duck species foraging areas in HIB with those of LTDU tending towards higher % organic matter and increasing fine/very fine sand fractions (Fig. 18). A similar pattern may occur in CB, although there appears to be more overlap between LTDU and SUSC foraging areas (Fig. 18).

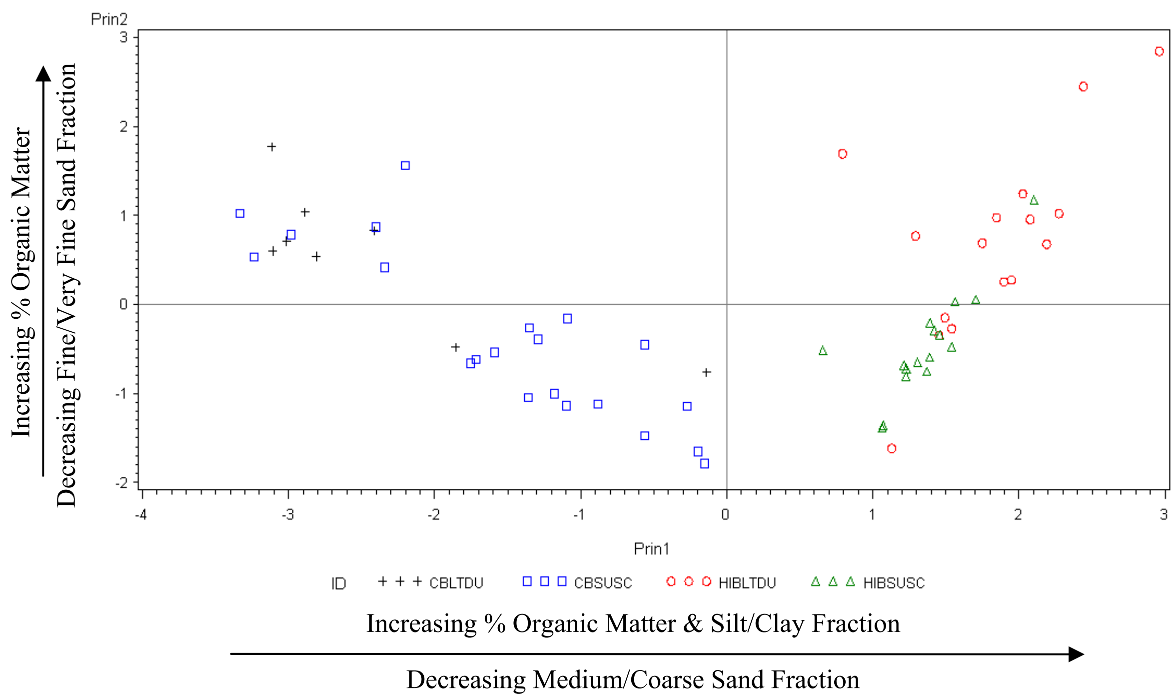
Diet Data - Principle components analysis was conducted on *esophageal biomass* ($g \cdot duck^{-2}$) by duck species and study area using total biomass, amphipod biomass, bivalve biomass, gastropod biomass and polychaete biomass. Ducks with no biomass in their esophagi were excluded from this analysis. PCI was composed of positively correlated total biomass and polychaete biomass. PCII was composed of gastropod biomass and bivalve biomass which were positive and negative relationships, respectively. These two components accounted for 75% of the variance in the correlation matrix and several patterns were again evident. SUSC in both study areas were tightly clustered to the left and below LTDU on PCI and PCII, respectively (Fig. 19), indicating little variance in SUSC diets. This separation was most pronounced relative to LTDU foraging in HIB. Additionally, the spread of LTDU plots was much higher than SUSC, again especially relative to LTDU in HIB (Fig. 19).

Additionally, in a separate analysis, *esophagus+gizzard abundance* ($\# \cdot duck^{-2}$) metrics total abundance, amphipod abundance, bivalve abundance and gastropod abundance were used to evaluate diet differences across duck species and study areas. Polychaete abundance was not included due to the difficulties of accurately enumerating individuals in both esophagi and, to a larger extent, gizzards. Also, ducks with no countable organisms in their esophagi and/or gizzards were excluded from this analysis. PCI was composed of positively correlated amphipod and gastropod abundance. PCII was composed positively correlated bivalve abundance and negatively correlated total abundance. These two components accounted for 57% of the variance in the correlation matrix. Substantial separation was observed for LTDU foraging in both study area compared to SUSC along PCI (Figure 20). Again, a much tighter spread of values were obvious for SUSC in general relative to LTDU, especially those foraging in HIB (Fig. 20).

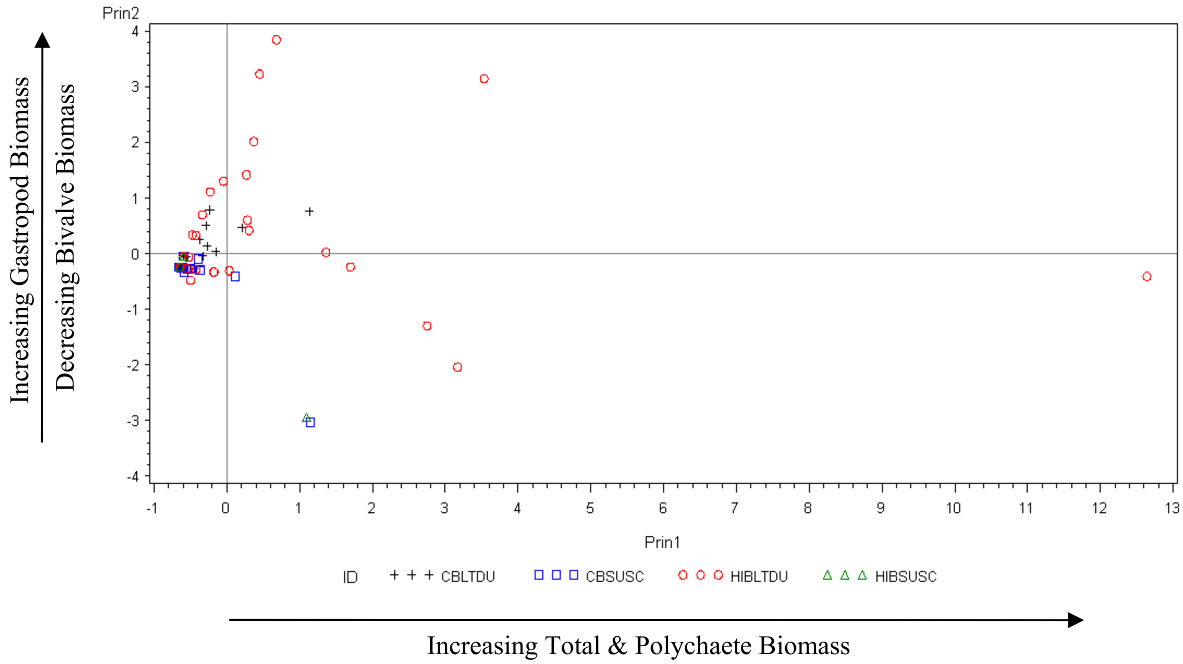
Figures 17. Principle Components Analysis output for biotic factors of benthic samples.



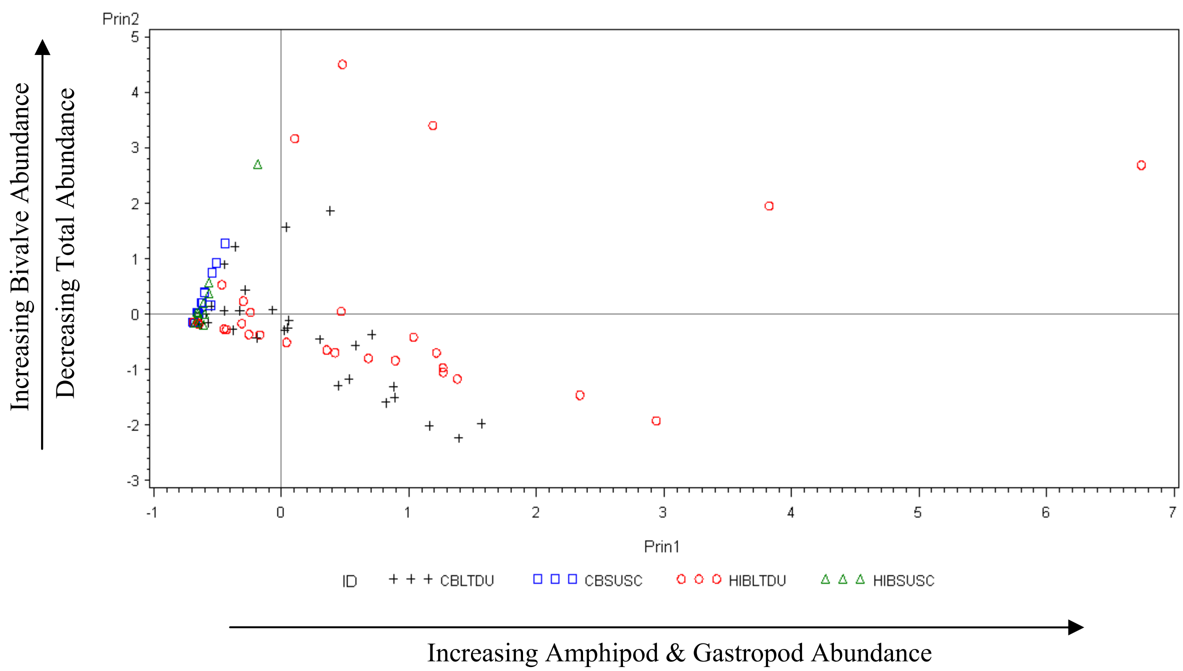
Figures 18. Principle Components Analysis output for abiotic factors of benthic samples.



Figures 19. Principle Components Analysis output for esophageal biomass metrics of sea duck diets.



Figures 20. Principle Components Analysis output for esophageal+gizzard abundance metrics of sea duck diets.



Discussion

The shallow water environments in the southeastern region of Chesapeake Bay and the Atlantic coastal bays in this study appear to be important winter foraging habitats for both surf scoters and long-tailed ducks. We observed species-specific differences in the spatial and temporal patterns of their aggregations, the physical characteristics of their foraging habitats, their available prey and their diets, both within and across study areas in the lower Chesapeake Bay and Atlantic coastal bays. Though some of these differences are subtle, they suggest some niche separation in habitat use and diet between the species.

Spatial and temporal segregation

SUSC arrived a little earlier than LTDU in both study areas and their peak abundance was observed at or shortly after the initial arrival of migrants. In CB, SUSC numbers steadily decreased throughout the winter, though they remained higher than those of LTDU until late December (Figure 7). This pattern suggests that after an initial significant migration (followed by the likely addition of a few later migrants throughout the early winter), a portion of the SUSC either embarked on regional movements or continued further southward migration. Anecdotal observations of state biologists during other waterfowl surveys indicate that scoter migration patterns to the Chesapeake Bay often start with accumulations of large flocks in the Upper Bay with subsequent movements down the eastern portion of the Bay and finally a more ubiquitous distribution throughout the central, western and lower portions (G. Costanza, VA Dept. Game and Inland Fisheries, pers. comm.). Our data support this concept locally within the CB study area; although without information from other regions of the Bay it is certainly not conclusive.

SUSC on the seaward side of the Eastern Shore of Virginia exhibited a different pattern. Again, peak density occurred relatively early (i.e. shortly after the first migrants were observed), but in this area subsequent density diminished rapidly and by December 2008, SUSC were rare in the study area until a brief period in April 2009 (Table 1). As noted in the Results section, during the December 8, 2008 survey, we estimated upwards of 10,000 SUSC (possibly mixed with other scoter species) in an area approximately 65 km^2 in the ocean just east of Hog Island and outside of the HIB study area. This group was gone by the next survey. Several scenarios could lead to this pattern in HIB. It is possible that after their initial arrival, ducks underwent regional movements into Chesapeake Bay or dispersed throughout the other coastal bays seaward of the Delmarva Peninsula. Alternatively, SUSC could have simply been staging in this coastal bay in preparation for further southward migration. Given our observation of a large temporary aggregation of ducks within 10 km of the HIB study area in early December, we suggest that the latter scenario is more likely.

LTDU arrived at both study areas later than SUSC and their densities remained relatively stable throughout the winter in both study areas, although much lower than SUSC (Table 1 and Fig. 7). This pattern suggests that both study areas are in regions of winter long LTDU use and may be similar in importance.

The collective timing of arrival and departure of LTDU and SUSC and their peak densities in both study areas suggest some temporal segregation. The earlier arriving SUSC are in a better position to exploit potentially shared prey items early in the winter.

Both sea duck species were observed throughout the CB study area (Fig. 8). LTDU were observed throughout the HIB study area, but SUSC were found primarily in aggregations at a single location west of the High Shoal Marsh (see Fig. 9).

Very few sea ducks were observed foraging within 50 m of SAV beds in CB (Table 5) and this habitat does not appear to be important for them in CB. However, it is worth noting that most of the SAV in this area is in shallow water (<1 m at MHHW). Few LTDU were documented foraging within 50 m of oyster reefs in HIB, although 15% of SUSC aggregations were observed in close proximity to oyster reefs in this region (Table 5). This result combined with the distribution patterns noted above may hint at some spatial segregation between the two duck species in HIB. The lack of obvious hard substrate use in HIB may be a result of the relatively high abundance of demersal and infaunal prey available in adjacent areas.

SUSC were much more abundant than LTDU in this study, accounting for 93% of 14,638 ducks counted in surveys. Additionally, mean aggregation size was much larger as well (Table 3). Interestingly, most foraging aggregations that we observed were single-species (98%). While there could be some observation error, distinguishing between these two species during either vessel or aerial based surveys was straightforward owing to size and plumage differences. The lack of more mixed aggregations further suggests localized spatial segregation.

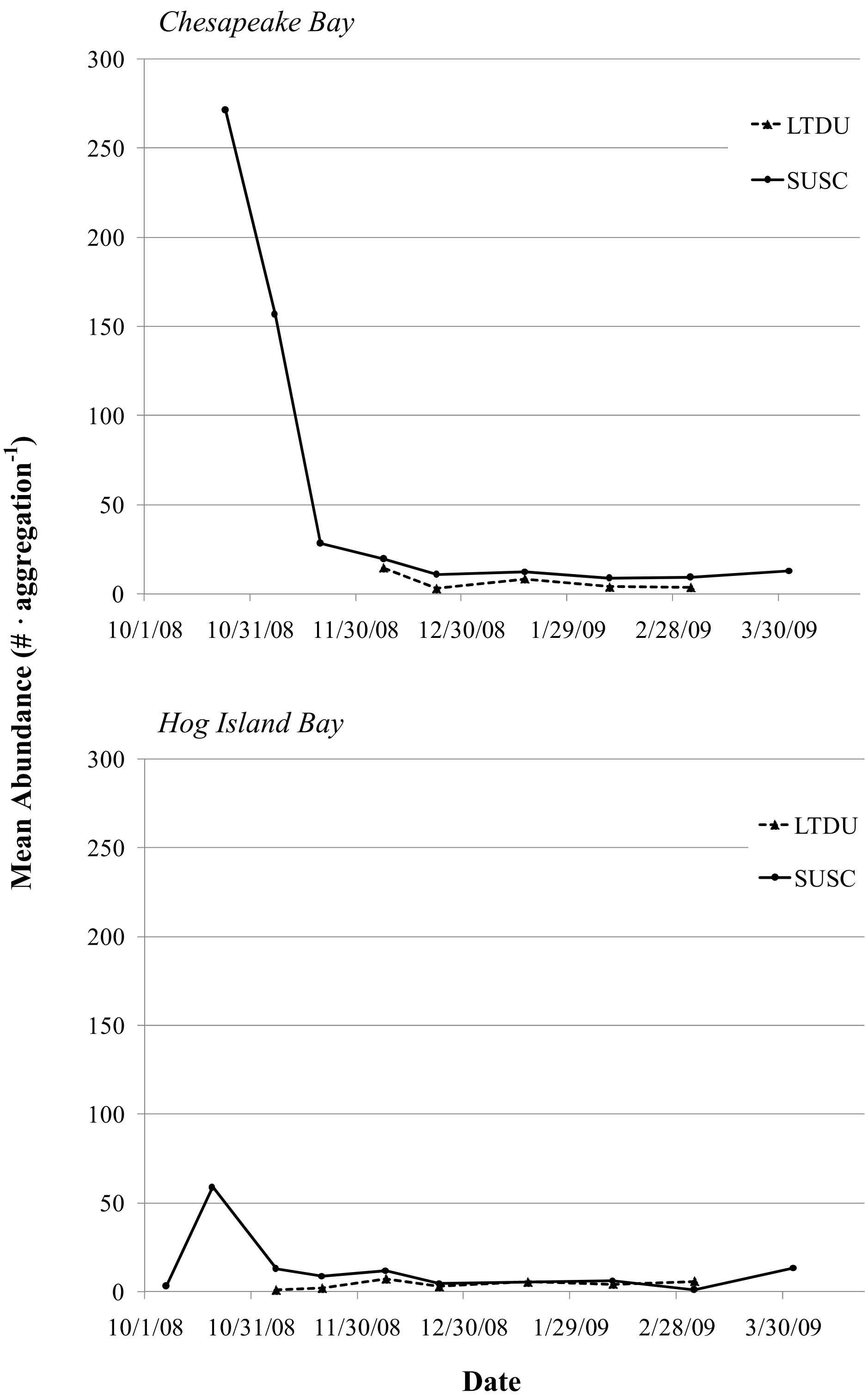
Overall, SUSC aggregations had substantially more ducks in them than LTDU (Table 3). However, that result is primarily due to very large SUSC aggregations early in the migration season, after which aggregation size becomes much more similar (Figure 21).

Physical Habitat Characteristics

There were clear differences between the physical aspects of our two study areas. Salinity varied across areas, while bathymetry and sediment characteristics varied both within and between areas, and some of the differences in duck foraging area were observed in relation to these factors.

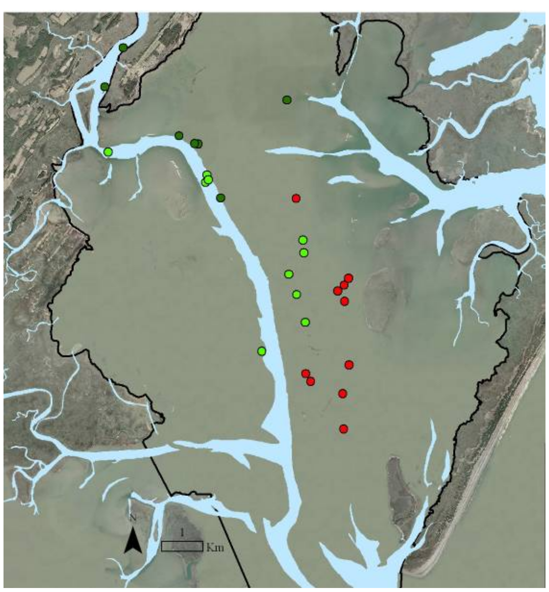
Although mean water depth of LTDU foraging areas where benthic samples were collected in CB were not statistically different than those of SUSC (Table 8), a practical look at the means and the frequency distribution suggest that there are some contrasts (Fig. 11).

Figure 21. Mean foraging aggregation abundance for LTDU and SUSC in both study areas during winter 2008/2009.



Only 27% of the foraging areas sampled were greater than 6 m deep for SUSC, whereas 63% of those for LTDU were, suggesting that LTDU tended to forage in deeper water. Significant differences in mean water depths at duck collection locations were observed between duck species in both study areas (Table 23), but it is important to note that collections were made haphazardly and opportunistically, whereas benthic sampling in foraging areas was random. Nevertheless, the pattern is similar in both instances: LTDU were found to forage in deeper water than SUSC. It is possible that some of these differences (especially in HIB) result from a bias resulting from greater success in collecting LTDU from deeper water adjacent to a channel in HIB (see Fig. 22) than in collecting SUSC observed in similar locations. We nevertheless argue that the basic pattern of LTDU foraging in deeper locations than SUSC is strongly supported by our data. It is worth noting that the minimum depth of foraging locations in HIB and CB was near 1 m for both duck species. Recall that these measurements reflect depth at MHHW. In the HIB study area, which has a mean tidal amplitude of 1.3 m, such depths represent intertidal areas that were exposed at low tide. However, those in CB were still subtidal (although quite shallow) at low tide owing to a mean tidal amplitude of only 0.5 m.

Figure 22. Location of sea duck collection locations in the HIB in relation to the main subtidal channels of significant depth (light blue). LTDU collected during early and late winter 2008/2009 are represented by light and dark green, respectively. SUSC were only collected in early winter 2008 (red) in HIB.



LTDU foraging areas in HIB tended to have higher organic matter (Table 10) and higher silt/clay (Fig. 12) content than those of SUSC. These related physical components play a clear role in the segregation of LTDU from SUSC in HIB in the principle components analysis as well (see Fig. 18). These two parameters are closely related and can impact fine-scale benthic pore water quality and the distribution of benthic organisms, especially in coastal lagoons and bays (McGlathery et al. 2001, Diaz-Asencio et al. 2009).

Diet

Though we report several different metrics for both benthic organisms and diet components, biomass is arguably the most meaningful. Since we did not measure biomass for gizzard samples, *esophagus+gizzard* abundance has some utility as well, especially considering the amount of organisms found in the gizzards.

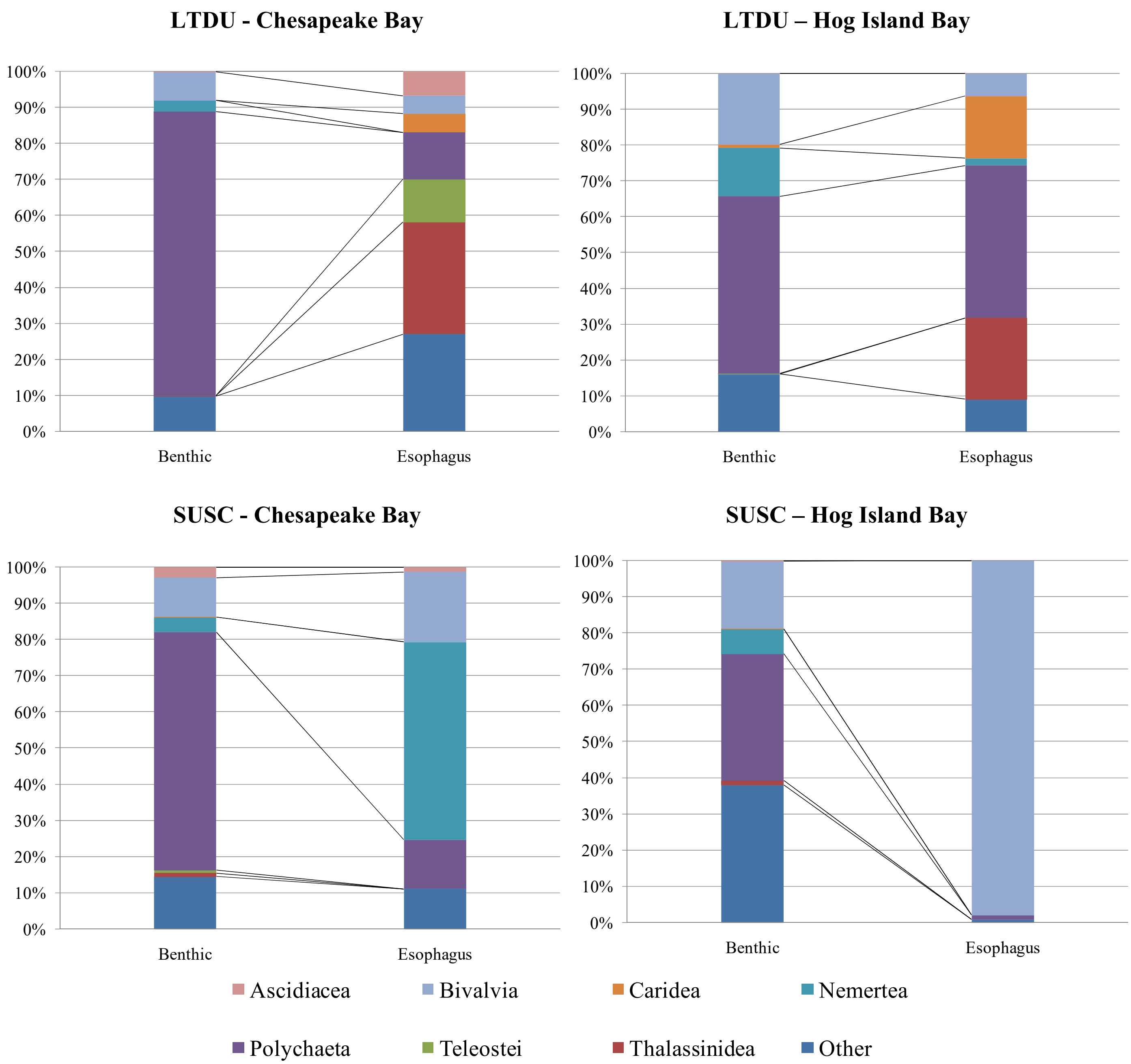
More potential prey biomass was found in sea duck foraging areas in HIB than in CB, and this biomass was higher in LTDU foraging areas than those of SUSC in HIB (Table 12). This same inter-specific pattern was observed for the total biomass of prey found in sea duck esophagi and the total abundance of organisms collected in *esophagus+gizzards* in both study areas (Tables 25-27). Also, LTDU consumed a broader range of prey types (as measured by richness) than did SUSC. These results suggest that, even though smaller by all anatomical metrics (see Table 20), LTDU foraged in areas of higher potential prey abundance and consumed more total prey biomass than did SUSC. Similar findings have been reported in previous studies (e.g. Goudie and Ankney 1986).

The types of prey consumed differed by duck species, especially within the two study areas. LTDU in CB mainly consumed ascidians, polychaetes, bivalves and crustaceans, whereas SUSC mainly consumed bivalves, polychaetes and nemerteans. These results are generally similar to data reported for the upper portion of Chesapeake Bay (Perry et al. 2004) with the exception of our higher reported importance of polychaetes and nemerteans and the lack of epifaunal bivalves (e.g. *Ischadium recurvum*) in SUSC diets. However, SUSC consumption of polychaetes has been reported elsewhere (e.g. Lacroix et al. 2005), especially when similar methods to ours were used that diminish bias towards soft-bodied prey (Anderson et al. 2008). In HIB, LTDU mainly consumed crustaceans, polychaetes, gastropods and some bivalves, but SUSC mainly ate bivalves along with some gastropods and polychaetes. In both study areas LTDU consumed a more diverse suite of prey than SUSC, which is similar to findings in other Atlantic regions (Stott and Olsen 1973, Goudie and Ankney 1986)

There are two main ways to compare relative proportions of biomass of different prey items in the diets of sea ducks: mean % per bird or aggregate % (i.e. for all birds in the study pooled). Anderson et al. (2008) make valid arguments for analyzing data using the former and that is the approach we have generally taken here. However, for comparison of benthic prey to actual diets, we calculated aggregate % biomass for eight of the dominant prey taxa. Replicate benthic grab samples were combined within each foraging area sampled and approximated an aggregate calculation. We wanted to follow a similar technique by using aggregate esophagus biomass as well for these comparisons. We limited analysis to those ducks that had measurable prey biomass in their esophagus, since we feel this is the most robust characterization of sea duck diet. This meant excluding individuals that had gizzard contents only.

In this analysis, the contrasts between relative proportions of prey availability compared to actual diets are striking (Figure 23). Aggregate % diet of LTDU in both study areas contains a disproportionate amount of crustaceans, especially those in the orders *Thalassinidea* and *Caridea*. These are burrowing shrimp and true shrimp (mainly *Crangon septemspinosa*), respectively. Similar results for crustaceans have been reported for LTDU foraging in

Figure 23. Aggregate % of prey biomass observed in benthic vs. esophagus samples for LTDU and SUSC in both Chesapeake Bay and Hog Island Bay study areas.



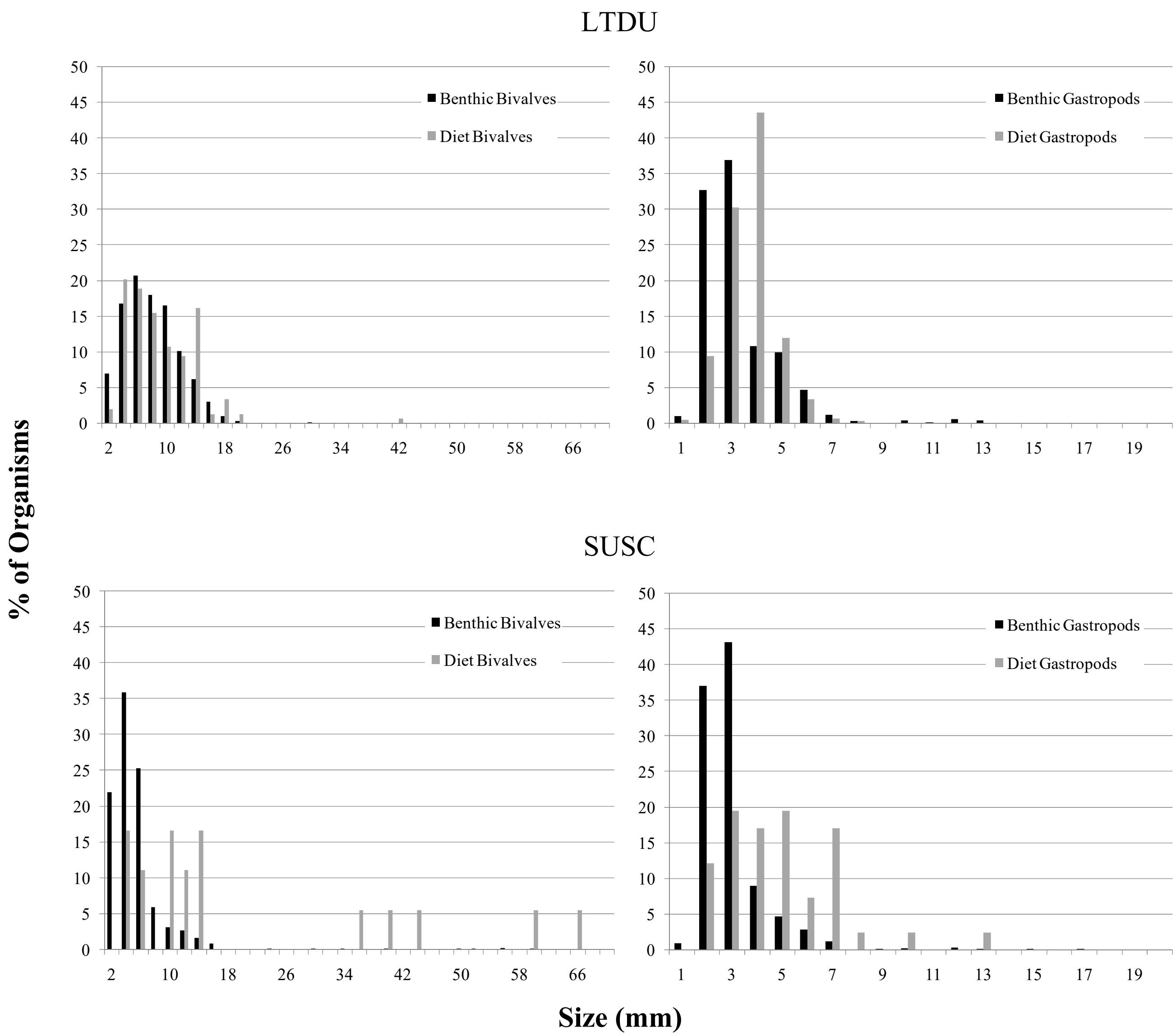
soft-sediments in the Baltic Sea (Zydelis and Ruskyte 2005), but contrast somewhat with those in the upper Chesapeake Bay (Perry et al. 2004). Other crustaceans included amphipods, isopods and some brachyurans are included in the "Other" category because of their minimal importance in diets. Two aspects of these thalassinideans and carideans are significant. The former are burrowers that are often found deep enough in the sediment to be undersampled by our Smith–McIntyre grab unless they happen to be near the opening or out of their burrows moving around. *Crangon* on the other hand are typically highly mobile shallow burrowers that may be considered nearly demersal (i.e. found on or near the seabed). Furthermore, in CB ascidians (mainly *Molgula manhattensis*) and demersal teleosts were important diet components for several individual birds, although rarely present in benthic samples. *Molgula* are benthic organisms growing on coarse sediments, vegetation/hydroids or hard substrate.

SUSC consumed bivalves (especially in HIB) and nemerteans in CB disproportionately to their availability in benthic samples (Figure 23). Nemerteans are relatively large infaunal worms and along with polychaetes, comprised ~65 % of the aggregate diet of SUSC which is comparable to results for several areas on the west coast (Anderson et al. 2008).

These results further accentuate the observations that LTDU tend to have a more diverse diet than SUSC. It also appears that their diet consists of infaunal, epifaunal and demersal organisms which suggests that LTDU are opportunistic generalists relative to SUSC which predominantly foraged on larger infaunal organisms (nemerteans and bivalves), even in areas of diverse prey availability (e.g. Fig. 14). The characteristics of species-specific segregations in some of the principle components analyses further support this conclusion (Figs. 19 & 20).

Comparisons of the sizes of bivalves and gastropods in benthic samples to that of gut samples (esophagi and gizzards combined) show that both LTDU and SUSC select larger individuals than are proportionally available in foraging areas. This trend is especially evident for SUSC (Fig. 24) and is similar to previous results for SUSC (Anderson et al. 2008).

Figure 24. Size frequency distribution of bivalves and gastropods sampled in LTDU and SUSC foraging areas (benthic samples) and found in their diets (esophagi and gizzards combined). Data pooled for both study areas.



Conclusions

Both study areas appear to be important to LTDU and SUSC, but for potentially different reasons. Data from this study suggest that the lower Chesapeake Bay and Atlantic coastal bays are important to LTDU throughout the winter. Similarly, SUSC used the lower Chesapeake Bay site throughout the winter. In contrast, SUSC appear to use the coastal bays as a staging area for subsequent regional movements or further southward migration; though this does not necessarily diminish the importance of these habitats to them.

Diets documented in this study show similarities and contrasts to those of sea ducks in the upper Chesapeake Bay. This is to be expected since salinity and benthic prey resources exhibit similarities and difference across the regions. Perry et al. (2004) suggest that sea ducks in the upper Bay use degraded oyster and gravel beds. We found some evidence of that in the lower Bay as well, but only minor use of healthy intertidal oyster reefs in HIB. However, the overall density of potential prey was much higher in this coastal bay than in CB (Table 12). This may suggest that in areas of very productive benthic communities, the importance of epifaunal oyster bed communities diminishes. If this is indeed the case, then the inverse may be inferred; as benthic (especially infaunal) communities diminish in eutrophied estuaries such as Chesapeake Bay, hard substrate communities may become relatively more important to sea ducks.

There appears to be segregation between these two sea duck species across many levels. We documented subtle, but possibly important, temporal and spatial differences. The abiotic and biotic components of habitat are often closely related and we observed differences between species for several aspects: bathymetry, sediment characteristics and diet. It appears that LTDU and SUSC exploit different dietary resources with the region, albeit with some overlap. These results are similar to those for multiple sea duck species in coastal Newfoundland (Goudie and Ankney 1988).

Several aspects of sea duck conservation are suggested by our data. Both the lower Chesapeake Bay and seaward coastal lagoons are important to both LTDU and SUSC, but species-specific habitat needs are at least partially different in both time and space. This suggests individual management perspectives for each species (e.g. protecting infaunal benthos vs. mobile crustaceans). Spatial analyses of prey availability, duck foraging sites and diet composition can be used to better understand foraging ecology and inform conservation strategies. For example, spatially explicit plots of the relative diet proportion of individual ducks (e.g. see Figs. 25 & 26) can suggest management options tied directly to anthropogenic activities such as hunting pressure, commercial wild fisheries and aquaculture development.

This study implies that the relationships between sea ducks and soft and hard bottom habitats in the mid-Atlantic are complex. In the face of continued habitat degradation and shoreline development, this type of detailed habitat data will be very meaningful and have practical impacts on sea duck conservation.

Figure 25. Distribution of sea ducks collected and represented as pie charts depicting the relative proportions of the dominant prey taxa observed in their esophagi (dry tissue biomass) in the Chesapeake Bay study area. Closely clustered pies are artificially spread out slightly so charts do not overlap. Charts with asterisks (*) are results for SUSC and all other are LTDU.

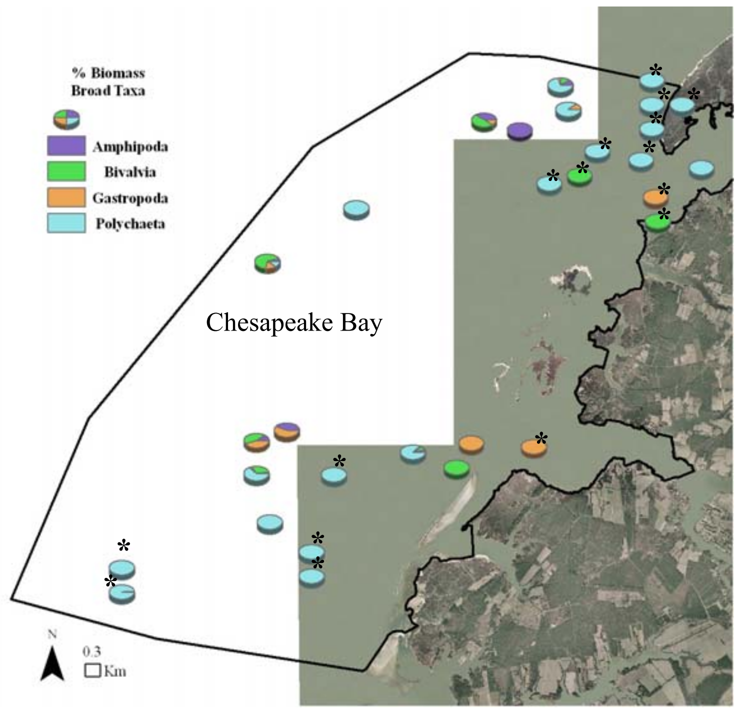
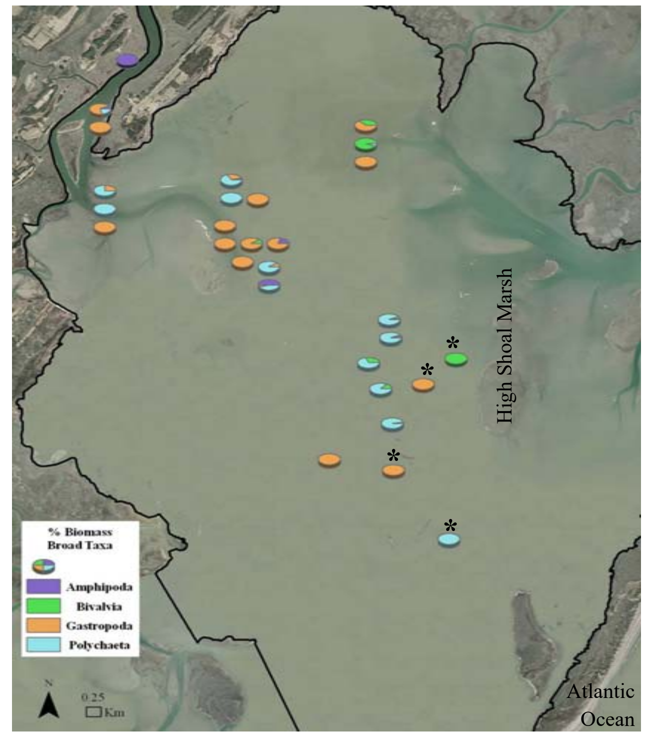


Figure 26. Distribution of sea ducks collected and represented as pie charts depicting the relative proportions of the dominant prey taxa observed in their esophagi (dry tissue biomass) in the HIB study area. Closely clustered pies are artificially spread out so charts do not overlap. Charts with asterisks (*) are results for SUSC and all other are LTDU.



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LIST OF APPENDICES

Appendix I. List of collaborators for sea duck tissue/organ samples.

Sample Type	Metric	Transferred/Archived	Contact
Heart Tissue	Genetic Database	Transferred	John Pearce USGS, Alaska Science Center john_m_pearce@usgs.gov
Primary Feathers	Stable Isotope	Transferred	Tim Bowman USFWS, Alaska Tim_Bowman@fws.gov
Lower Intestine	Parasite ID	Transferred	Terry Miller Queensland Museum, Australia
Multiple Tissues	Heavy Metal Accumulation	Archived -80ºC @ Eastern Shore Lab, Wachapreague, VA	Dan Cristol College of William & Mary dacris@wm.edu

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
10/24/08	B1	BAYSIDE	1	SUSC	1	-75.804079891	37.729685390	1962	1-730	>50	>50
10/24/08	B2	BAYSIDE	2	SUSC	2	-75.889983987	37.657531192	1962	1-730	>50	>50
10/24/08	B3	BAYSIDE	3	SUSC	86	-75.901020706	37.637963661	7013	1-730	>50	>50
10/24/08	B4	BAYSIDE	4	SUSC	510	-75.908276368	37.635407289	18457	1-730	>50	>50
10/24/08	B5	BAYSIDE	5	SUSC	2	-75.920304931	37.639632761	1962	>730	>50	>50
10/24/08	B6	BAYSIDE	6	SUSC	475	-75.912785427	37.658773086	6915	>730	>50	>50
10/24/08	B7	BAYSIDE	7	SUSC	450	-75.899850422	37.666496749	17004	>730	>50	>50
10/24/08	B8	BAYSIDE	8	SUSC	3	-75.889225743	37.684251826	1962	>730	>50	>50
10/24/08	B9	BAYSIDE	9	SUSC	300	-75.917433904	37.653791583	4442	>730	>50	>50
10/24/08	B10	BAYSIDE	10	SUSC	120	-75.923528941	37.648765178	4442	>730	>50	>50
10/24/08	B11	BAYSIDE	11	SUSC	102	-75.947475637	37.646970679	1962	>730	>50	>50
10/24/08	B12	BAYSIDE	12	SUSC	250	-75.939000320	37.657167644	6871	>730	>50	>50
10/24/08	B13	BAYSIDE	13	SUSC	175	-75.925052940	37.668789158	1962	>730	>50	>50
10/24/08	B14	BAYSIDE	14	SUSC	5	-75.884156395	37.701450882	1962	>730	>50	>50
10/24/08	B15	BAYSIDE	15	SUSC	15	-75.897290142	37.700324168	7848	>730	>50	>50
10/24/08	B16	BAYSIDE	16	SUSC	150	-75.929520777	37.669594667	6871	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
10/24/08	B17	BAYSIDE	17	SUSC	600	-75.945346366	37.658279871	256517	>730	>50	>50
10/24/08	B18	BAYSIDE	18	SUSC	900	-75.942102106	37.673754625	347609	>730	>50	>50
10/24/08	B19	BAYSIDE	19	SUSC	630	-75.930344215	37.680838866	154937	>730	>50	>50
10/24/08	B20	BAYSIDE	20	SUSC	650	-75.920412880	37.691923356	30306	>730	>50	>50
11/7/08	B21	BAYSIDE	21	SUSC	250	-75.907421207	37.643719402	31391	>730	>50	>50
11/7/08	B22	BAYSIDE	22	SUSC	250	-75.907475888	37.652176831	31391	>730	>50	>50
11/7/08	B23	BAYSIDE	23	SUSC	15	-75.903861024	37.656305200	1962	>730	>50	>50
11/7/08	B24	BAYSIDE	24	SUSC	100	-75.929730512	37.663069275	4449	>730	>50	>50
11/7/08	B25	BAYSIDE	25	SUSC	32	-75.953139291	37.681756726	1962	>730	>50	>50
11/7/08	B26	BAYSIDE	26	SUSC	475	-75.949006520	37.649925590	325392	>730	>50	>50
11/7/08	B27	BAYSIDE	27	MIXED	25	-75.914107695	37.723150580	1962	>730	>50	>50
11/7/08	B28	BAYSIDE	28	SUSC	7	-75.874966682	37.701499254	1962	>730	>50	>50
11/7/08	B29	BAYSIDE	29	SUSC	18	-75.890265212	37.685868793	4451	>730	>50	>50
11/7/08	B30	BAYSIDE	30	SUSC	72	-75.900848190	37.683086451	6952	>730	>50	>50
11/7/08	B31	BAYSIDE	31	SUSC	28	-75.905764552	37.676043753	1962	>730	>50	>50
11/7/08	B32	BAYSIDE	32	SUSC	1000	-75.872966391	37.724994731	290403	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
11/7/08	B33	BAYSIDE	33	SUSC	7	-75.895049440	37.700045945	1962	>730	>50	>50
11/7/08	B34	BAYSIDE	34	SUSC	60	-75.853215318	37.715530917	6938	>730	>50	>50
11/7/08	B35	BAYSIDE	35	SUSC	14	-75.886715568	37.690305348	1962	>730	>50	>50
11/7/08	B36	BAYSIDE	36	SUSC	26	-75.893149727	37.684054791	1962	>730	>50	>50
11/20/08	B37	BAYSIDE	37	SUSC	4	-75.890475561	37.654084855	1959	1-730	>50	>50
11/20/08	B38	BAYSIDE	38	SUSC	26	-75.906659334	37.639702384	1962	1-730	>50	>50
11/20/08	B39	BAYSIDE	39	SUSC	3	-75.886030228	37.659679046	1962	1-730	>50	>50
11/20/08	B40	BAYSIDE	40	SUSC	5	-75.886900384	37.661349001	1962	1-730	>50	>50
11/20/08	B41	BAYSIDE	41	SUSC	5	-75.880708890	37.666046143	1962	1-730	>50	>50
11/20/08	B42	BAYSIDE	42	SUSC	4	-75.851486673	37.711218213	4441	1-730	>50	>50
11/20/08	B43	BAYSIDE	43	SUSC	21	-75.843129530	37.720679999	4441	>730	>50	>50
11/20/08	B44	BAYSIDE	44	SUSC	20	-75.836819142	37.727784837	9389	1-730	>50	>50
11/20/08	B45	BAYSIDE	45	SUSC	4	-75.833204718	37.733607253	4441	1-730	>50	>50
11/20/08	B46	BAYSIDE	46	SUSC	7	-75.837858071	37.738309998	1962	>730	>50	>50
11/20/08	B47	BAYSIDE	47	SUSC	19	-75.849149301	37.729017686	9389	>730	>50	>50
11/20/08	B48	BAYSIDE	48	SUSC	8	-75.854879790	37.722641171	4441	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
11/20/08	B49	BAYSIDE	49	SUSC	7	-75.864438626	37.718821094	1962	>730	>50	>50
11/20/08	B50	BAYSIDE	50	SUSC	4	-75.855084008	37.716392695	1962	>730	>50	>50
11/20/08	B51	BAYSIDE	51	SUSC	4	-75.870406931	37.704354433	1962	>730	>50	>50
11/20/08	B52	BAYSIDE	52	SUSC	3	-75.881631960	37.692312490	1962	>730	>50	>50
11/20/08	B53	BAYSIDE	53	SUSC	3	-75.883504299	37.686647248	1962	>730	>50	>50
11/20/08	B54	BAYSIDE	54	SUSC	2	-75.885641614	37.680403148	1962	>730	>50	>50
11/20/08	B55	BAYSIDE	55	SUSC	3	-75.893964520	37.667326430	1962	>730	>50	>50
11/20/08	B56	BAYSIDE	56	SUSC	2	-75.900320718	37.653559063	1962	>730	>50	>50
11/20/08	B57	BAYSIDE	57	SUSC	17	-75.896827236	37.659762343	4434	>730	>50	>50
11/20/08	B58	BAYSIDE	58	SUSC	40	-75.917158695	37.639408072	17810	>730	>50	>50
11/20/08	B59	BAYSIDE	59	SUSC	16	-75.905747530	37.641537130	4434	>730	>50	>50
11/20/08	B60	BAYSIDE	60	SUSC	7	-75.918218802	37.636818883	1962	>730	>50	>50
11/20/08	B61	BAYSIDE	61	SUSC	32	-75.913945438	37.646027473	4456	>730	>50	>50
11/20/08	B62	BAYSIDE	62	SUSC	2	-75.908333037	37.653353464	1962	>730	>50	>50
11/20/08	B63	BAYSIDE	63	SUSC	6	-75.905257171	37.658649769	1962	>730	>50	>50
11/20/08	B64	BAYSIDE	64	SUSC	2	-75.901283068	37.664709988	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
11/20/08	B65	BAYSIDE	65	SUSC	16	-75.902671611	37.662337938	1962	>730	>50	>50
11/20/08	B66	BAYSIDE	66	SUSC	18	-75.898664838	37.668542524	1962	>730	>50	>50
11/20/08	B67	BAYSIDE	67	SUSC	5	-75.896268442	37.671985767	1962	>730	>50	>50
11/20/08	B68	BAYSIDE	68	SUSC	3	-75.889789340	37.681111006	1962	>730	>50	>50
11/20/08	B69	BAYSIDE	69	SUSC	1	-75.874676366	37.706555595	1962	>730	>50	>50
11/20/08	B70	BAYSIDE	70	SUSC	4	-75.875936383	37.709515842	1962	>730	>50	>50
11/20/08	B71	BAYSIDE	71	SUSC	4	-75.862169202	37.740254254	1962	>730	>50	>50
11/20/08	B72	BAYSIDE	72	SUSC	26	-75.867252151	37.740554889	6820	>730	>50	>50
11/20/08	B73	BAYSIDE	73	SUSC	1	-75.879862481	37.722050840	1962	>730	>50	>50
11/20/08	B74	BAYSIDE	74	SUSC	3	-75.880875003	37.720357833	1962	>730	>50	>50
11/20/08	B75	BAYSIDE	75	SUSC	4	-75.894731582	37.698544664	1962	>730	>50	>50
11/20/08	B76	BAYSIDE	76	SUSC	3	-75.893411702	37.695684842	1962	>730	>50	>50
11/20/08	B77	BAYSIDE	77	SUSC	3	-75.903476359	37.672606727	1962	>730	>50	>50
11/20/08	B78	BAYSIDE	78	SUSC	28	-75.906284087	37.666307585	4442	>730	>50	>50
11/20/08	B79	BAYSIDE	79	SUSC	5	-75.925046483	37.648167189	1962	>730	>50	>50
11/20/08	B80	BAYSIDE	80	SUSC	6	-75.912250324	37.652935622	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
11/20/08	B81	BAYSIDE	81	SUSC	17	-75.914162670	37.648955036	1962	>730	>50	>50
11/20/08	B82	BAYSIDE	82	SUSC	60	-75.909900765	37.667631654	6870	>730	>50	>50
11/20/08	B83	BAYSIDE	83	SUSC	38	-75.917547843	37.642687030	4446	>730	>50	>50
11/20/08	B84	BAYSIDE	84	SUSC	11	-75.902091832	37.678162045	1962	>730	>50	>50
11/20/08	B85	BAYSIDE	85	SUSC	2	-75.897232819	37.686156035	1962	>730	>50	>50
11/20/08	B86	BAYSIDE	86	SUSC	3	-75.900708118	37.686564218	1962	>730	>50	>50
11/20/08	B87	BAYSIDE	87	SUSC	7	-75.905342161	37.685246846	1962	>730	>50	>50
11/20/08	B88	BAYSIDE	88	SUSC	2	-75.901241420	37.689388208	1962	>730	>50	>50
11/20/08	B89	BAYSIDE	89	SUSC	5	-75.900413193	37.692179568	1962	>730	>50	>50
11/20/08	B90	BAYSIDE	90	SUSC	3	-75.892015008	37.713541305	1962	>730	>50	>50
11/20/08	B91	BAYSIDE	91	SUSC	3	-75.889833296	37.721795722	1962	>730	>50	>50
11/20/08	B92	BAYSIDE	92	SUSC	1170	-75.911051959	37.716554405	1084069	>730	>50	>50
11/20/08	B93	BAYSIDE	93	SUSC	2	-75.907159725	37.683982167	1962	>730	>50	>50
11/20/08	B94	BAYSIDE	94	SUSC	2	-75.911722038	37.679240468	1958	>730	>50	>50
11/20/08	B95	BAYSIDE	95	SUSC	9	-75.914106908	37.673056559	4447	>730	>50	>50
11/20/08	B96	BAYSIDE	96	SUSC	2	-75.917833937	37.663563877	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
11/20/08	B97	BAYSIDE	97	SUSC	2	-75.920371486	37.658803181	1962	>730	>50	>50
12/8/08	B98	BAYSIDE	98	SUSC	12	-75.902656176	37.658843629	1962	>730	>50	>50
12/8/08	B99	BAYSIDE	99	SUSC	10	-75.880630057	37.665092878	1962	1-730	>50	>50
12/8/08	B100	BAYSIDE	100	SUSC	5	-75.836564778	37.715155577	1962	1-730	>50	>50
12/8/08	B101	BAYSIDE	101	SUSC	1	-75.831111519	37.719583514	1962	1-730	>50	>50
12/8/08	B102	BAYSIDE	102	SUSC	62	-75.848245982	37.732591342	6917	>730	>50	>50
12/8/08	B103	BAYSIDE	103	MIXED	55	-75.849800917	37.727845321	6968	>730	>50	>50
12/8/08	B104	BAYSIDE	104	SUSC	10	-75.852147974	37.722560863	1962	>730	>50	>50
12/8/08	B105	BAYSIDE	105	SUSC	35	-75.857503703	37.711733412	4459	>730	>50	>50
12/8/08	B106	BAYSIDE	106	SUSC	6	-75.876750062	37.681143770	1962	1-730	>50	>50
12/8/08	B107	BAYSIDE	107	SUSC	6	-75.878155660	37.677412699	1962	>730	>50	>50
12/8/08	B108	BAYSIDE	108	SUSC	20	-75.879813382	37.674390047	4459	1-730	>50	>50
12/8/08	B109	BAYSIDE	109	SUSC	21	-75.884414155	37.664891761	1962	1-730	>50	>50
12/8/08	B110	BAYSIDE	110	SUSC	20	-75.902337211	37.646522181	9472	>730	>50	>50
12/8/08	B111	BAYSIDE	111	SUSC	18	-75.912549318	37.635682151	1962	>730	>50	>50
12/8/08	B112	BAYSIDE	112	SUSC	9	-75.905136295	37.662948359	9275	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
12/8/08	B113	BAYSIDE	113	SUSC	2	-75.902063724	37.668318275	1962	>730	>50	>50
12/8/08	B114	BAYSIDE	114	SUSC	2	-75.894988381	37.676026090	1962	>730	>50	>50
12/8/08	B115	BAYSIDE	115	SUSC	15	-75.890867523	37.681052656	4462	>730	>50	>50
12/8/08	B116	BAYSIDE	116	SUSC	6	-75.881505448	37.692984089	7848	>730	>50	>50
12/8/08	B117	BAYSIDE	117	SUSC	7	-75.867492501	37.709597084	1962	>730	>50	>50
12/8/08	B118	BAYSIDE	118	SUSC	3	-75.863782161	37.714123018	1962	>730	>50	>50
12/8/08	B119	BAYSIDE	119	SUSC	15	-75.859388575	37.720705693	1962	>730	>50	>50
12/8/08	B120	BAYSIDE	120	SUSC	64	-75.858404141	37.742585030	17663	>730	>50	>50
12/8/08	B121	BAYSIDE	121	SUSC	19	-75.876291846	37.723321228	1962	>730	>50	>50
12/8/08	B122	BAYSIDE	122	SUSC	33	-75.878743877	37.725862592	1962	>730	>50	>50
12/8/08	B123	BAYSIDE	123	LTDU	4	-75.874236533	37.722227891	1962	>730	>50	>50
12/8/08	B124	BAYSIDE	124	SUSC	2	-75.877617329	37.717371760	1962	>730	>50	>50
12/8/08	B125	BAYSIDE	125	LTDU	8	-75.879792118	37.714182942	1962	>730	>50	>50
12/8/08	B126	BAYSIDE	126	SUSC	4	-75.886971994	37.705500731	1962	>730	>50	>50
12/8/08	B127	BAYSIDE	127	SUSC	2	-75.888037690	37.702548355	1962	>730	>50	>50
12/8/08	B128	BAYSIDE	128	SUSC	5	-75.893526708	37.693926415	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
12/8/08	B129	BAYSIDE	129	SUSC	5	-75.900667550	37.681325864	1962	>730	>50	>50
12/8/08	B130	BAYSIDE	130	LTDU	10	-75.901577673	37.679858413	4459	>730	>50	>50
12/8/08	B131	BAYSIDE	131	SUSC	4	-75.911760325	37.663854346	1962	>730	>50	>50
12/8/08	B132	BAYSIDE	132	SUSC	5	-75.923908176	37.646869187	1962	>730	>50	>50
12/8/08	B133	BAYSIDE	133	SUSC	17	-75.928891573	37.642821819	1962	>730	>50	>50
12/8/08	B134	BAYSIDE	134	LTDU	2	-75.929229641	37.657291655	1962	>730	>50	>50
12/8/08	B135	BAYSIDE	135	SUSC	6	-75.921992508	37.669786552	1962	>730	>50	>50
12/8/08	B136	BAYSIDE	136	LTDU	5	-75.918237638	37.676088949	1962	>730	>50	>50
12/8/08	B137	BAYSIDE	137	SUSC	4	-75.901163406	37.703955401	1962	>730	>50	>50
12/8/08	B138	BAYSIDE	138	SUSC	58	-75.890611671	37.722241898	9557	>730	>50	>50
12/8/08	B139	BAYSIDE	139	SUSC	71	-75.876543222	37.740091397	9259	>730	>50	>50
12/8/08	B140	BAYSIDE	140	SUSC	21	-75.878660794	37.742501627	4457	>730	>50	>50
12/8/08	B141	BAYSIDE	141	SUSC	77	-75.900415287	37.729707855	17753	>730	>50	>50
12/8/08	B142	BAYSIDE	142	LTDU	3	-75.904909912	37.723393425	1962	>730	>50	>50
12/8/08	B143	BAYSIDE	143	LTDU	77	-75.913767386	37.715339112	47477	>730	>50	>50
12/8/08	B144	BAYSIDE	144	LTDU	32	-75.916139930	37.708363061	4434	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
12/8/08	B145	BAYSIDE	145	SUSC	37	-75.925975736	37.694489319	6955	>730	>50	>50
12/8/08	B146	BAYSIDE	146	SUSC	9	-75.932450515	37.685477231	1962	>730	>50	>50
12/8/08	B147	BAYSIDE	147	LTDU	3	-75.937796739	37.677728648	1962	>730	>50	>50
12/8/08	B148	BAYSIDE	148	LTDU	5	-75.950119694	37.659331854	1962	>730	>50	>50
12/8/08	B149	BAYSIDE	149	SUSC	21	-75.949235491	37.658772739	7848	>730	>50	>50
12/8/08	B150	BAYSIDE	150	SUSC	34	-75.957720787	37.645049261	1962	>730	>50	>50
12/8/08	B151	BAYSIDE	151	SUSC	100	-75.965227486	37.655829594	17764	>730	>50	>50
12/8/08	B152	BAYSIDE	152	LTDU	6	-75.954335335	37.671908714	1962	>730	>50	>50
12/8/08	B153	BAYSIDE	153	SUSC	3	-75.942189711	37.689641379	1962	>730	>50	>50
12/8/08	B154	BAYSIDE	154	SUSC	3	-75.933151850	37.704336024	1962	>730	>50	>50
12/8/08	B155	BAYSIDE	155	LTDU	22	-75.928359939	37.711234435	4486	>730	>50	>50
12/8/08	B156	BAYSIDE	156	LTDU	12	-75.911654016	37.727415393	17882	>730	>50	>50
12/23/08	B157	BAYSIDE	157	SUSC	16	-75.833655671	37.716510516	4395	1-730	>50	>50
12/23/08	B158	BAYSIDE	158	LTDU	3	-75.833682638	37.733450425	1962	1-730	>50	>50
12/23/08	B159	BAYSIDE	159	SUSC	43	-75.843580002	37.722469296	7848	>730	>50	>50
12/23/08	B160	BAYSIDE	160	SUSC	2	-75.848505863	37.715620030	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
12/23/08	B161	BAYSIDE	161	SUSC	4	-75.895219807	37.653597910	1962	1-730	>50	>50
12/23/08	B162	BAYSIDE	162	SUSC	13	-75.908229704	37.636490621	7848	1-730	>50	>50
12/23/08	B163	BAYSIDE	163	LTDU	2	-75.911628336	37.648424869	1962	>730	>50	>50
12/23/08	B163	BAYSIDE	163	SUSC	1	-75.886171474	37.709051602	1962	>730	>50	>50
12/23/08	B164	BAYSIDE	164	SUSC	2	-75.898797146	37.660709098	1962	>730	>50	>50
12/23/08	B165	BAYSIDE	165	LTDU	3	-75.894233819	37.664961931	1962	>730	>50	>50
12/23/08	B166	BAYSIDE	166	LTDU	9	-75.890472786	37.669028268	1962	>730	>50	>50
12/23/08	B167	BAYSIDE	167	MIXED	9	-75.889109590	37.670715005	1962	>730	>50	>50
12/23/08	B168	BAYSIDE	168	SUSC	2	-75.859674236	37.710077198	1962	1-730	>50	>50
12/23/08	B169	BAYSIDE	169	SUSC	3	-75.849000651	37.724178897	1962	>730	>50	>50
12/23/08	B170	BAYSIDE	170	SUSC	27	-75.841376372	37.735951475	4412	>730	>50	>50
12/23/08	B171	BAYSIDE	171	SUSC	49	-75.852513763	37.728858271	12845	>730	>50	>50
12/23/08	B172	BAYSIDE	172	SUSC	2	-75.891823096	37.680689722	1962	>730	>50	>50
12/23/08	B173	BAYSIDE	173	SUSC	5	-75.893546505	37.680738120	1962	>730	>50	>50
12/23/08	B174	BAYSIDE	174	SUSC	4	-75.901537732	37.670764870	1962	>730	>50	>50
12/23/08	B175	BAYSIDE	175	SUSC	4	-75.907766932	37.662722456	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
12/23/08	B176	BAYSIDE	176	SUSC	10	-75.923346513	37.645449521	1962	>730	>50	>50
12/23/08	B177	BAYSIDE	177	LTDU	2	-75.931851806	37.652115439	1962	>730	>50	>50
12/23/08	B178	BAYSIDE	178	LTDU	2	-75.929940060	37.654123755	1962	>730	>50	>50
12/23/08	B179	BAYSIDE	179	SUSC	19	-75.918335516	37.668670644	1962	>730	>50	>50
12/23/08	B180	BAYSIDE	180	LTDU	1	-75.917654551	37.669598375	1962	>730	>50	>50
12/23/08	B181	BAYSIDE	181	MIXED	4	-75.914482315	37.674090185	1962	>730	>50	>50
12/23/08	B182	BAYSIDE	182	LTDU	2	-75.902823969	37.688015127	1962	>730	>50	>50
12/23/08	B183	BAYSIDE	183	SUSC	3	-75.899696743	37.692022820	1962	>730	>50	>50
12/23/08	B184	BAYSIDE	184	SUSC	6	-75.893527681	37.699676768	1962	>730	>50	>50
12/23/08	B185	BAYSIDE	185	SUSC	2	-75.891594698	37.702133955	1962	>730	>50	>50
12/23/08	B186	BAYSIDE	186	LTDU	2	-75.884465801	37.708999629	1962	>730	>50	>50
12/23/08	B188	BAYSIDE	188	SUSC	2	-75.878547416	37.717346814	1962	>730	>50	>50
12/23/08	B189	BAYSIDE	189	SUSC	3	-75.874879424	37.721898655	1962	>730	>50	>50
12/23/08	B190	BAYSIDE	190	SUSC	9	-75.873357659	37.724914770	1962	>730	>50	>50
12/23/08	B191	BAYSIDE	191	SUSC	17	-75.870406697	37.728048573	1962	>730	>50	>50
12/23/08	B192	BAYSIDE	192	LTDU	9	-75.860440097	37.737056739	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
12/23/08	B194	BAYSIDE	194	SUSC	47	-75.872290749	37.737240033	7848	>730	>50	>50
12/23/08	B195	BAYSIDE	195	LTDU	4	-75.888151816	37.723698276	1962	>730	>50	>50
12/23/08	B196	BAYSIDE	196	SUSC	3	-75.902335717	37.711362741	1962	>730	>50	>50
12/23/08	B197	BAYSIDE	197	LTDU	1	-75.904039716	37.711396412	1962	>730	>50	>50
12/23/08	B198	BAYSIDE	198	LTDU	1	-75.912194615	37.702102552	1962	>730	>50	>50
12/23/08	B199	BAYSIDE	199	LTDU	1	-75.918533391	37.695473800	1962	>730	>50	>50
12/23/08	B200	BAYSIDE	200	LTDU	2	-75.920411359	37.693266422	9266	>730	>50	>50
12/23/08	B201	BAYSIDE	201	LTDU	2	-75.944307296	37.667518236	1962	>730	>50	>50
12/23/08	B202	BAYSIDE	202	LTDU	1	-75.928474825	37.703165207	1962	>730	>50	>50
12/23/08	B203	BAYSIDE	203	LTDU	2	-75.925591644	37.706666906	1962	>730	>50	>50
12/23/08	B204	BAYSIDE	204	LTDU	5	-75.922526690	37.710169966	1962	>730	>50	>50
12/23/08	B205	BAYSIDE	205	LTDU	2	-75.918910799	37.714100846	1962	>730	>50	>50
12/23/08	B206	BAYSIDE	206	SUSC	12	-75.920052294	37.714132970	1962	>730	>50	>50
12/23/08	B207	BAYSIDE	207	LTDU	4	-75.910717293	37.724132874	1962	>730	>50	>50
12/23/08	B208	BAYSIDE	208	SUSC	3	-75.907340925	37.728268847	1962	>730	>50	>50
12/23/08	B209	BAYSIDE	209	SUSC	8	-75.902652988	37.731944742	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
1/17/09	B210	BAYSIDE	210	SUSC	14	-75.897211715	37.647670106	1962	1-730	>50	>50
1/17/09	B211	BAYSIDE	211	SUSC	4	-75.875179672	37.674099977	1962	1-730	>50	>50
1/17/09	B212	BAYSIDE	212	SUSC	36	-75.858245926	37.723837521	12835	>730	>50	>50
1/17/09	B213	BAYSIDE	213	SUSC	62	-75.847900824	37.727224308	9456	>730	>50	>50
1/17/09	B214	BAYSIDE	214	SUSC	1	-75.858804207	37.716875024	1962	>730	>50	>50
1/17/09	B215	BAYSIDE	215	LTDU	7	-75.869125237	37.704315960	1962	>730	>50	>50
1/17/09	B216	BAYSIDE	216	SUSC	15	-75.871237793	37.701764004	9365	>730	>50	>50
1/17/09	B217	BAYSIDE	217	MIXED	16	-75.884182555	37.683177645	1962	>730	>50	>50
1/17/09	B218	BAYSIDE	218	SUSC	3	-75.894696284	37.667617194	1960	>730	>50	>50
1/17/09	B219	BAYSIDE	219	SUSC	15	-75.899960052	37.660436130	1962	>730	>50	>50
1/17/09	B220	BAYSIDE	220	SUSC	9	-75.905625774	37.653615759	1962	>730	>50	>50
1/17/09	B221	BAYSIDE	221	SUSC	6	-75.912302724	37.641461438	1961	>730	>50	>50
1/17/09	B222	BAYSIDE	222	SUSC	1	-75.922362392	37.641031763	1962	>730	>50	>50
1/17/09	B223	BAYSIDE	223	SUSC	6	-75.894336512	37.693704648	1959	>730	>50	>50
1/17/09	B224	BAYSIDE	224	SUSC	4	-75.879723242	37.713155986	1962	>730	>50	>50
1/17/09	B225	BAYSIDE	225	SUSC	3	-75.873781384	37.718256510	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
1/17/09	B226	BAYSIDE	226	SUSC	12	-75.870713035	37.720748755	1962	>730	>50	>50
1/17/09	B227	BAYSIDE	227	SUSC	42	-75.864504267	37.726200927	4557	>730	>50	>50
1/17/09	B228	BAYSIDE	228	LTDU	33	-75.869549936	37.737407480	6836	>730	>50	>50
1/17/09	B229	BAYSIDE	229	SUSC	19	-75.882681641	37.729211173	7849	>730	>50	>50
1/17/09	B230	BAYSIDE	230	SUSC	1	-75.896807413	37.717687016	1962	>730	>50	>50
1/17/09	B231	BAYSIDE	231	SUSC	1	-75.905431300	37.710616249	1962	>730	>50	>50
1/17/09	B232	BAYSIDE	232	SUSC	4	-75.904000509	37.710575802	1962	>730	>50	>50
1/17/09	B233	BAYSIDE	233	SUSC	2	-75.916914569	37.698496772	1962	>730	>50	>50
1/17/09	B234	BAYSIDE	234	LTDU	2	-75.928059584	37.686468436	1962	>730	>50	>50
1/17/09	B235	BAYSIDE	235	LTDU	7	-75.931172256	37.681138060	1962	>730	>50	>50
1/17/09	B236	BAYSIDE	236	SUSC	16	-75.946709802	37.658830369	1962	>730	>50	>50
1/17/09	B237	BAYSIDE	237	SUSC	14	-75.958222926	37.660902958	7849	>730	>50	>50
1/17/09	B238	BAYSIDE	238	LTDU	2	-75.957873466	37.671934113	1962	>730	>50	>50
1/17/09	B239	BAYSIDE	239	SUSC	8	-75.953298213	37.679808494	1962	>730	>50	>50
1/17/09	B240	BAYSIDE	240	SUSC	2	-75.935528716	37.703120277	1962	>730	>50	>50
1/17/09	B241	BAYSIDE	241	LTDU	2	-75.932588106	37.708234114	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
1/17/09	B242	BAYSIDE	242	LTDU	2	-75.932100948	37.708469862	1962	>730	>50	>50
1/17/09	B243	BAYSIDE	243	LTDU	12	-75.929904842	37.711391849	1962	>730	>50	>50
1/17/09	B244	BAYSIDE	244	SUSC	20	-75.918035227	37.719902078	7010	>730	>50	>50
2/10/09	B245	BAYSIDE	245	LTDU	2	-75.844686106	37.674816747	1962	1-730	>50	>50
2/10/09	B246	BAYSIDE	246	SUSC	2	-75.833413252	37.718026764	1962	1-730	>50	>50
2/10/09	B247	BAYSIDE	247	SUSC	1	-75.808711033	37.725615852	1962	1-730	>50	>50
2/10/09	B248	BAYSIDE	248	SUSC	16	-75.843262425	37.720479656	1962	>730	>50	>50
2/10/09	B249	BAYSIDE	249	SUSC	5	-75.848954421	37.714566767	1962	>730	>50	>50
2/10/09	B250	BAYSIDE	250	LTDU	1	-75.873752950	37.677785077	1962	1-730	1-50	>50
2/10/09	B251	BAYSIDE	251	LTDU	3	-75.876768718	37.673238546	7848	1-730	>50	>50
2/10/09	B252	BAYSIDE	252	SUSC	1	-75.877625854	37.669980813	1962	1-730	>50	>50
2/10/09	B253	BAYSIDE	253	SUSC	2	-75.904924626	37.634983777	1962	1-730	>50	>50
2/10/09	B254	BAYSIDE	254	LTDU	2	-75.907016038	37.651585646	1962	>730	>50	>50
2/10/09	B255	BAYSIDE	255	SUSC	2	-75.892693024	37.663371537	1962	>730	>50	>50
2/10/09	B256	BAYSIDE	256	SUSC	4	-75.894920466	37.664567861	1962	>730	>50	>50
2/10/09	B257	BAYSIDE	257	SUSC	14	-75.892121303	37.670335982	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
2/10/09	B258	BAYSIDE	258	SUSC	17	-75.867275282	37.710341628	1962	>730	>50	>50
2/10/09	B259	BAYSIDE	259	SUSC	3	-75.852958386	37.730892093	1962	>730	>50	>50
2/10/09	B260	BAYSIDE	260	MIXED	12	-75.860908619	37.738329982	1962	>730	>50	>50
2/10/09	B261	BAYSIDE	261	LTDU	3	-75.869172828	37.726825942	1962	>730	>50	>50
2/10/09	B262	BAYSIDE	262	SUSC	2	-75.870999310	37.722443842	1962	>730	>50	>50
2/10/09	B263	BAYSIDE	263	SUSC	83	-75.875063786	37.718235059	17835	>730	>50	>50
2/10/09	B264	BAYSIDE	264	SUSC	10	-75.884175131	37.709169663	1962	>730	>50	>50
2/10/09	B265	BAYSIDE	265	SUSC	2	-75.886771971	37.701999059	1962	>730	>50	>50
2/10/09	B266	BAYSIDE	266	SUSC	9	-75.889620747	37.697364188	1962	>730	>50	>50
2/10/09	B267	BAYSIDE	267	SUSC	10	-75.892528113	37.693888929	7848	>730	>50	>50
2/10/09	B268	BAYSIDE	268	SUSC	5	-75.894421716	37.688947021	1962	>730	>50	>50
2/10/09	B269	BAYSIDE	269	SUSC	6	-75.908834229	37.663971500	1962	>730	>50	>50
2/10/09	B270	BAYSIDE	270	SUSC	2	-75.908892792	37.693020802	1962	>730	>50	>50
2/10/09	B271	BAYSIDE	271	SUSC	6	-75.897260460	37.712001524	1962	>730	>50	>50
2/10/09	B272	BAYSIDE	272	LTDU	13	-75.881719458	37.733453387	4507	>730	>50	>50
2/10/09	B273	BAYSIDE	273	SUSC	9	-75.904814796	37.722276743	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
2/10/09	B274	BAYSIDE	274	LTDU	2	-75.910305081	37.713773291	1962	>730	>50	>50
2/10/09	B275	BAYSIDE	275	SUSC	7	-75.914144394	37.708587416	1962	>730	>50	>50
2/10/09	B276	BAYSIDE	276	SUSC	2	-75.918918710	37.703529261	1962	>730	>50	>50
2/10/09	B277	BAYSIDE	277	SUSC	2	-75.920548537	37.699748298	1962	>730	>50	>50
3/5/09	B278	BAYSIDE	278	SUSC	3	-75.861948422	37.671366434	1962	1-730	1-50	>50
3/5/09	B279	BAYSIDE	279	SUSC	22	-75.831241812	37.714542648	9378	1-730	1-50	>50
3/5/09	B280	BAYSIDE	280	LTDU	2	-75.855989482	37.710920966	1962	1-730	>50	>50
3/5/09	B281	BAYSIDE	281	LTDU	2	-75.870723381	37.676052744	1962	1-730	>50	>50
3/5/09	B282	BAYSIDE	282	SUSC	3	-75.888859901	37.657386451	1962	1-730	>50	>50
3/5/09	B283	BAYSIDE	283	LTDU	1	-75.886928371	37.671527557	1962	>730	>50	>50
3/5/09	B284	BAYSIDE	284	SUSC	27	-75.866562975	37.704429645	1962	1-730	>50	>50
3/5/09	B285	BAYSIDE	285	LTDU	3	-75.859967527	37.740053884	1962	>730	>50	>50
3/5/09	B286	BAYSIDE	286	LTDU	30	-75.869973561	37.720582989	7848	>730	>50	>50
3/5/09	B287	BAYSIDE	287	SUSC	3	-75.875593552	37.714667645	1962	>730	>50	>50
3/5/09	B288	BAYSIDE	288	SUSC	21	-75.880356829	37.697000214	1962	>730	>50	>50
3/5/09	B289	BAYSIDE	289	MIXED	3	-75.896558738	37.670667620	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
3/5/09	B290	BAYSIDE	290	MIXED	10	-75.902047635	37.659494551	1962	>730	>50	>50
3/5/09	B291	BAYSIDE	291	SUSC	3	-75.910095773	37.646381709	1962	>730	>50	>50
3/5/09	B292	BAYSIDE	292	LTDU	1	-75.922392581	37.652224375	1962	>730	>50	>50
3/5/09	B293	BAYSIDE	293	MIXED	4	-75.912348948	37.665377505	1962	>730	>50	>50
3/5/09	B294	BAYSIDE	294	LTDU	1	-75.902456673	37.680167533	1962	>730	>50	>50
3/5/09	B295	BAYSIDE	295	LTDU	2	-75.897220026	37.686050193	1962	>730	>50	>50
3/5/09	B296	BAYSIDE	296	LTDU	3	-75.891574301	37.695205768	1962	>730	>50	>50
3/5/09	B297	BAYSIDE	297	LTDU	2	-75.894743695	37.723453030	1962	>730	>50	>50
3/5/09	B298	BAYSIDE	298	SUSC	2	-75.902076770	37.709227266	1962	>730	>50	>50
3/5/09	B299	BAYSIDE	299	SUSC	2	-75.916607064	37.677201230	1962	>730	>50	>50
3/5/09	B300	BAYSIDE	300	LTDU	1	-75.938395674	37.671803833	1962	>730	>50	>50
3/5/09	B301	BAYSIDE	301	LTDU	2	-75.934309941	37.680009585	1962	>730	>50	>50
3/5/09	B302	BAYSIDE	302	LTDU	2	-75.931571768	37.684132217	1962	>730	>50	>50
3/5/09	B303	BAYSIDE	303	LTDU	2	-75.920741383	37.701970804	1962	>730	>50	>50
3/5/09	B304	BAYSIDE	304	LTDU	2	-75.906586630	37.725038967	1962	>730	>50	>50
3/5/09	B305	BAYSIDE	305	LTDU	3	-75.908081200	37.728488453	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
3/5/09	B306	BAYSIDE	306	LTDU	2	-75.911061604	37.717996856	1962	>730	>50	>50
3/5/09	B307	BAYSIDE	307	LTDU	2	-75.920338135	37.702622874	1962	>730	>50	>50
4/2/2009	B193	BAYSIDE	193	SUSC	37	-75.856050353	37.715574513	7848	>730	>50	>50
4/2/2009	B308	BAYSIDE	308	SUSC	24	-75.888442339	37.660661180	4439	1-730	>50	>50
4/2/2009	B309	BAYSIDE	309	SUSC	8	-75.883825051	37.720353778	1962	>730	>50	>50
4/2/2009	B310	BAYSIDE	310	SUSC	17	-75.894061944	37.703358987	7848	>730	>50	>50
4/2/2009	B311	BAYSIDE	311	SUSC	4	-75.895872571	37.698469238	1962	>730	>50	>50
4/2/2009	B312	BAYSIDE	312	SUSC	2	-75.899721636	37.690782180	1962	>730	>50	>50
4/2/2009	B313	BAYSIDE	313	SUSC	3	-75.911933867	37.670720287	1962	>730	>50	>50
4/2/2009	B314	BAYSIDE	314	SUSC	2	-75.923306079	37.652254764	1962	>730	>50	>50
4/2/2009	B315	BAYSIDE	315	SUSC	19	-75.915817857	37.718172173	6950	>730	>50	>50
11/7/08	O1	OCEAN	1	SUSC	200	-75.697685321	37.390046570	17657	>730	>50	>50
10/7/08	S1	SEASIDE	1	SUSC	3	-75.750974915	37.455048143	1962	>730	>50	>50
10/20/08	S2	SEASIDE	2	SUSC	7	-75.773356199	37.420463037	1962	>730	>50	>50
10/20/08	S3	SEASIDE	3	SUSC	2	-75.784333767	37.397009474	1962	>730	>50	>50
10/20/08	S4	SEASIDE	4	SUSC	1	-75.745604505	37.394664145	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
10/20/08	S5	SEASIDE	5	OTHER	2	-75.733297974	37.379201474	1961	1-730	>50	>50
10/20/08	S6	SEASIDE	6	SUSC	425	-75.737088565	37.420314568	299027	1-730	>50	>50
10/20/08	S7	SEASIDE	7	SUSC	67	-75.742051528	37.419821597	11809	1-730	>50	>50
10/20/08	S8	SEASIDE	8	SUSC	120	-75.743573203	37.425352787	13481	1-730	>50	>50
10/20/08	S9	SEASIDE	9	SUSC	75	-75.747910740	37.429702029	9376	>730	>50	>50
10/20/08	S10	SEASIDE	10	SUSC	80	-75.743590899	37.430118179	6948	1-730	>50	>50
10/20/08	S11	SEASIDE	11	SUSC	1	-75.739858520	37.431872288	1962	1-730	>50	>50
10/20/08	S12	SEASIDE	12	SUSC	17	-75.739156522	37.430596766	4459	1-730	>50	>50
10/20/08	S13	SEASIDE	13	SUSC	3	-75.738028700	37.426241236	1962	1-730	>50	>50
10/20/08	S14	SEASIDE	14	SUSC	27	-75.738077905	37.423212353	4450	>730	>50	>50
10/20/08	S15	SEASIDE	15	SUSC	7	-75.735063938	37.412035928	1958	>730	>50	>50
10/20/08	S16	SEASIDE	16	SUSC	1	-75.734220313	37.408922798	1962	>730	>50	>50
10/20/08	S17	SEASIDE	17	SUSC	5	-75.733437719	37.406304695	1962	>730	>50	>50
10/20/08	S18	SEASIDE	18	SUSC	19	-75.719172675	37.391537772	1961	1-730	>50	1-50
10/20/08	S19	SEASIDE	19	SUSC	60	-75.740017853	37.441164291	7848	1-730	>50	>50
10/20/08	S20	SEASIDE	20	SUSC	77	-75.733328596	37.445799260	72652	1-730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
10/20/08	S21	SEASIDE	21	SUSC	334	-75.740417825	37.446011868	77946	>730	>50	1-50
10/20/08	S22	SEASIDE	22	SUSC	75	-75.745530002	37.444141060	33139	>730	>50	>50
10/20/08	S23	SEASIDE	23	SUSC	53	-75.741815943	37.452569561	4461	>730	>50	>50
10/20/08	S24	SEASIDE	24	SUSC	12	-75.723050475	37.460008488	1962	1-730	>50	>50
10/20/08	S25	SEASIDE	25	SUSC	8	-75.725664147	37.462525259	1962	1-730	>50	>50
10/20/08	S26	SEASIDE	26	SUSC	48	-75.723003941	37.468093911	1962	1-730	>50	>50
10/20/08	S27	SEASIDE	27	SUSC	3	-75.740020774	37.467853357	1962	>730	>50	>50
10/20/08	S28	SEASIDE	28	SUSC	42	-75.754863826	37.453890172	1962	>730	>50	>50
10/20/08	S29	SEASIDE	29	SUSC	97	-75.753324565	37.448632241	9464	>730	>50	>50
10/20/08	S30	SEASIDE	30	SUSC	1	-75.757268626	37.470348984	1962	>730	>50	>50
10/20/08	S31	SEASIDE	31	SUSC	42	-75.750206485	37.474305441	4499	>730	>50	1-50
11/7/08	S32	SEASIDE	32	SUSC	2	-75.790946411	37.396679191	1962	1-730	>50	>50
11/7/08	S33	SEASIDE	33	SUSC	17	-75.782986486	37.400510311	1962	>730	>50	>50
11/7/08	S34	SEASIDE	34	LTDU	1	-75.782953690	37.410245372	1962	>730	>50	>50
11/7/08	S35	SEASIDE	35	SUSC	3	-75.768149377	37.462770639	1960	>730	>50	1-50
11/7/08	S36	SEASIDE	36	SUSC	58	-75.739154331	37.418689929	11439	1-730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
11/7/08	S37	SEASIDE	37	SUSC	5	-75.740145829	37.435248110	1962	1-730	>50	>50
11/7/08	S38	SEASIDE	38	SUSC	3	-75.718961503	37.441204170	1962	1-730	>50	1-50
11/7/08	S39	SEASIDE	39	SUSC	5	-75.720201709	37.441244816	1962	1-730	>50	1-50
11/7/08	S40	SEASIDE	40	SUSC	6	-75.714864494	37.393845264	1962	1-730	>50	0
11/7/08	S41	SEASIDE	41	SUSC	17	-75.719132115	37.398269412	1962	1-730	>50	0
11/20/08	S42	SEASIDE	42	SUSC	5	-75.758359910	37.470909920	1961	>730	>50	>50
11/20/08	S43	SEASIDE	43	SUSC	8	-75.773226398	37.456184559	1962	>730	>50	>50
11/20/08	S44	SEASIDE	44	SUSC	3	-75.780909624	37.438536649	1962	>730	>50	0
11/20/08	S45	SEASIDE	45	SUSC	3	-75.785741499	37.417136474	1962	>730	>50	>50
11/20/08	S46	SEASIDE	46	SUSC	4	-75.750088219	37.443246038	1962	>730	>50	>50
11/20/08	S47	SEASIDE	47	LTDU	1	-75.756854474	37.440480807	1962	>730	>50	>50
11/20/08	S48	SEASIDE	48	SUSC	6	-75.746922018	37.452252585	1962	>730	>50	>50
11/20/08	S49	SEASIDE	49	SUSC	5	-75.727635520	37.470146800	1961	1-730	>50	>50
11/20/08	S50	SEASIDE	50	LTDU	3	-75.744538824	37.444506960	1962	>730	>50	>50
11/20/08	S51	SEASIDE	51	SUSC	4	-75.742613648	37.435018790	1962	>730	>50	>50
11/20/08	S52	SEASIDE	52	SUSC	58	-75.748938461	37.427338268	32409	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
11/20/08	S53	SEASIDE	53	SUSC	2	-75.785270748	37.396940169	1962	>730	>50	>50
11/20/08	S54	SEASIDE	54	SUSC	3	-75.737250005	37.411373662	1962	>730	>50	>50
11/20/08	S55	SEASIDE	55	SUSC	8	-75.740435445	37.413553086	1962	>730	>50	>50
11/20/08	S56	SEASIDE	56	SUSC	3	-75.715372476	37.391074180	1962	1-730	>50	>50
12/8/08	S57	SEASIDE	57	LTDU	1	-75.761913952	37.471560242	1962	>730	>50	>50
12/8/08	S58	SEASIDE	58	LTDU	3	-75.752342545	37.461918023	1962	>730	>50	>50
12/8/08	S59	SEASIDE	59	SUSC	1	-75.773912911	37.453789661	1962	>730	>50	>50
12/8/08	S60	SEASIDE	60	MIXED	11	-75.773989475	37.449040858	1962	>730	>50	>50
12/8/08	S61	SEASIDE	61	LTDU	2	-75.774428061	37.449345075	1962	>730	>50	>50
12/8/08	S62	SEASIDE	62	LTDU	4	-75.725764222	37.458444801	1962	1-730	>50	>50
12/8/08	S63	SEASIDE	63	SUSC	5	-75.752460049	37.435237875	1962	>730	>50	>50
12/8/08	S64	SEASIDE	64	LTDU	2	-75.763785199	37.423914368	1962	>730	>50	>50
12/8/08	S65	SEASIDE	65	LTDU	2	-75.777364652	37.414250630	1962	>730	>50	>50
12/8/08	S66	SEASIDE	66	LTDU	4	-75.789600273	37.402562853	1962	1-730	>50	>50
12/8/08	S67	SEASIDE	67	LTDU	1	-75.771592190	37.401636169	1962	>730	>50	>50
12/8/08	S68	SEASIDE	68	SUSC	18	-75.746139723	37.414255305	4536	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
12/8/08	S69	SEASIDE	69	SUSC	7	-75.748989251	37.431661567	1962	>730	>50	>50
12/8/08	S70	SEASIDE	70	SUSC	8	-75.749934752	37.426734162	1962	>730	>50	>50
12/8/08	S71	SEASIDE	71	LTDU	7	-75.738936532	37.409362120	1962	>730	>50	>50
12/8/08	S72	SEASIDE	72	SUSC	31	-75.745104726	37.406650110	4466	>730	>50	0
12/8/08	S73	SEASIDE	73	LTDU	9	-75.744397768	37.406667590	1962	>730	>50	1-50
12/8/08	S74	SEASIDE	74	LTDU	2	-75.753446039	37.386826066	1962	>730	>50	>50
12/8/08	S75	SEASIDE	75	LTDU	27	-75.766693883	37.379963240	7848	>730	>50	>50
12/8/08	S76	SEASIDE	76	LTDU	37	-75.763774553	37.349371733	7848	>730	>50	>50
12/8/08	S77	SEASIDE	77	LTDU	2	-75.733577131	37.398959997	1962	1-730	>50	>50
12/8/08	S78	SEASIDE	78	LTDU	4	-75.751464334	37.349577452	1962	>730	>50	>50
12/23/08	S79	SEASIDE	79	SUSC	4	-75.774419435	37.490305149	1962	1-730	>50	>50
12/23/08	S80	SEASIDE	80	LTDU	2	-75.780105009	37.459852921	1962	>730	>50	>50
12/23/08	S81	SEASIDE	81	LTDU	2	-75.769593298	37.470921266	1962	>730	>50	>50
12/23/08	S82	SEASIDE	82	SUSC	5	-75.746061067	37.490855993	1962	1-730	>50	>50
12/23/08	S83	SEASIDE	83	LTDU	3	-75.759558568	37.449096624	1962	>730	>50	>50
12/23/08	S84	SEASIDE	84	LTDU	5	-75.754617956	37.454539394	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
12/23/08	S85	SEASIDE	85	LTDU	3	-75.756266716	37.422511521	1962	>730	>50	>50
12/23/08	S86	SEASIDE	86	LTDU	7	-75.746785494	37.431693536	1962	>730	>50	>50
12/23/08	S87	SEASIDE	87	LTDU	1	-75.719847930	37.457378055	1962	1-730	>50	>50
12/23/08	S88	SEASIDE	88	LTDU	1	-75.749427028	37.396976409	1962	>730	>50	>50
12/23/08	S89	SEASIDE	89	LTDU	2	-75.764398073	37.368548796	1962	1-730	>50	>50
12/23/08	S90	SEASIDE	90	LTDU	4	-75.747149089	37.380683234	1962	>730	>50	>50
12/23/08	S91	SEASIDE	91	LTDU	1	-75.751119356	37.359411564	1962	>730	>50	>50
12/23/08	S92	SEASIDE	92	LTDU	4	-75.757678477	37.342713766	1962	1-730	>50	>50
1/17/09	S93	SEASIDE	93	LTDU	1	-75.793948966	37.466647031	1962	1-730	>50	>50
1/17/09	S94	SEASIDE	94	LTDU	15	-75.781066196	37.474700825	6939	>730	>50	>50
1/17/09	S95	SEASIDE	95	LTDU	4	-75.791563376	37.461509512	1962	>730	>50	>50
1/17/09	S96	SEASIDE	96	LTDU	4	-75.790807354	37.450838999	1962	>730	>50	>50
1/17/09	S97	SEASIDE	97	LTDU	2	-75.777291771	37.460069759	1962	>730	>50	>50
1/17/09	S98	SEASIDE	98	LTDU	4	-75.779351132	37.463727779	1962	>730	>50	>50
1/17/09	S99	SEASIDE	99	LTDU	4	-75.763182242	37.468039533	1962	>730	>50	>50
1/17/09	S100	SEASIDE	100	LTDU	7	-75.741734074	37.470101283	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
1/17/09	S101	SEASIDE	101	LTDU	3	-75.767422329	37.454708128	1962	>730	>50	>50
1/17/09	S102	SEASIDE	102	LTDU	6	-75.774887294	37.449494666	7848	>730	>50	>50
1/17/09	S103	SEASIDE	103	LTDU	2	-75.781218041	37.445108465	1962	>730	>50	>50
1/17/09	S104	SEASIDE	104	LTDU	4	-75.795572158	37.428740231	1962	>730	>50	>50
1/17/09	S105	SEASIDE	105	LTDU	5	-75.780431690	37.423778570	4453	>730	>50	>50
1/17/09	S106	SEASIDE	106	LTDU	2	-75.763047489	37.434744420	1962	>730	>50	>50
1/17/09	S107	SEASIDE	107	LTDU	10	-75.755487449	37.437229767	7848	>730	>50	>50
1/17/09	S108	SEASIDE	108	LTDU	8	-75.743133563	37.446444711	7848	>730	>50	>50
1/17/09	S109	SEASIDE	109	LTDU	3	-75.730131007	37.455584370	1962	>730	>50	>50
1/17/09	S110	SEASIDE	110	LTDU	8	-75.718913959	37.455525766	6960	1-730	>50	>50
1/17/09	S111	SEASIDE	111	LTDU	2	-75.724177270	37.451393652	1962	1-730	>50	>50
1/17/09	S112	SEASIDE	112	LTDU	3	-75.755734311	37.426886511	1962	>730	>50	>50
1/17/09	S113	SEASIDE	113	LTDU	2	-75.771331880	37.414769378	1962	>730	>50	>50
1/17/09	S114	SEASIDE	114	LTDU	17	-75.780757241	37.405892612	7848	>730	>50	>50
1/17/09	S115	SEASIDE	115	LTDU	12	-75.788761516	37.400152810	7848	1-730	>50	>50
1/17/09	S116	SEASIDE	116	LTDU	3	-75.789298048	37.388828145	1962	1-730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
1/17/09	S117	SEASIDE	117	LTDU	5	-75.755049982	37.408259798	1962	>730	>50	>50
1/17/09	S118	SEASIDE	118	LTDU	3	-75.742342245	37.401805409	1962	>730	>50	>50
2/10/09	S119	SEASIDE	119	LTDU	1	-75.786506726	37.460112712	1962	>730	>50	0
2/10/09	S120	SEASIDE	120	LTDU	12	-75.781459087	37.453065814	1962	>730	>50	>50
2/10/09	S121	SEASIDE	121	LTDU	5	-75.774150381	37.462380128	6930	>730	>50	>50
2/10/09	S122	SEASIDE	122	LTDU	8	-75.750932888	37.491392830	1962	1-730	>50	0
2/10/09	S123	SEASIDE	123	MIXED	23	-75.770051758	37.448740853	7848	>730	>50	>50
2/10/09	S124	SEASIDE	124	LTDU	3	-75.777204339	37.443972177	1962	>730	>50	>50
2/10/09	S125	SEASIDE	125	LTDU	3	-75.795259966	37.399118512	1962	1-730	>50	>50
2/10/09	S126	SEASIDE	126	LTDU	2	-75.776087492	37.423195140	1962	>730	>50	>50
2/10/09	S127	SEASIDE	127	SUSC	6	-75.763928521	37.441833264	1962	>730	>50	>50
2/10/09	S128	SEASIDE	128	LTDU	2	-75.773198218	37.412997953	1962	>730	>50	>50
2/10/09	S129	SEASIDE	129	LTDU	5	-75.758327497	37.415053102	1962	>730	>50	>50
2/10/09	S130	SEASIDE	130	LTDU	2	-75.746070883	37.418266831	1962	>730	>50	>50
3/5/09	S131	SEASIDE	131	LTDU	8	-75.800808189	37.463176392	1962	1-730	>50	>50
3/5/09	S132	SEASIDE	132	LTDU	5	-75.788430247	37.466315294	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
3/5/09	S133	SEASIDE	133	LTDU	1	-75.785379884	37.471211042	1962	>730	>50	>50
3/5/09	S134	SEASIDE	134	LTDU	5	-75.767947276	37.491102914	1962	1-730	>50	>50
3/5/09	S135	SEASIDE	135	LTDU	6	-75.782811689	37.473613394	1962	>730	>50	>50
3/5/09	S136	SEASIDE	136	LTDU	2	-75.781997732	37.461363693	1962	>730	>50	>50
3/5/09	S137	SEASIDE	137	LTDU	11	-75.779883892	37.463582001	7848	>730	>50	>50
3/5/09	S138	SEASIDE	138	LTDU	4	-75.779686523	37.451515244	1962	>730	>50	>50
3/5/09	S139	SEASIDE	139	LTDU	10	-75.774374892	37.446947195	7848	>730	>50	>50
3/5/09	S140	SEASIDE	140	LTDU	27	-75.752614492	37.479351654	4453	>730	>50	>50
3/5/09	S141	SEASIDE	141	LTDU	4	-75.751413815	37.475807409	1962	>730	>50	>50
3/5/09	S142	SEASIDE	142	LTDU	7	-75.771297863	37.444050376	1962	>730	>50	>50
3/5/09	S143	SEASIDE	143	LTDU	4	-75.770459353	37.442118416	1962	>730	>50	>50
3/5/09	S144	SEASIDE	144	LTDU	1	-75.775039846	37.397940499	1962	>730	>50	>50
3/5/09	S145	SEASIDE	145	LTDU	10	-75.769536066	37.410956457	9319	>730	>50	>50
3/5/09	S146	SEASIDE	146	LTDU	2	-75.764437467	37.433599731	1962	>730	>50	>50
3/5/09	S147	SEASIDE	147	LTDU	3	-75.760821732	37.442141008	1962	>730	>50	>50
3/5/09	S148	SEASIDE	148	LTDU	4	-75.754434634	37.461795263	1962	>730	>50	>50

Appendix II. Coordinates of sea duck aggregations observed during vessel/aerial surveys along with their raw count, aerial footprint and nearness to emergent shoreline, submerged aquatic vegetation and intertidal oyster reefs

Survey Date	Flock ID	Study Area	Flock ID2	Species	Count	Longitude	Latitude	Aggregation Footprint Area (m^2)	Emergent Shoreline Distance (m)	SAV Distance (m)	Oyster Reef Distance (m)
3/5/09	S149	SEASIDE	149	LTDU	2	-75.750618088	37.471064933	1962	>730	>50	>50
3/5/09	S150	SEASIDE	150	LTDU	2	-75.744976543	37.477898164	1962	1-730	>50	>50
3/5/09	S151	SEASIDE	151	LTDU	4	-75.767762028	37.410494425	1962	>730	>50	>50
3/5/09	S152	SEASIDE	152	LTDU	4	-75.753490501	37.381127644	1962	>730	>50	>50
3/5/09	S153	SEASIDE	153	LTDU	16	-75.753207995	37.383943032	9590	>730	>50	>50
3/5/09	S154	SEASIDE	154	LTDU	3	-75.748513804	37.424778208	1962	>730	>50	>50
3/5/09	S155	SEASIDE	155	SUSC	1	-75.723514438	37.457716552	1962	1-730	>50	>50
3/5/09	S156	SEASIDE	156	LTDU	7	-75.732982274	37.382844813	4473	1-730	>50	>50
3/5/09	S157	SEASIDE	157	LTDU	2	-75.732931455	37.385121977	1962	1-730	>50	>50
3/5/09	S158	SEASIDE	158	LTDU	6	-75.727438345	37.400505437	1962	1-730	>50	>50
3/5/09	S159	SEASIDE	159	LTDU	2	-75.707682503	37.453898630	1962	1-730	>50	>50
4/2/2009	S160	SEASIDE	160	SUSC	6	-75.755498748	37.391058962	1962	>730	>50	>50
4/2/2009	S161	SEASIDE	161	SUSC	11	-75.756768946	37.371319982	1962	>730	>50	>50
4/2/2009	S162	SEASIDE	162	SUSC	28	-75.754526148	37.365248354	6953	>730	>50	>50
4/2/2009	S163	SEASIDE	163	SUSC	9	-75.740530213	37.374956131	1962	>730	>50	>50
4/2/2009	S164	SEASIDE	164	SUSC	12	-75.733316983	37.379066197	1962	>730	>50	>50

Appendix III. Water depth and water quality measurements (water temperature, salinity, turbidity and dissolved oxygen) observed at sea duck foraging locations that were selected for benthic sampling. "WQ Depth Category" refers to samples within 1 m of the surface (S) and 1 m of the bottom (B).

Flock ID	Study Area	Flock ID2	Date	Season	Water Depth (m)	Corrected to MHHW (m)	WQ Depth Category	WT (C)	Sal. (PSU)	Turbidity (NTU)	DO (mg/L)
B2	BAYSIDE	2	11/23/08	EARLY	2.3	2.6	S	4.9	20.5	6.6	8.6
B7	BAYSIDE	7	11/23/08	EARLY	2.7	2.9	S	6.2	20.5	7.4	8.3
B8	BAYSIDE	8	11/23/08	EARLY	1.5	1.8	S	5.8	20.5	13.4	8.5
B11	BAYSIDE	11	12/3/08	EARLY	6.1	6.8	S	7.4	21.0	4.7	7.2
B11	BAYSIDE	11	12/3/08	EARLY	6.1	.	B	7.5	21.2	5.1	7.2
B12	BAYSIDE	12	12/3/08	EARLY	6.8	7.5	S	7.3	20.8	5.5	7.2
B12	BAYSIDE	12	12/3/08	EARLY	6.8	.	B	7.4	21.0	6.1	7.2
B14	BAYSIDE	14	11/23/08	EARLY	1.4	1.9	S	5.3	20.8	6.5	8.4
B15	BAYSIDE	15	12/3/08	EARLY	2.5	2.8	S	7.5	20.9	3.7	7.6
B18	BAYSIDE	18	12/3/08	EARLY	6.5	7.3	S	7.2	20.6	3.7	7.2
B18	BAYSIDE	18	12/3/08	EARLY	6.5	.	B	7.2	20.6	4.7	7.3
B20	BAYSIDE	20	12/6/08	EARLY	5.8	6.3	S	6.5	21.0	3.4	7.7
B20	BAYSIDE	20	12/6/08	EARLY	5.8	.	B	7.5	21.2	6.6	7.5
B23	BAYSIDE	23	11/23/08	EARLY	5.5	5.8	S	5.9	20.4	6.8	8.1
B23	BAYSIDE	23	11/23/08	EARLY	5.5	.	B	5.8	20.5	8.8	8.1
B25	BAYSIDE	25	12/3/08	EARLY	7.8	8.2	S	7.9	20.6	3.0	7.2

Appendix III. Water depth and water quality measurements (water temperature, salinity, turbidity and dissolved oxygen) observed at sea duck foraging locations that were selected for benthic sampling. "WQ Depth Category" refers to samples within 1 m of the surface (S) and 1 m of the bottom (B).

Flock ID	Study Area	Flock ID2	Date	Season	Water Depth (m)	Corrected to MHHW (m)	WQ Depth Category	WT (C)	Sal. (PSU)	Turbidity (NTU)	DO (mg/L)
B25	BAYSIDE	25	12/3/08	EARLY	7.8	.	B	7.9	21.5	11.9	6.9
B27	BAYSIDE	27	12/3/08	EARLY	7.4	7.7	S	7.6	20.6	3.2	7.4
B27	BAYSIDE	27	12/3/08	EARLY	7.4	.	B	7.2	20.7	3.7	7.6
B30	BAYSIDE	30	11/23/08	EARLY	3.5	3.9	S	6.3	20.4	6.8	7.9
B30	BAYSIDE	30	11/23/08	EARLY	3.5	.	B	6.3	20.4	11.5	7.9
B34	BAYSIDE	34	12/3/08	EARLY	1.0	1.3	S	7.4	20.8	3.1	7.5
B35	BAYSIDE	35	11/23/08	EARLY	1.0	1.4	S	5.4	20.7	9.2	7.9
S1	SEASIDE	1	10/27/08	EARLY	1.3	2.3	S	15.7	30.0	4.4	8.2
S3	SEASIDE	3	10/31/08	EARLY	4.9	5.1	S	10.3	30.0	10.7	8.8
S3	SEASIDE	3	10/31/08	EARLY	4.9	.	B	10.3	30.0	15.3	8.8
S4	SEASIDE	4	11/11/08	EARLY	.	1.0	S	12.3	31.5	11.1	6.2
S6	SEASIDE	6	10/27/08	EARLY	1.1	2.4	S	15.6	30.0	4.7	8.4
S7	SEASIDE	7	10/31/08	EARLY	2.1	2.3	S	9.4	30.2	5.0	9.5
S8	SEASIDE	8	10/27/08	EARLY	0.8	2.2	S	16.0	30.1	4.5	8.6
S17	SEASIDE	17	11/11/08	EARLY	1.5	2.2	S	11.5	31.7	8.9	6.2
S19	SEASIDE	19	11/10/08	EARLY	0.6	2.1	S	14.6	31.2	4.7	6.2

Appendix III. Water depth and water quality measurements (water temperature, salinity, turbidity and dissolved oxygen) observed at sea duck foraging locations that were selected for benthic sampling. "WQ Depth Category" refers to samples within 1 m of the surface (S) and 1 m of the bottom (B).

Flock ID	Study Area	Flock ID2	Date	Season	Water Depth (m)	Corrected to MHHW (m)	WQ Depth Category	WT (C)	Sal. (PSU)	Turbidity (NTU)	DO (mg/L)
S20	SEASIDE	20	11/10/08	EARLY	0.6	2.0	S	14.0	31.2	3.9	6.3
S27	SEASIDE	27	11/10/08	EARLY	0.5	1.8	S	14.0	31.2	6.7	5.6
S28	SEASIDE	28	10/27/08	EARLY	1.2	2.4	S	15.7	30.1	3.4	8.3
S30	SEASIDE	30	11/10/08	EARLY	0.9	1.9	S	14.0	31.0	4.9	5.6
S31	SEASIDE	31	10/27/08	EARLY	1.0	1.7	S	15.8	29.9	5.6	8.0
S34	SEASIDE	34	11/11/08	EARLY	0.8	2.0	S	12.3	31.4	4.0	6.6
S37	SEASIDE	37	11/10/08	EARLY	0.5	2.0	S	14.8	31.2	4.2	6.3
S40	SEASIDE	40	11/11/08	EARLY	0.8	1.7	S	11.8	31.6	5.0	6.2
B212	BAYSIDE	212	2/25/09	LATE	5.3	5.9	S	2.4	17.4	1.5	8.5
B212	BAYSIDE	212	2/25/09	LATE	5.3	.	B	2.4	17.6	1.8	8.7
B215	BAYSIDE	215	3/5/09	LATE	1.0	1.7	S	2.1	17.7	3.6	9.5
B224	BAYSIDE	224	3/5/09	LATE	2.9	3.6	S	2.6	17.9	2.0	8.9
B225	BAYSIDE	225	3/5/09	LATE	3.2	3.7	S	2.2	17.7	2.6	9.2
B225	BAYSIDE	225	3/5/09	LATE	3.2	.	B	.	.	.	.
B229	BAYSIDE	229	2/25/09	LATE	7.4	7.7	S	3.2	17.6	2.0	8.7
B229	BAYSIDE	229	2/25/09	LATE	7.4	.	B	2.8	18.1	2.4	8.7

Appendix III. Water depth and water quality measurements (water temperature, salinity, turbidity and dissolved oxygen) observed at sea duck foraging locations that were selected for benthic sampling. "WQ Depth Category" refers to samples within 1 m of the surface (S) and 1 m of the bottom (B).

Flock ID	Study Area	Flock ID2	Date	Season	Water Depth (m)	Corrected to MHHW (m)	WQ Depth Category	WT (C)	Sal. (PSU)	Turbidity (NTU)	DO (mg/L)
B230	BAYSIDE	230	3/5/09	LATE	4.7	5.3	S	2.7	18.0	2.6	8.9
B230	BAYSIDE	230	3/5/09	LATE	4.7	.	B	2.9	18.4	.	9.0
B234	BAYSIDE	234	3/18/09	LATE	6.2	6.8	S	6.6	19.8	0.8	7.9
B234	BAYSIDE	234	3/18/09	LATE	6.2	.	B	6.1	22.0	2.3	7.7
B235	BAYSIDE	235	3/18/09	LATE	6.2	6.7	S	6.5	20.0	0.6	7.8
B235	BAYSIDE	235	3/18/09	LATE	6.2	.	B	6.1	22.1	1.7	7.9
B237	BAYSIDE	237	3/18/09	LATE	8.5	9.1	S	6.7	20.0	0.5	8.0
B237	BAYSIDE	237	3/18/09	LATE	8.5	.	B	6.3	22.3	1.3	7.9
B238	BAYSIDE	238	3/18/09	LATE	7.8	8.4	S	6.8	19.9	0.9	7.7
B238	BAYSIDE	238	3/18/09	LATE	7.8	.	B	6.4	22.2	0.4	7.9
B246	BAYSIDE	246	3/5/09	LATE	1.7	2.5	S	2.4	17.6	3.2	9.4
B251	BAYSIDE	251	3/18/09	LATE	2.0-5.0	3.9	S	7.3	18.3	1.2	7.6
B251	BAYSIDE	251	3/18/09	LATE	2.0-5.0	.	B	6.6	20.1	1.4	7.7
B258	BAYSIDE	258	3/5/09	LATE	1.8	2.5	S	2.6	17.7	2.1	8.8
B260	BAYSIDE	260	2/25/09	LATE	8.4	8.9	S	2.7	17.5	1.1	9.1
B260	BAYSIDE	260	2/25/09	LATE	8.4	.	B	2.7	17.9	3.5	9.0

Appendix III. Water depth and water quality measurements (water temperature, salinity, turbidity and dissolved oxygen) observed at sea duck foraging locations that were selected for benthic sampling. “WQ Depth Category” refers to samples within 1 m of the surface (S) and 1 m of the bottom (B).

Flock ID	Study Area	Flock ID2	Date	Season	Water Depth (m)	Corrected to MHHW (m)	WQ Depth Category	WT (C)	Sal. (PSU)	Turbidity (NTU)	DO (mg/L)
B268	BAYSIDE	268	3/18/09	LATE	2.8	3.3	S	7.2	19.0	0.9	7.8
B272	BAYSIDE	272	2/25/09	LATE	10.8	11.2	S	2.8	17.6	3.8	8.7
B272	BAYSIDE	272	2/25/09	LATE	10.8	.	B	3.1	17.6	3.9	8.9
B274	BAYSIDE	274	3/18/09	LATE	4.0	4.5	S	6.9	19.2	0.9	7.8
B274	BAYSIDE	274	3/18/09	LATE	4.0	.	B	6.4	22.3	0.5	7.7
S94	SEASIDE	94	3/25/09	LATE	1.7	2.2	S	8.2	31.8	2.6	6.3
S98	SEASIDE	98	3/25/09	LATE	0.9	2.2	S	9.2	31.6	3.7	6.2
S100	SEASIDE	100	3/25/09	LATE	1.6	2.1	S	7.6	31.6	2.8	6.9
S103	SEASIDE	103	4/13/09	LATE	0.8	1.3	S	12.7	31.6	7.2	5.7
S107	SEASIDE	107	3/25/09	LATE	1.5	2.4	S	8.6	31.6	2.4	6.4
S108	SEASIDE	108	3/25/09	LATE	0.6	1.3	S	8.2	31.7	2.1	6.6
S111	SEASIDE	111	3/25/09	LATE	1.2	1.7	S	7.8	31.6	1.9	6.9
S112	SEASIDE	112	4/13/09	LATE	1.8	2.2	S	11.8	31.7	4.7	6.0
S114	SEASIDE	114	4/13/09	LATE	1.4	1.8	S	11.5	31.6	8.8	5.9
S115	SEASIDE	115	4/13/09	LATE	1.4	2.0	S	11.5	31.5	8.4	5.7
S122	SEASIDE	122	3/25/09	LATE	1.4	1.6	S	7.8	31.7	3.0	6.4

Appendix III. Water depth and water quality measurements (water temperature, salinity, turbidity and dissolved oxygen) observed at sea duck foraging locations that were selected for benthic sampling. “WQ Depth Category” refers to samples within 1 m of the surface (S) and 1 m of the bottom (B).

Flock ID	Study Area	Flock ID2	Date	Season	Water Depth (m)	Corrected to MHHW (m)	WQ Depth Category	WT (C)	Sal. (PSU)	Turbidity (NTU)	DO (mg/L)
S123	SEASIDE	123	3/25/09	LATE	1.0	2.2	S	8.8	31.6	3.1	6.4
S124	SEASIDE	124	4/13/09	LATE	1.0	1.4	S	12.1	31.6	8.8	5.8
S127	SEASIDE	127	3/25/09	LATE	1.3	2.4	S	8.5	31.6	2.3	6.6
S128	SEASIDE	128	4/13/09	LATE	1.8	2.2	S	11.5	31.7	10.5	5.9
S129	SEASIDE	129	4/13/09	LATE	8.3	8.7	S	10.8	31.9	5.4	6.1
S129	SEASIDE	129	4/13/09	LATE	8.3	.	B	10.3	31.9	9.2	6.2
S130	SEASIDE	130	4/13/09	LATE	1.9	2.3	S	11.9	31.7	4.1	6.0

Appendix IV. Sediment characteristics in sea duck foraging areas where benthic samples were collected.

Study Area	Polygon #	Species	Season	% Organic by Wt.	Dry wt. retained on # 5 sieve (%)	Dry wt. retained on # 10 sieve (%)	Dry wt. retained on #60 sieve (%)	Dry wt. retained on #230 sieve (%)	Dry wt. residual (%)
BAYSIDE	2	EARLY	SUSC	0.3	0.0	0.2	61.7	38.2	0.0
BAYSIDE	7	EARLY	SUSC	0.3	0.0	0.1	19.4	80.3	0.3
BAYSIDE	8	EARLY	SUSC	0.3	0.0	0.5	43.0	56.4	0.1
BAYSIDE	12	EARLY	SUSC	0.5	0.0	0.6	71.1	26.7	1.6
BAYSIDE	14	EARLY	SUSC	0.4	0.0	0.0	13.3	86.6	0.1
BAYSIDE	15	EARLY	SUSC	0.4	0.0	0.4	32.1	67.4	0.1
BAYSIDE	18	EARLY	SUSC	0.3	0.1	0.9	81.9	16.9	0.3
BAYSIDE	20	EARLY	SUSC	0.5	0.0	0.5	70.0	29.4	0.3
BAYSIDE	23	EARLY	SUSC	0.8	0.0	0.0	19.2	79.4	1.4
BAYSIDE	25	EARLY	SUSC	0.3	0.0	0.0	87.2	12.8	0.1
BAYSIDE	27	EARLY	MIXED	0.4	0.0	0.1	42.3	57.4	0.2
BAYSIDE	30	EARLY	SUSC	0.3	0.0	1.2	50.8	47.7	0.3
BAYSIDE	34	EARLY	SUSC	0.3	0.0	0.2	70.1	29.7	0.1
BAYSIDE	35	EARLY	SUSC	0.3	0.0	0.0	53.6	46.4	0.0
BAYSIDE	212	LATE	SUSC	0.5	0.0	0.0	38.0	61.2	0.7
BAYSIDE	215	LATE	LTDU	0.3	0.0	0.0	73.0	26.9	0.1
BAYSIDE	224	LATE	SUSC	0.3	0.0	0.3	35.4	64.2	0.1
BAYSIDE	225	LATE	SUSC	0.4	0.0	0.4	48.4	49.6	1.5
BAYSIDE	229	LATE	LTDU	0.6	0.0	0.0	70.2	29.1	0.6
BAYSIDE	230	LATE	SUSC	0.2	0.0	0.5	91.7	7.8	0.0
BAYSIDE	234	LATE	LTDU	0.3	0.0	1.8	77.2	20.9	0.1
BAYSIDE	235	LATE	LTDU	0.3	0.0	1.2	84.3	14.4	0.1
BAYSIDE	237	LATE	SUSC	1.0	0.0	2.0	67.6	27.1	3.3
BAYSIDE	238	LATE	LTDU	0.4	0.0	0.0	78.6	20.5	0.8
BAYSIDE	246	LATE	SUSC	0.6	0.0	0.0	21.4	77.7	0.9
BAYSIDE	251	LATE	LTDU	0.8	0.0	0.0	16.7	81.1	2.2
BAYSIDE	258	LATE	SUSC	0.7	0.0	0.2	56.8	41.1	1.8
BAYSIDE	260	LATE	MIXED	1.9	0.0	0.0	0.6	86.8	12.6
BAYSIDE	268	LATE	SUSC	0.4	0.0	0.0	9.4	90.4	0.2
BAYSIDE	272	LATE	LTDU	0.7	0.0	0.0	78.9	20.1	1.0
BAYSIDE	274	LATE	LTDU	0.3	0.0	0.8	93.5	5.7	0.0
SEASIDE	1	EARLY	SUSC	1.4	0.0	0.0	0.2	82.3	17.5
SEASIDE	3	EARLY	SUSC	1.0	0.0	0.0	0.7	90.7	8.6
SEASIDE	4	EARLY	SUSC	1.4	0.0	0.0	1.0	81.3	17.6
SEASIDE	6	EARLY	SUSC	1.1	0.1	0.1	0.4	87.4	12.1
SEASIDE	7	EARLY	SUSC	1.4	0.0	0.0	0.5	80.5	18.9
SEASIDE	8	EARLY	SUSC	1.3	0.0	0.0	0.4	87.1	12.6
SEASIDE	17	EARLY	SUSC	1.1	0.0	0.0	0.4	87.1	12.5
SEASIDE	19	EARLY	SUSC	1.1	0.0	0.4	0.4	88.0	11.2
SEASIDE	20	EARLY	SUSC	1.4	0.0	0.0	0.5	86.9	12.6

Appendix IV. Sediment characteristics in sea duck foraging areas where benthic samples were collected.

Study Area	Polygon #	Species	Season	% Organic by Wt.	Dry wt. retained on # 5 sieve (%)	Dry wt. retained on # 10 sieve (%)	Dry wt. retained on #60 sieve (%)	Dry wt. retained on #230 sieve (%)	Dry wt. residual (%)
SEASIDE	27	EARLY	SUSC	0.9	0.0	0.1	0.8	93.6	5.5
SEASIDE	28	EARLY	SUSC	1.6	0.0	0.0	0.2	85.2	14.5
SEASIDE	30	EARLY	SUSC	1.9	0.0	0.0	0.2	78.1	21.7
SEASIDE	31	EARLY	SUSC	1.9	0.1	0.9	2.0	77.1	19.9
SEASIDE	34	EARLY	LTDU	2.7	0.0	0.1	0.5	80.5	18.9
SEASIDE	37	EARLY	SUSC	0.8	0.0	0.0	0.2	93.9	5.9
SEASIDE	40	EARLY	SUSC	1.3	0.0	0.0	0.6	87.8	11.5
SEASIDE	94	LATE	LTDU	4.3	0.9	0.7	1.7	38.9	57.8
SEASIDE	98	LATE	LTDU	2.9	0.0	0.0	0.1	67.0	32.9
SEASIDE	100	LATE	LTDU	1.7	0.0	0.0	0.3	83.7	15.9
SEASIDE	103	LATE	LTDU	3.0	0.0	0.0	0.3	70.8	28.9
SEASIDE	107	LATE	LTDU	3.1	0.0	0.0	1.1	62.5	36.5
SEASIDE	108	LATE	LTDU	2.4	0.5	0.3	0.4	74.9	23.9
SEASIDE	111	LATE	LTDU	0.9	0.0	0.0	0.2	96.5	3.4
SEASIDE	112	LATE	LTDU	2.7	0.1	0.4	2.1	64.5	32.9
SEASIDE	114	LATE	LTDU	2.5	12.9	5.6	6.7	54.7	20.1
SEASIDE	115	LATE	LTDU	2.2	0.4	0.5	1.3	66.2	31.5
SEASIDE	122	LATE	LTDU	5.3	0.0	0.0	0.2	33.8	65.9
SEASIDE	123	LATE	MIXED	1.9	0.0	0.1	0.3	70.5	29.2
SEASIDE	124	LATE	LTDU	3.3	0.0	0.0	0.5	65.3	34.2
SEASIDE	127	LATE	SUSC	3.2	0.0	0.0	0.4	64.8	34.8
SEASIDE	128	LATE	LTDU	1.7	0.0	0.2	0.8	85.3	13.7
SEASIDE	129	LATE	LTDU	2.3	0.0	0.0	0.5	71.0	28.5
SEASIDE	130	LATE	LTDU	1.6	0.0	0.0	0.3	81.2	18.5

Appendix V. Inclusive species/taxa list for benthic samples.

Broad Taxon	Family	Genus	Suffix
Actiniaria	Cerianthidae	Ceriantheopsis	americanus
Actiniaria	Diadumeneidae	Diadumene	leucolena
Actiniaria	Edwardsiidae	Edwardsia	elegans
Actiniaria	Haloclaridae	Haloclara	producta
Actiniaria	Tublendriidae	Ectopleum	sp
Algae	Chlorophyta	Chaetomorpha	sp
Algae	Chlorophyta	Enteromopha	sp
Algae	Chlorophyta	Ulva	sp
Algae	Rhodophyta	Agardhiella	sp
Algae	Rhodophyta	Ceramium	sp
Algae	Rhodophyta	Gracilaria	sp
Amphioxiformes	Branchiostomidae	Branchiostoma	virginiae
Amphipoda	Ampeliscidae	Ampelisca	sp
Amphipoda	Ampithoidae	Ampithoe	sp
Amphipoda	Bateidae	Batea	catharinensis
Amphipoda	Caprellidae	Caprella	penantis
Amphipoda	Caprellidae	Paracaprella	tenuis
Amphipoda	Corophidae	Corophium	sp
Amphipoda	Gammaridae	Gammarus	sp
Amphipoda	Haustoriidae	Acanthohaustorius	sp
Amphipoda	Haustoriidae	Bathyporeia	sp
Amphipoda	Haustoriidae	Neohaustorius	sp
Amphipoda	Liljeborgiidae	Listriella	barnardi
Amphipoda	Liljeborgiidae	Listriella	clymenellae
Amphipoda	Melitidae	Melita	sp
Amphipoda	Phoxocephalidae	Paraphoxus	sp
Amphipoda	Phoxocephalidae	Phoxocephalus	sp
Amphipoda	Phoxocephalidae	Trichophoxus	sp
Amphipoda	Phoxocephalidae	Unk	unk
Anomura	Paguridae	Pagurus	longicarpus
Anomura	Paguridae	Pagurus	sp
Anomura	Porcellanidae	Euceramus	praelongus
Anomura	Porcellanidae	Polyonyx	gibessi

Appendix V. Inclusive species/taxa list for benthic samples.

Broad Taxon	Family	Genus	Suffix
Ascidiacea	Molgulidae	Molgula	manhattensis
Bivalvia	Arcidae	Anadara	ovalis
Bivalvia	Arcidae	Anadara	transversa
Bivalvia	Mactridae	Mulinia	lateralis
Bivalvia	Myidae	Mya	arenaria
Bivalvia	Mytilidae	Geukensia	demissa
Bivalvia	Pharidae	Ensis	directus
Bivalvia	Pholadidae	Barnea	truncata
Bivalvia	Semelidae	Abra	aequalis
Bivalvia	Solecurtidae	Tagelus	divisus
Bivalvia	Solecurtidae	Tagelus	plebius
Bivalvia	Solenidae	Solen	viridis
Bivalvia	Tellinidae	Macoma	balthica
Bivalvia	Tellinidae	Macoma	tenta
Bivalvia	Veneridae	Dosinia	discus
Bivalvia	Veneridae	Gemma	gemma
Bivalvia	Veneridae	Mercenaria	mercenaria
Brachyura	Cancridae	Cancer	irroratus
Brachyura	Majidae	Libinia	emarginata
Brachyura	Pinnotheridae	Pinnixa	sp
Brachyura	Portunidae	Callinectes	sapidus
Brachyura	Xanthidae	Eurypanopeus	sp
Brachyura	Xanthidae	Panopeus	herbstii
Caridea	Alpheidae	Alpheus	heterochaelis
Caridea	Crangonidae	Crangon	septemspinosa
Caridea	Ogyrididae	Ogyrides	alphaerostris
Cumacea	Diastylidae	Unk	unk
Echinodermata	Amphiuridae	Microphiopholis	atra
Echinodermata	Amphiuridae	Microphiopholis	gracillima
Echinodermata	Amphiuridae	Ophiopharagmus	sp
Echinodermata	Cucumaridae	Cucumaria	pulcherrima
Gastropoda	Calyptraeidae	Crepidula	fornicata

Appendix V. Inclusive species/taxa list for benthic samples.

Broad Taxon	Family	Genus	Suffix
Gastropoda	Columbellidae	Anachis	sp
Gastropoda	Columbellidae	Astyris	lunata
Gastropoda	Columbellidae	Costoanachis	avara
Gastropoda	Cylichnidae	Acteocina	caniculata
Gastropoda	Epitoniidae	Epitonium	multistriatum
Gastropoda	Haminoeidae	Haminoea	solitaria
Gastropoda	Hyrobiidae	Hydrobia	sp
Gastropoda	Muricidae	Nucella	sp
Gastropoda	Muricidae	Trophon	sp
Gastropoda	Muricidae	Urosalpinx	sp
Gastropoda	Nassaridae	Nassarius	vibex
Gastropoda	Naticidae	Polinices	duplicatus
Gastropoda	Patellidae	Patella	sp
Gastropoda	Pyramidellidae	Boonea	sp
Gastropoda	Pyramidellidae	Odostomia	sp
Gastropoda	Pyramidellidae	Turbonilla	sp
Gastropoda	Rissoidae	Rissoina	sp
Gastropoda	Turridae	Mangelina	cerina
Gastropoda	Turridae	Mangelina	plicosa
Hemichordata	Unk	Unk	unk
Hydrozoa	Halocardylidae	Unk	unk
Hydrozoa	Piscicolidae	Calliobdella	sp
Hydrozoa	Sertulariidae	Sertularia	sp
Hydrozoa	Tubulariidae	Ectopleura	sp
Hydrozoa	Tubulariidae	Garveia	sp
Hydrozoa	Tubulariidae	Pennaria	sp
Isopoda	Anthuridae	Cyathura	carinata
Isopoda	Anthuridae	Cygnathus	sp
Isopoda	Idoteidae	Chiridotea	sp
Isopoda	Idoteidae	Edotea	triloba
Isopoda	Idoteidae	Erichsonella	sp
Nemertea	Tubulanidae	Tubulanus	sp

Appendix V. Inclusive species/taxa list for benthic samples.

Broad Taxon	Family	Genus	Suffix
Neoloricata	Ischnochitonidae	Chaetopleura	apiculata
Polychaeta	Ampharetidae	Ampharete	acutifrons
Polychaeta	Ampharetidae	Amphitrite	ornata
Polychaeta	Ampharetidae	Melinna	cristata
Polychaeta	Ampharetidae	Melinna	maculata
Polychaeta	Arabellidae	Arabella	iricolor
Polychaeta	Arabellidae	Drilonereis	sp
Polychaeta	Capitellidae	Notomastus	sp
Polychaeta	Chaetopteridae	Chaetopterus	variopedatus
Polychaeta	Chaetopteridae	Spiochaetopterus	oculatus
Polychaeta	Cirratulidae	Cirriforma	grandis
Polychaeta	Dorvilleidae	Schistomeringos	caecus
Polychaeta	Eunicidae	Marphysa	sp
Polychaeta	Flabelligeridae	Flabelligera	affinis
Polychaeta	Glyceridae	Glycera	capita
Polychaeta	Glyceridae	Glycera	dibranchiata
Polychaeta	Goniadidae	Glycinde	solitaria
Polychaeta	Goniadidae	Goniada	sp
Polychaeta	Lumbrineridae	Lumbrineris	sp
Polychaeta	Maldanidae	Asychis	elongata
Polychaeta	Maldanidae	Clymenella	torquata
Polychaeta	Maldanidae	Marioclymene	zonalis
Polychaeta	Maldanidae	Nicomache	lumbricalis
Polychaeta	Nephtyidae	Nephtys	sp
Polychaeta	Nereidae	Neanthes	sp
Polychaeta	Onuphidae	Diopatra	cuprea
Polychaeta	Opheliidae	Ophelia	sp
Polychaeta	Opheliidae	Ophelina	sp
Polychaeta	Orbiniidae	Leitoscoloplos	sp
Polychaeta	Orbiniidae	Orbinia	sp
Polychaeta	Orbiniidae	Scoloplos	rubra
Polychaeta	Oweniidae	Owenia	fusiforms

Appendix V. Inclusive species/taxa list for benthic samples.

Broad Taxon	Family	Genus	Suffix
Polychaeta	Paraonidae	Paraonis	sp
Polychaeta	Pectinariidae	Pectinaria	gouldii
Polychaeta	Phyllodocidae	Eteone	sp
Polychaeta	Phyllodocidae	Eumida	sanguinea
Polychaeta	Phyllodocidae	Paranaitis	speciosa
Polychaeta	Phyllodocidae	Phyllodoce	sp
Polychaeta	Polygordiidae	Polygordius	sp
Polychaeta	Polynoidae	Unk	unk
Polychaeta	Sabellariidae	Sarabella	vulgaris
Polychaeta	Syllidae	Exogone	sp
Polychaeta	Terebellidae	Melinna	cristata
SAV	Zosteraceae	Zostera	marina
Teleostei	Cynoglossidae	Symphurus	plagiusa
Teleostei	Ophidiidae	Ophidion	marginatum
Thalassinidea	Callianassidae	Callianassa	atlantica
Thalassinidea	Upogebiidae	Upogebia	affinis
Xiphosura	Limulidae	Limulus	phemius

Appendix VI. Copies of two band reports received from USGS for banded SUSC collected during January 2009 in the Chesapeake Bay study area as part of this project.

USGS
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CERTIFICATE OF APPRECIATION
AWARDED TO:

PAIGE ROSS

CANADIAN WILDLIFE SERVICE • SERVICE CANADIEN DE LA FAUNE • 1947 1997

Banding Data

Band Number 1547-39006 **Banded** 07/13/2007
Species SURF SCOTER **Sex** MALE
Age of Bird HATCHED IN 2006 OR EARLIER
Location 50 KM ESE RIGOLET, NEWFOUNDLAND AND LABRADOR, CANADA (COORDINATES: LAT: 54.08333; LON: -57.91667)
Bander NFLD-CWS-ST JOHN'S
GREGORY ROBERTSON 6 BRUCE ST
MOUNT PEARL NF
A1N 4T3 CANADA

Encounter Data

Location 2 mi WNW of HARBORTON, ACCOMACK COUNTY, VIRGINIA, UNITED STATES **Encountered** 01/13/2009
Desc: PUNGOTEAGUE CREEK

USGS
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CERTIFICATE OF APPRECIATION
AWARDED TO:

PAIGE ROSS

CANADIAN WILDLIFE SERVICE • SERVICE CANADIEN DE LA FAUNE • 1947 1997

Banding Data

Band Number 1717-45226 **Banded** 08/16/2004
Species SURF SCOTER **Sex** MALE
Age of Bird HATCHED IN 2003 OR EARLIER
Location UIGORTLEK ISLAND, NEWFOUNDLAND AND LABRADOR, CANADA (COORDINATES: LAT: 56.41667; LON: -61.25)
Bander NFLD-CWS-ST JOHN'S
GREGORY ROBERTSON 6 BRUCE ST
MOUNT PEARL NF
A1N 4T3 CANADA

Encounter Data

Location 4 mi WNW of CASHVILLE, ACCOMACK COUNTY, VIRGINIA, UNITED STATES **Encountered** 01/12/2009
Desc: CHESAPEAKE BAY

Appendix VII. Coordinates, sex, age and anatomical metrics for all sea ducks collected in this study.

Bird ID	Date	Study Area	Lat./Long.	Sex	Age	Wet Whole Mass (g)	Rt. Wing-notch Length (mm)	Tarsus Length (mm)	Culmen-Forefeather Length (mm)	Culmen Nostril-tip Length (mm)	Bill Height (mm)	Bill Base Width (mm)	Image Archived
LTDU1	11/12/08	HIB	N37.41802 W75.76357	M	AHY	820	224	35.0	27.0	17.0	18.3	19.0	Y
LTDU2	11/17/08	HIB	N37.42398 W75.75152	M	AHY	860	226	35.5	27.2	21.3	16.6	18.4	N
LTDU3	11/17/08	HIB	N37.43000 W75.75352	M	AHY	880	229	34.4	27.8	18.8	16.6	19.4	N
LTDU4	11/17/08	HIB	N37.43453 W75.75562	M	AHY	900	230	38.7	27.0	17.9	20.7	20.0	N
LTDU5	11/17/08	HIB	N37.43906 W75.75130	M	AHY	900	225	35.7	27.2	18.3	17.0	18.8	N
LTDU6	11/17/08	HIB	N37.44191 W75.75151	M	AHY	860	230	36.6	28.4	18.6	18.0	20.1	N
LTDU7	12/2/08	CB	N37.72319 W75.82545	M	AHY	780	231	35.2	27.5	18.4	17.1	18.8	Y
LTDU8	12/2/08	CB	N37.71601 W75.91417	M	AHY	880	230	35.6	28.9	18.9	16.6	20.0	Y
LTDU9	12/2/08	CB	N37.71546 W75.90406	M	AHY	880	228	35.3	26.0	17.4	16.9	19.6	Y
LTDU10	12/2/08	CB	N37.72213 W75.90140	M	AHY	880	235	36.9	26.3	18.4	15.7	19.3	Y
LTDU11	12/9/08	CB	N37.65424 W75.92927	F	AHY	580	211	32.4	25.0	17.8	16.1	16.5	Y
LTDU12	12/9/08	CB	N37.67026 W75.89087	F	AHY	660	208	33.0	26.0	16.1	15.1	17.6	Y
LTDU13	12/9/08	CB	N37.66819 W75.89199	F	HY	560	193	34.4	24.0	15.1	15.7	18.2	Y
LTDU14	12/9/08	CB	N37.66934 W75.87898	F	AHY	680	210	33.1	26.0	17.3	15.9	17.5	Y
LTDU15	12/9/08	CB	N37.67315 W75.87746	M	AHY	700	225	33.9	25.4	18.0	16.7	20.0	Y
LTDU16	12/9/08	CB	N37.66961 W75.88097	M	AHY	800	228	36.4	28.5	18.0	16.3	18.4	Y
LTDU17	12/9/08	CB	N37.72369 W75.82649	M	AHY	860	216	35.2	27.8	18.4	17.7	18.2	Y
LTDU18	12/17/08	CB	N37.70695 W75.91256	F	HY	680	207	33.0	23.9	16.5	15.4	15.7	Y

Appendix VII. Coordinates, sex, age and anatomical metrics for all sea ducks collected in this study.

Bird ID	Date	Study Area	Lat./Long.	Sex	Age	Wet Whole Mass (g)	Rt. Wing-notch Length (mm)	Tarsus Length (mm)	Culmen-Forefeather Length (mm)	Culmen Nostril-tip Length (mm)	Bill Height (mm)	Bill Base Width (mm)	Image Archived
LTDU19	12/17/08	CB	N37.71704 W75.90233	M	AHY	900	229	35.3	24.2	16.6	14.8	17.5	Y
LTDU20	12/17/08	CB	N37.72694 W75.90406	M	AHY	840	224	34.0	26.6	18.3	17.4	18.4	Y
LTDU21	12/17/08	CB	N37.72614 W75.91026	F	HY	660	218	33.0	26.0	15.9	16.8	17.8	Y
LTDU22	12/18/08	HIB	N37.46223 W75.80392	M	AHY	800	226	34.0	27.8	19.8	15.9	19.4	Y
LTDU23	12/18/08	HIB	N37.46223 W75.80392	M	AHY	820	224	35.6	28.6	18.1	16.2	20.0	Y
LTDU24	12/18/08	HIB	N37.46223 W75.80392	M	HY	680	224	33.7	25.0	17.0	16.6	18.2	Y
LTDU25	12/18/08	HIB	N37.45559 W75.77675	M	AHY	660	233	34.4	26.0	16.5	14.8	17.2	Y
LTDU26	12/18/08	HIB	N37.45559 W75.77675	M	AHY	800	222	32.6	26.5	18.3	16.7	17.8	Y
LTDU27	12/18/08	HIB	N37.45559 W75.77675	M	AHY	860	225	35.3	25.6	19.0	17.0	18.7	Y
LTDU28	12/18/08	HIB	N37.45559 W75.77675	F	AHY	600	205	33.5	24.3	16.1	14.2	16.5	Y
LTDU29	12/18/08	HIB	N37.45663 W75.77718	M	HY	680	217	35.2	27.6	17.4	17.2	18.0	Y
LTDU30	12/18/08	HIB	N37.45491 W75.77754	M	AHY	840	226	33.4	28.0	20.0	17.6	20.0	Y
LTDU31	1/12/09	CB	N37.66199 W75.92396	F	AHY	740	208	33.6	24.0	16.2	15.0	18.1	Y
LTDU32	1/12/09	CB	N37.66623 W75.92692	F	AHY	740	213	33.0	26.0	17.8	15.4	18.0	Y
LTDU33	1/13/09	CB	N37.73819 W75.85470	F	AHY	700	212	33.1	25.1	18.0	15.9	18.9	Y
LTDU34	1/13/09	CB	N37.73306 W75.85717	M	AHY	680	217	32.2	25.0	18.6	16.6	18.3	Y
LTDU35	1/13/09	CB	N37.73177 W75.85319	F	AHY	700	208	32.3	25.7	18.4	14.8	17.0	Y
LTDU36	1/13/09	CB	N37.73036 W75.86436	M	AHY	620	228	35.7	25.1	17.4	17.0	19.7	Y

Appendix VII. Coordinates, sex, age and anatomical metrics for all sea ducks collected in this study.

Bird ID	Date	Study Area	Lat./Long.	Sex	Age	Wet Whole Mass (g)	Rt. Wing-notch Length (mm)	Tarsus Length (mm)	Culmen-Forefeather Length (mm)	Culmen Nostril-tip Length (mm)	Bill Height (mm)	Bill Base Width (mm)	Image Archived
LTDU37	1/13/09	CB	N37.72486 W75.85993	M	HY	620	205	33.5	25.0	17.5	15.4	17.2	Y
LTDU38	1/13/09	CB	N37.73230 W75.87246	M	AHY	780	230	35.7	26.0	16.4	17.9	18.1	Y
LTDU39	1/13/09	CB	N37.72488 W75.91449	F	HY	640	206	33.2	24.6	16.6	18.4	18.7	Y
LTDU40	1/13/09	CB	N37.71162 W75.91329	M	HY	740	213	35.0	26.9	18.0	15.4	18.4	Y
LTDU41	1/26/09	HIB	N37.48470 W75.79894	M	HY	840	222	36.3	26.6	18.4	16.5	19.6	Y
LTDU42	1/26/09	HIB	N37.48470 W75.79894	M	HY	720	214	33.0	26.7	17.6	16.4	19.1	Y
LTDU43	1/26/09	HIB	N37.48470 W75.79894	M	HY	780	224	35.0	26.5	18.4	15.9	18.7	Y
LTDU44	1/26/09	HIB	N37.47633 W75.80430	M	AHY	760	221	33.2	26.0	16.8	16.8	18.1	Y
LTDU45	1/26/09	HIB	N37.47633 W75.80430	F	HY	760	206	33.6	28.1	18.4	16.1	17.5	Y
LTDU46	1/13/09	CB	N37.71608 W75.91382	M	AHY	820	221	35.9	27.4	17.4	18.4	18.3	Y
LTDU47	1/13/09	CB	N37.70782 W75.92297	F	AHY	740	210	32.6	24.7	16.7	15.3	19.1	Y
LTDU48	1/13/09	CB	N37.67538 W75.92298	M	AHY	820	230	36.3	27.4	18.8	17.6	18.6	Y
LTDU49	1/13/09	CB	N37.67719 W75.91955	F	HY	600	202	33.9	25.7	18.8	15.8	17.3	Y
LTDU50	1/13/09	CB	N37.66509 W75.92677	F	AHY	720	211	34.0	26.2	17.5	15.9	16.9	Y
LTDU51	1/26/09	HIB	N37.47633 W75.80430	F	HY	620	194	34.6	26.5	17.7	14.0	18.4	Y
LTDU52	1/26/09	HIB	N37.46523 W75.78435	M	AHY	780	216	32.5	26.5	17.4	16.2	18.2	Y
LTDU53	1/26/09	HIB	N37.46336 W75.77914	M	AHY	820	217	34.8	28.0	18.9	17.4	19.8	Y
LTDU54	1/26/09	HIB	N37.46356 W75.78022	M	AHY	840	226	36.4	26.2	18.0	16.6	19.7	Y

Appendix VII. Coordinates, sex, age and anatomical metrics for all sea ducks collected in this study.

Bird ID	Date	Study Area	Lat./Long.	Sex	Age	Wet Whole Mass (g)	Rt. Wing-notch Length (mm)	Tarsus Length (mm)	Culmen-Forefeather Length (mm)	Culmen Nostril-tip Length (mm)	Bill Height (mm)	Bill Base Width (mm)	Image Archived
LTDU55	1/26/09	HIB	N37.46356 W75.78022	F	AHY	720	209	34.0	24.6	16.5	15.3	17.6	Y
LTDU56	1/26/09	HIB	N37.47236 W75.75474	M	AHY	720	222	33.2	28.5	17.5	15.0	17.1	Y
LTDU57	1/26/09	HIB	N37.47236 W75.75474	F	AHY	680	208	33.0	24.2	16.7	14.7	17.5	Y
LTDU58	1/26/09	HIB	N37.47236 W75.75474	M	AHY	760	224	34.0	26.0	17.0	17.7	20.6	Y
LTDU59	1/26/09	HIB	N37.45152 W75.77363	M	AHY	840	222	35.5	27.7	18.2	17.7	19.2	Y
LTDU60	1/26/09	HIB	N37.45152 W75.77363	F	AHY	700	213	35.3	25.6	16.4	16.0	18.3	Y
SUSC1	11/3/08	HIB	N37.43055 W75.74245	M	AHY	1220	240	.	34.0	27.0	21.0	25.0	Y
SUSC2	11/3/08	HIB	N37.42827 W75.74060	M	AHY	1200	235	.	36.0	25.0	22.0	23.0	Y
SUSC3	11/3/08	HIB	N37.43179 W75.74058	F	AHY	1000	230	.	38.0	26.0	20.0	23.0	Y
SUSC4	11/12/08	HIB	N37.41443 W75.73993	M	AHY	1080	248	45.8	39.3	27.4	24.9	26.0	Y
SUSC5	11/12/08	HIB	N37.40828 W75.74176	F	AHY	880	228	40.5	38.5	25.5	20.0	21.6	Y
SUSC6	11/12/08	HIB	N37.40062 W75.74183	M	AHY	1100	242	43.0	37.2	26.1	23.0	25.2	Y
SUSC7	11/12/08	HIB	N37.40062 W75.74183	M	AHY	1020	245	40.5	35.0	23.5	23.5	25.4	Y
SUSC8	11/12/08	HIB	N37.41112 W75.75035	M	AHY	1080	250	42.9	33.3	26.6	23.7	25.1	Y
SUSC9	11/12/08	HIB	N37.41112 W75.75035	F	AHY	920	233	40.9	36.8	22.9	21.4	21.0	Y
SUSC10	11/12/08	HIB	N37.41276 W75.75175	M	AHY	1020	246	44.7	37.8	26.3	22.5	26.4	Y
SUSC11	11/12/08	HIB	N37.41276 W75.75175	F	AHY	1000	180	42.3	37.7	23.6	20.0	24.1	Y

Appendix VII. Coordinates, sex, age and anatomical metrics for all sea ducks collected in this study.

Bird ID	Date	Study Area	Lat./Long.	Sex	Age	Wet Whole Mass (g)	Rt. Wing-notch Length (mm)	Tarsus Length (mm)	Culmen-Forefeather Length (mm)	Culmen Nostril-tip Length (mm)	Bill Height (mm)	Bill Base Width (mm)	Image Archived
SUSC12	11/17/08	HIB	N37.43333 W75.73933	M	AHY	1060	243	42.3	37.9	26.4	22.3	26.3	N
SUSC13	11/17/08	HIB	N37.45092 W75.75292	M	AHY	1060	235	44.5	38.8	27.3	23.0	25.4	N
SUSC14	12/2/08	CB	N37.71749 W75.83368	M	AHY	1020	244	42.1	34.2	25.0	23.0	26.7	Y
SUSC15	12/2/08	CB	N37.71749 W75.83368	F	AHY	940	218	39.0	37.0	21.3	20.3	21.5	Y
SUSC16	12/2/08	CB	N37.72609 W75.84671	M	AHY	1040	240	41.6	35.3	26.2	25.0	25.3	Y
SUSC17	12/2/08	CB	N37.72940 W75.85384	F	AHY	960	238	42.8	38.8	22.4	20.8	22.3	Y
SUSC18	12/2/08	CB	N37.72940 W75.85384	M	AHY	980	222	43.0	37.2	26.9	22.4	24.6	Y
SUSC19	12/2/08	CB	N37.73423 W75.83388	M	HY	1040	241	45.9	42.4	23.3	23.6	23.2	Y
SUSC20	12/2/08	CB	N37.73423 W75.83388	F	AHY	960	226	41.5	36.3	21.4	20.5	20.8	Y
SUSC21	12/2/08	CB	N37.73423 W75.83388	F	AHY	1060	231	40.9	36.6	20.7	21.2	22.0	Y
SUSC22	12/2/08	CB	N37.73423 W75.83388	F	AHY	960	234	41.8	35.4	22.2	20.9	22.0	Y
SUSC23	12/2/08	CB	N37.73423 W75.83388	F	HY	980	228	41.0	37.0	22.4	21.9	19.8	Y
SUSC24	12/2/08	CB	N37.71474 W75.86855	M	AHY	1040	250	45.5	39.4	23.7	25.3	25.2	Y
SUSC25	12/9/08	CB	N37.69466 W75.90981	M	AHY	1080	241	43.4	34.0	24.3	24.4	26.0	Y
SUSC26	12/9/08	CB	N37.65064 W75.91479	M	AHY	1120	240	44.4	34.0	24.4	22.4	26.9	Y
SUSC27	12/9/08	CB	N37.65064 W75.91479	F	AHY	1100	230	35.6	34.2	22.0	21.5	22.8	Y
SUSC28	12/17/08	CB	N37.70863 W75.90627	M	AHY	1000	250	43.0	34.2	23.9	23.6	23.0	Y
SUSC29	1/12/09	CB	N37.72676 W75.81664	M	HY	1040	228	43.4	40.2	23.0	22.2	23.5	Y

Appendix VII. Coordinates, sex, age and anatomical metrics for all sea ducks collected in this study.

Bird ID	Date	Study Area	Lat./Long.	Sex	Age	Wet Whole Mass (g)	Rt. Wing-notch Length (mm)	Tarsus Length (mm)	Culmen-Forefeather Length (mm)	Culmen Nostril-tip Length (mm)	Bill Height (mm)	Bill Base Width (mm)	Image Archived
SUSC30	1/12/09	CB	N37.72676 W75.81664	M	AHY	880	242	42.0	36.6	26.0	23.0	25.0	Y
SUSC31	1/12/09	CB	N37.72095 W75.83359	M	AHY	1160	243	42.5	38.5	25.5	25.7	28.2	Y
SUSC32	1/12/09	CB	N37.71817 W75.83314	M	AHY	1040	232	43.5	35.8	24.4	24.0	25.3	Y
SUSC33	1/12/09	CB	N37.72176 W75.82989	M	AHY	1100	248	44.5	35.4	25.0	24.7	25.0	Y
SUSC34	1/12/09	CB	N37.72176 W75.82989	M	HY	1020	230	44.2	40.3	24.5	22.8	23.0	Y
SUSC35	1/12/09	CB	N37.71992 W75.83734	M	AHY	1080	236	44.4	37.7	24.6	22.6	27.6	Y
SUSC36	1/12/09	CB	N37.67297 W75.86317	M	AHY	1120	241	42.9	32.2	23.7	23.0	24.0	Y
SUSC37	1/12/09	CB	N37.65629 W75.90280	M	AHY	1040	243	41.0	36.4	27.1	23.7	24.0	Y
SUSC38	1/12/09	CB	N37.66887 W75.90911	M	AHY	1080	234	44.6	39.4	26.2	25.4	27.4	Y
SUSC39	1/12/09	CB	N37.68557 W75.90053	M	AHY	1140	242	46.4	38.0	26.6	24.4	26.0	Y
SUSC40	1/12/09	CB	N37.72357 W75.85781	F	AHY	960	236	40.0	40.2	23.5	22.2	23.9	Y
SUSC41	1/13/09	CB	N37.72826 W75.89358	M	AHY	1040	250	45.2	37.0	23.6	22.8	26.2	Y
SUSC42	1/13/09	CB	N37.65539 W75.94658	F	AHY	980	227	40.5	39.0	25.6	19.7	22.6	Y
SUSC43	1/13/09	CB	N37.64874 W75.95839	M	AHY	1000	245	41.5	33.7	24.7	22.2	25.3	Y
SUSC44	1/13/09	CB	N37.64874 W75.95839	F	AHY	1000	238	40.8	37.3	21.5	21.0	24.3	Y

Appendix VIII. Water depth and water quality measures for all sea ducks collected during this study.

Bird ID	Water Depth (m)	Within 1 m of Surface: Water Temp (C)	Sal (psu)	DO (mg/L)	Turbidity (NTU)	Within 1 m of Seabed: Water Temp (C)	Sal (psu)	DO (mg/L)	Turbidity (NTU)
LTDU1	1.7	12.5	29.7	9.0	5.3	.	.	.	.
LTDU2	2.5	.	.	.	.	.	.	.	.
LTDU3	2.2	.	.	.	.	.	.	.	.
LTDU4	2.7	.	.	.	.	.	.	.	.
LTDU5	2.4	.	.	.	.	.	.	.	.
LTDU6	1.9	.	.	.	.	.	.	.	.
LTDU7	4.9	7.5	20.3	7.7	5.1	7.5	20.3	7.5	5.4
LTDU8	5.9	7.5	20.7	7.5	4.4	7.5	20.9	7.4	5.0
LTDU9	5.0	7.5	20.7	7.5	4.4	7.5	20.9	7.4	5.0
LTDU10	5.8	7.5	20.7	7.5	4.4	7.5	20.9	7.4	5.0
LTDU11	5.7	5.5	21.0	8.2	4.8	5.6	21.0	7.9	5.3
LTDU12	2.9	5.5	20.9	8.0	4.1	.	.	.	.
LTDU13	2.9	5.5	20.9	8.0	4.1	.	.	.	.
LTDU14	5.6	4.4	20.9	8.1	2.9	4.4	20.9	8.2	5.1
LTDU15	2.3	4.8	20.9	8.1	3.9	.	.	.	.
LTDU16	4.7	4.4	20.9	8.1	2.9	4.4	20.9	8.2	5.1
LTDU17	6.6	4.4	20.7	8.3	4.3	4.5	20.6	8.4	4.3
LTDU18	6.0	6.9	20.1	7.5	.	7.0	20.1	7.5	.
LTDU19	5.6	6.9	20.1	7.5	.	7.0	20.1	7.5	.
LTDU20	6.9	6.9	20.4	7.5	.	6.9	20.4	7.5	.
LTDU21	6.0	6.9	20.4	7.5	.	6.9	20.4	7.5	.
LTDU22	8.2	8.9	29.0	6.2	7.2	8.8	29.0	6.4	8.6
LTDU23	8.2	8.9	29.0	6.2	7.2	8.8	29.0	6.4	8.6
LTDU24	8.2	8.9	29.0	6.2	7.2	8.8	29.0	6.4	8.6
LTDU25	7.8	8.9	30.3	7.0	5.4	8.9	30.3	6.4	5.3
LTDU26	7.8	8.9	30.3	7.0	5.4	8.9	30.3	6.4	5.3

Appendix VIII. Water depth and water quality measures for all sea ducks collected during this study.

Bird ID	Water Depth (m)	Within 1 m of Surface: Water Temp (C)	Sal (psu)	DO (mg/L)	Turbidity (NTU)	Within 1 m of Seabed: Water Temp (C)	Sal (psu)	DO (mg/L)	Turbidity (NTU)
LTDU27	7.8	8.9	30.3	7.0	5.4	8.9	30.3	6.4	5.3
LTDU28	7.8	8.9	30.3	7.0	5.4	8.9	30.3	6.4	5.3
LTDU29	7.7	8.9	30.3	7.0	5.4	8.9	30.3	6.4	5.3
LTDU30	7.8	8.9	30.3	7.0	5.4	8.9	30.3	6.4	5.3
LTDU31	4.3	5.2	19.6	8.2	3.1	5.2	19.6	8.3	5.4
LTDU32	6.6	5.2	19.6	8.2	3.1	5.2	19.6	8.3	5.4
LTDU33	8.4	4.3	19.3	8.5	1.1	4.5	19.2	8.5	2.2
LTDU34	8.5	4.3	19.3	8.5	1.1	4.5	19.2	8.5	2.2
LTDU35	7.8	4.3	19.3	8.5	1.1	4.5	19.2	8.5	2.2
LTDU36	7.6	4.3	19.3	8.5	1.1	4.5	19.2	8.5	2.2
LTDU37	6.3	4.6	19.2	8.2	1.6	4.7	19.5	8.2	2.5
LTDU38	9.4	4.6	19.2	8.2	1.6	4.7	19.5	8.2	2.5
LTDU39	6.3	4.8	19.9	8.0	2.2	5.1	20.3	7.9	3.0
LTDU40	6.1	4.9	20.0	8.1	6.1	4.9	20.0	8.1	5.9
LTDU41	5.5	1.7	30.3	8.8	4.0	1.7	31.0	8.6	5.3
LTDU42	5.5	1.7	30.3	8.8	4.0	1.7	31.0	8.6	5.3
LTDU43	5.5	1.7	30.3	8.8	4.0	1.7	31.0	8.6	5.3
LTDU44	1.5	1.7	30.3	8.8	4.0	.	.	.	.
LTDU45	1.5	1.7	30.3	8.8	4.0	.	.	.	.
LTDU46	6.2	4.9	20.0	8.1	6.1	4.9	20.0	8.1	5.9
LTDU47	6.9	4.9	20.0	8.1	6.1	4.9	20.0	8.1	5.9
LTDU48	6.3	4.9	19.6	8.1	1.6	5.0	20.2	7.9	3.3
LTDU49	6.8	4.9	19.6	8.1	1.6	5.0	20.2	7.9	3.3
LTDU50	6.6	4.9	19.8	7.9	1.2	5.0	20.1	7.9	2.3
LTDU51	1.5	1.7	30.3	8.8	4.0	.	.	.	.
LTDU52	2.3	1.7	31.4	8.5	5.5	.	.	.	.

Appendix VIII. Water depth and water quality measures for all sea ducks collected during this study.

		Within 1 m of Surface				Within 1 m of Seabed			
Bird ID	**Water Depth (m)**	**Water Temp (C)**	**Sal (psu)**	**DO (mg/L)**	**Turbidity (NTU)**	**Water Temp (C)**	**Sal (psu)**	**DO (mg/L)**	**Turbidity (NTU)**
LTDU53	2.0	1.7	31.4	8.5	5.5	.	.	.	.
LTDU54	2.5	1.7	31.4	8.5	5.5	.	.	.	.
LTDU55	2.5	1.7	31.4	8.5	5.5	.	.	.	.
LTDU56	1.9	2.1	31.4	8.6	6.7	.	.	.	.
LTDU57	1.9	2.1	31.4	8.6	6.7	.	.	.	.
LTDU58	2.0	2.1	31.4	8.6	6.7	.	.	.	.
LTDU59	3.7	1.8	31.2	8.5	6.7	.	.	.	.
LTDU60	3.7	1.8	31.2	8.5	6.7	.	.	.	.
SUSC1	2.1	13.5	31.2	6.5	3.8	.	.	.	.
SUSC2	2.1	13.5	31.5	6.7	3.4	.	.	.	.
SUSC3	2.0	13.7	31.5	6.8	2.7	.	.	.	.
SUSC4	2.4	12.7	29.7	9.5	2.8	.	.	.	.
SUSC5	2.3	12.6	29.7	9.3	3.6	.	.	.	.
SUSC6	1.8	12.3	29.8	9.2	3.7	.	.	.	.
SUSC7	1.8	12.3	29.8	9.2	3.7	.	.	.	.
SUSC8	2.7	13.4	29.7	9.3	8.1	.	.	.	.
SUSC9	2.7	13.4	29.7	9.3	8.1	.	.	.	.
SUSC10	2.8	13.4	29.8	9.3	8.2	.	.	.	.
SUSC11	2.8	13.4	29.8	9.3	8.2	.	.	.	.
SUSC12	1.8	.	.	.	.	.	.	.	.
SUSC13	2.3	.	.	.	.	.	.	.	.
SUSC14	2.5	7.3	20.7	7.5	4.2	.	.	.	.
SUSC15	2.5	7.3	20.7	7.5	4.2	.	.	.	.
SUSC16	2.5	7.5	20.7	7.4	7.2	.	.	.	.
SUSC17	5.2	7.4	20.8	7.4	6.1	7.4	20.8	7.4	6.1

Appendix VIII. Water depth and water quality measures for all sea ducks collected during this study.

Bird ID	Water Depth (m)	Within 1 m of Surface: Water Temp (C)	Sal (psu)	DO (mg/L)	Turbidity (NTU)	Within 1 m of Seabed: Water Temp (C)	Sal (psu)	DO (mg/L)	Turbidity (NTU)
SUSC18	5.2	7.4	20.8	7.4	6.1	7.4	20.8	7.4	6.1
SUSC19	1.5	7.5	20.4	7.3	10.3	.	.	.	.
SUSC20	1.5	7.5	20.4	7.3	10.3	.	.	.	.
SUSC21	1.5	7.5	20.4	7.3	10.3	.	.	.	.
SUSC22	1.5	7.5	20.4	7.3	10.3	.	.	.	.
SUSC23	1.5	7.5	20.4	7.3	10.3	.	.	.	.
SUSC24	2.7	7.5	21.2	7.5	7.2	.	.	.	.
SUSC25	6.0	5.4	20.8	7.8	4.4	5.4	20.8	7.8	3.7
SUSC26	6.5	5.6	21.0	7.8	3.0	5.5	21.0	7.9	3.6
SUSC27	6.5	5.6	21.0	7.8	3.0	5.5	21.0	7.9	3.6
SUSC28	3.6	6.9	20.2	7.5	8.1	.	.	.	.
SUSC29	4.6	4.4	18.1	8.6	5.1	4.4	18.9	8.4	4.1
SUSC30	4.6	4.4	18.1	8.6	5.1	4.4	18.9	8.4	4.1
SUSC31	2.0	4.6	19.0	8.3	5.2	.	.	.	.
SUSC32	2.5	4.5	19.0	8.5	4.1	.	.	.	.
SUSC33	5.5	4.6	19.0	8.3	3.3	4.6	19.0	8.4	3.6
SUSC34	5.5	4.6	19.0	8.3	3.3	4.6	19.0	8.4	3.6
SUSC35	1.5	5.1	19.0	8.4	2.5	.	.	.	.
SUSC36	1.4	4.9	19.3	8.3	2.7	.	.	.	.
SUSC37	5.6	5.3	19.6	8.4	3.1	5.1	19.7	8.3	4.1
SUSC38	3.4	4.8	19.2	8.3	8.1	4.9	19.2	8.3	14.6
SUSC39	3.9	4.8	19.2	8.4	4.0	4.8	19.2	8.4	4.6
SUSC40	5.6	4.7	19.0	8.5	2.6	4.7	19.0	8.4	3.4
SUSC41	9.3	4.8	19.9	8.1	2.8	4.9	19.9	8.1	2.8
SUSC42	6.9	5.3	21.0	7.8	2.8	5.3	21.0	7.9	6.5
SUSC43	7.2	5.3	21.0	7.8	2.8	5.3	21.0	7.9	6.5

Appendix VIII. Water depth and water quality measures for all sea ducks collected during this study.

Bird ID	Water Depth (m)	Within 1 m of Surface: Water Temp (C)	Sal (psu)	DO (mg/L)	Turbidity (NTU)	Within 1 m of Seabed: Water Temp (C)	Sal (psu)	DO (mg/L)	Turbidity (NTU)
SUSC44	7.2	5.3	21.0	7.8	2.8	5.3	21.0	7.9	6.5

Appendix IX. Inclusive species/taxa list for esophagi and gizzard samples.

Broad Taxon	**Family**	**Genus**	**Suffix**
Actiniaria	.	.	.
Algae	Chlorophyta	Cladophora	sp
Algae	Chlorophyta	Ulva	sp
Algae	Rhodophyta	Gracilaria	sp
Amphioxiformes	Branchiostomatidae	Branchiostoma	virginiae
Amphipoda	Ampeliscidae	Ampelisca	sp
Amphipoda	Ampithoidae	Ampithoe	sp
Amphipoda	Bateidae	Batea	catharineusis
Amphipoda	Caprellidae	Caprella	penantis
Amphipoda	Caprellidae	Paracaprella	tenuis
Amphipoda	Corophidae	Corophium	sp
Amphipoda	Gammaridae	Gammarus	sp
Amphipoda	Liljborgiidae	Listriella	clymenellae
Amphipoda	Melitidae	Melita	dentata
Amphipoda	Melitidae	Melita	sp
Anomura	Paguridae	Pagurus	sp
Ascidiacea	Molgulidae	Molgula	manhattensis
Bivalvia	Arcidae	Anadara	ovalis
Bivalvia	Arcidae	Anadara	transversa
Bivalvia	Lyonsidae	Lyonsia	hyalina
Bivalvia	Mactridae	Mulinia	lateralis
Bivalvia	Pharidae	Ensis	directus
Bivalvia	Solecurtidae	Tagelus	plebius
Bivalvia	Solenidae	Solen	viridis
Bivalvia	Tellinidae	Macoma	balthica
Bivalvia	Tellinidae	Macoma	tenta
Bivalvia	Veneridae	Mercenaria	mercenaria
Brachyura	Cancridae	Cancer	irroratus

Appendix IX. Inclusive species/taxa list for esophagi and gizzard samples.

Broad Taxon	Family	Genus	Suffix
Brachyura	Cancridae	Cancer	sp
Brachyura	Majidae	Libinia	sp
Brachyura	Pinnotheridae	Pinnixa	sp
Brachyura	Portunidae	Callinectes	sapidus
Brachyura	Xanthidae	Eurypanopeus	depressus
Brachyura	Xanthidae	Neopanope	sayi
Brachyura	Xanthidae	Panopeus	herbstii
Bryozoa	Membraniporidae	Membranipora	tenuis
Caridea	Alpheidae	Alpheus	heterochaelis
Caridea	Bresilliidae	Discias	atlanticus
Caridea	Crangonidae	Crangon	septemspinosa
Caridea	Hippolytidae	Hippolyte	pleuracanthus
Caridea	Ogyrididae	Ogyrides	alphaerostris
Caridea	Palaemonidae	Palaemonetes	sp
Cumacea	.	.	.
Echinodermata	Amphiuridae	Microphiopholis	atra
Echinodermata	Amphiuridae	.	.
Gastropoda	Caecidae	Caecum	sp
Gastropoda	Calyptraeidae	Crepidula	fornicata
Gastropoda	Cerithiidae	Seila	adamsi
Gastropoda	Columbellidae	Astyris	lunata
Gastropoda	Columbellidae	Costoanachis	avara
Gastropoda	Cylichnidae	Acteocina	caniculata
Gastropoda	Dendrodorididae	Doriopsilla	pharpa
Gastropoda	Epitoniidae	Epitonium	multistriatum
Gastropoda	Epitoniidae	Epitonium	sp
Gastropoda	Muricidae	Nucella	sp
Gastropoda	Muricidae	Trophora	nigrocincta

Appendix IX. Inclusive species/taxa list for esophagi and gizzard samples.

Broad Taxon	Family	Genus	Suffix
Gastropoda	Muricidae	Urosalpinx	sp
Gastropoda	Nassaridae	Nassarius	vibex
Gastropoda	Nassaridae	Nassarius	sp
Gastropoda	Naticdae	Polinices	sp
Gastropoda	Pyramidellidae	Boonea	impressa
Gastropoda	Pyramidellidae	Odostomia	sp
Gastropoda	Pyramidellidae	Turbonilla	sp
Gastropoda	Rissoidae	Rissoina	sp
Gastropoda	Turridae	Mangelina	cerina
Gastropoda	Turridae	Mangelina	plicosa
Gastropoda	Turridae	Mangelina	sp
Gastropoda	Vitrinellidae	Vitrinella	helicoidea
Hydrozoa	.	.	.
Isopoda	Anthuridae	.	.
Isopoda	Idoteidae	Edotea	triloba
Isopoda	Idoteidae	Edotea	sp
Isopoda	Idoteidae	Erichsonella	attenuata
Isopoda	Idoteidae	Erichsonella	sp
Isopoda	Idoteidae	Synidotea	sp
Nemertea	.	.	.
Polychaeta	Chaetopteridae	.	.
Polychaeta	Goniadidae	Goniadella	sp
Polychaeta	Maldanidae	.	.
Polychaeta	Nereidae	Neanthes	sp
Polychaeta	Nereidae	Neanthes	succinea
Polychaeta	Nereidae	Neanthes	virens
Polychaeta	Nereidae	Neanthes	virens
Polychaeta	Onuphidae	Diapatra	cuprea

Appendix IX. Inclusive species/taxa list for esophagi and gizzard samples.

Broad Taxon	Family	Genus	Suffix
Polychaeta	Opheliidae	.	.
Polychaeta	Phyllodocidae	.	.
Sav	Zosteraceae	Zostera	marina
Seed	.	.	.
Sessilia	Balanidae	Balanus	sp
Stomatopoda	Squillidae	Squilla	empusa
Teleostei	Batrachoididae	Opsanus	tau
Teleostei	Gobiidae	Gobiosoma	bosc
Teleostei	Gobiidae	Gobiosoma	sp
Teleostei	Gobiidae	Microgobius	sp
Thalassinidea	Callianassidae	Callianassa	sp
Thalassinidea	Upogebiidae	Upogebia	affinis