PRINCE WILLIAM SOUND OIL SPILL RECOVERY INSTITUTE
FINAL REPORT

Montague Island: A Crucial Stopover for Surfbirds and Black Turnstones

Project 09–10–16

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Abstract

Identifying migratory pathways — important stopover sites linked by specific migration routes— is an essential first step in the conservation of migratory shorebirds. Little is known about the migration pathways of Black Turnstones (*Arenaria melanocephala*) and Surfbirds (*Aphriza virgata*), two species that winter and migrate along rocky shorelines of the North Pacific coast. During damage assessments surveys following the 1989 *Exxon Valdez* oil spill, it was discovered that Prince William Sound's Montague Island, located in the spill area, was a spring stopover area for both Surfbird and Black Turnstone. Studies conducted between 1989 and 1997 indicated that a major proportion of each species' population stopped at Montague Island. This study was undertaken during spring 2010 to update baseline information on the numbers and distribution of Surfbird and Black Turnstone stopping at Montague Island. We found reduced numbers of spring migrant Black Turnstones and Surfbirds with < 7,800 shorebirds total observed over 19 survey days compared with single-day high counts of ~8,800 Surfbird and 11,200 Black Turnstone observed in the 1990's. We documented the importance of Unakwik Inlet in northern Prince William Sound for migrant Surfbirds with more than 10,600 birds recorded at an intertidal glacial moraine. None of the 35 Black Turnstone and 10 Surfbird previously color-banded and radiotagged at two sites in the Salish Sea were observed or detected at either northern Montague Island or Unakwik Inlet. These results suggest that Black Turnstone and Surfbird have either altered their migration behaviors or have both undergone significant population declines.

Keywords: Black Turnstone, *Arenaria melanocephala,* Surfbird, *Aphriza virgata,* migration, herring spawn, Prince William Sound

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Introduction

The rocky shorelines of the North Pacific provide wintering and migration habitat for two species of particular interest, Black Turnstone (*Arenaria melanocephala*) and Surfbird (*Aphriza virgata*). Historically, Black Turnstone and Surfbird have been understudied because their populations are relatively small (<100,000 birds) and sparsely distributed and in addition, their preferred habitats are difficult to access. Presently both species are listed by the U.S. Shorebird Conservation Plan as "Species of High Concern" (Brown et al. 2001) and appear on 2010 Audubon Alaska WatchList (Kirchhoff and Padula 2010), a comprehensive list of bird species in need of immediate conservation effort.

In March 1989 the *Exxon Valdez* oil spill occurred in the marine waters of Alaska's Prince William Sound. During damage assessment surveys, it was discovered that Montague Island, located in the spill area, was a major spring stopover area for both Surfbird and Black Turnstone (Norton et al. 1990, Martin 1993). Spring shorebird surveys conducted by the Principal Investigator on northern Montague Island from 1994 through 1997 recorded single-day high counts of >13,800 Surfbirds and >11,200 Black Turnstones indicating that a major proportion of each species population stopped at Montague Island (Bishop and Green 1999, Bishop et al. 1998). More recently, northern Montague Island was named an Important Bird Area in 2006 by National Audubon Society and BirdLife International because of the island's importance as a migratory stopover for Surfbird and Black Turnstone.

Studies at Montague Island found that high shorebird numbers were associated with presence of spawn from the Pacific herring (*Clupea pallasii)*. Spring diets of both Black Turnstone and Surfbird at Montague Island were dominated by Pacific herring spawn *(*Norton et al. 1990, Martin 1993, Bishop and Green 1999, 2001). Body condition of collected specimens yielded relatively high fat levels (Bishop unpubl. data) suggesting that herring spawn may be an important source of fat deposition that allows these shorebirds to withstand adverse weather conditions and more rapidly produce eggs upon arrival to the breeding grounds.

Subsequent to the *Exxon Valdez* oil spill, the PWS herring population collapsed (Thorne and Thomas 2011) and has yet to recover (EVOS Trustee Council, 2010). With reduced adult herring recruitment, miles of herring spawn deposition have been steadily declining at Montague Island. This study was undertaken during spring 2010 to update baseline information on the numbers and distribution of Surfbird and Black Turnstone numbers stopping at Montague Island during the influential pre-breeding period. Our objectives included:

1. Determine the phenology and length of stay of Surfbirds and Black Turnstones stopping at northern Montague Island Important Bird Area Alaska during spring migration.

2. Estimate the population size of Surfbirds and Black Turnstones stopping at northern Montague Island.

3. Characterize the spatial and temporal distribution of Surfbirds and Black Turnstones at northern Montague Island by identifying areas of shorebird concentration and documenting shorebird response to herring spawn within the IBA.

4. Identify conservation concerns at Montague Island with regards to Surfbird and Black Turnstone.

Methods

Trapping & Radio-tagging – Barkley Sound, BC/Oak Harbor, Washington

Black Turnstones and Surfbirds were captured at Barkley Sound, BC and Oak Harbor, WA by Audrey Taylor (Windbird Resources) during late March to early April 2009. Both locations are located in the Salish Sea in NW Washington and southern BC along the northbound migration route of these species (Figs. 1, 2).

Fig. 1 Location of trapping and tagging sites in Salish Sea. Spring 2010.

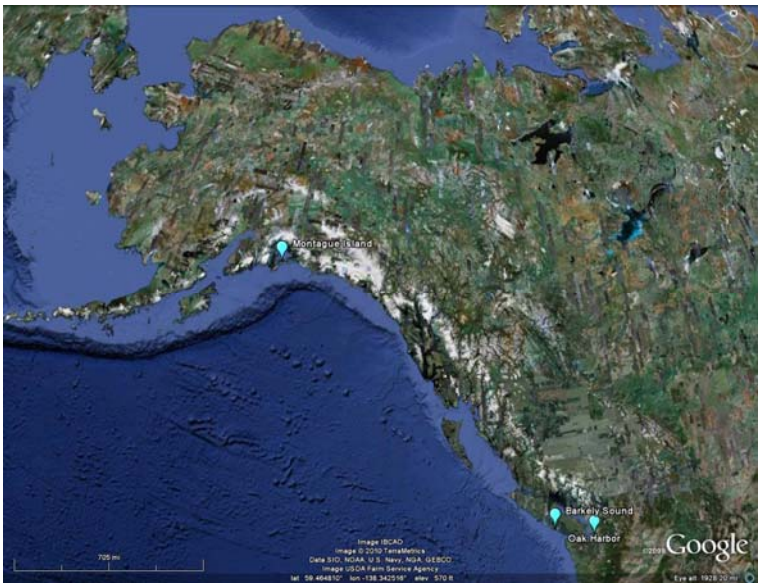

Fig. 2. Map of radio-tagging locations (Barkley Sound and Oak Harbor) in relation to stopover location (Montague Island). Satellite photo from Google Earth.

Shorebirds were captured using 3-5 noose mats constructed out of hardware cloth with fishing line nooses tied on the top side. At Barkley Sound, the noose mats were placed on natural rock outcrops where birds were seen feeding or roosting. At Oak Harbor, the birds roosted at high tide on concrete docks in a public marina. Here the noose mats were placed on the docks where birds were seen roosting or there was evidence of recent roosting activity (Fig. 3). At both locations, groups of birds were "herded" into the vicinity of the noose mats by several people working in concert to prevent them from landing in other areas. Typically, once a flock of birds landed near the noose mats several individuals would walk over the noose mats, entangling their legs in the fishing line. Time from capture to removal from the mat was usually less than 5 minutes.

Fig. 3. Salish Sea shorebird capture and tagging sites. left: Barkley Sound, Pacific Rim National Park, Canada. right: Oak Harbor Marina, Whidbey Island, Washington. Note shorebirds on dock.

Once captured, each bird was weighed to the nearest 0.5g and measured for exposed culmen, diagonal tarsus, and flattened wing chord. Characteristics related to age, feather condition, and fat reserves were also scored. All captured birds were banded with U.S. Fish and Wildlife Service (USFWS) aluminum bands on the upper left leg and a yellow darvic band on both the lower left and lower right legs. Each individual was then equipped with a radio transmitter weighing 1.8 g (model BD-2, Holohill Systems Inc., Ontario Canada), representing <2% of total body mass for either species (Fig. 4). Before attachment, we clipped the body feathers from an area slightly bigger than the transmitter located approximately 1 cm above the uropygial gland.

Transmitters were then attached using superglue and a spray-on catalyst (Loctite 454 Prism Instant Adhesive and 7452 Accelerator) and a leg-loop harness made of 1 mm thick, stretchable beading cord (StretchMagic; Pepperell Braiding Company, Inc.; Sanzenbacher et al. 2000). Transmitter battery life was designed for ~10-20 weeks. Individuals were released back to the wild within 15 minutes of capture. All capture and radio-marking activities for this project were regulated under an Institutional Animal Care and Use protocol issued to the Prince William Sound Science Center, and by appropriate Canadian, US Federal, and State of Washington bird collection, banding, and land use permits.

At the Oak Harbor capture site, radio-marked birds were monitored periodically after trapping to determine how long individuals remained in the capture vicinity and to locate potentially shed transmitters. We were unable to monitor the length of stay at the capture site for birds captured in Barkley Sound due to the difficulty in accessing the capture site.

Fig. 4. Left: Radiotagged birds were banded on both lower legs with one yellow band. Right: Radio transmitters were attached using superglue and a leg-loop harness.

Shorebird Surveys Prince William Sound Alaska

At Montague Island, field crews conducted daily shoreline surveys using 5.2 m skiffs. Shoreline survey length was typically ~85 km and was located within the Montague Island IBA (Fig. 5). One skiff surveyed a northern route typically spanning the shoreline between Stockdale Harbor to Middle Point, located between Rocky and Zaikof Bays. A second skiff surveyed a southern route typically spanning the shoreline from southern Stockdale Harbor to just south of Port Chalmers (Fig. 6). Surveys began at approximately 0800h with the start and end point locations alternating between surveys.

During surveys, the skiff was driven as close to the shoreline as possible and at a speed of approximately 5 knots. In addition to the island's shoreline, field crews surveyed offshore rocks and reefs. We used a modified version of USFWS marine bird surveys that have been adapted for GPS-integrated data entry programs (USFWS 2007). During each survey a global positioning system (GPS) recorded a track line at least every 10 seconds. One observer scanned the shoreline for shorebirds and when a flock was observed, we stopped the boat and recorded location, number, species, and behavior (feeding, roosting or flying). Each location was recorded using a GPS receiver and later mapped using ArcMap 10 (ESRI, Redland, CA, USA). For each survey day we calculated total abundance by species.

I added a second survey area in northern Prince William Sound at Unakwik Inlet by the Cannery Creek Hatchery (Fig. 5). The decision to add this area was based on observations provided by a vessel charter service as well as the availability of a local resident at the hatchery for hire. For this site, all observations were conducted at low tide when the glacial moraine spit was exposed. The observer walked along the moraine and recorded species and numbers, and provided a daily tally.

Field personnel monitored for radiotagged birds from the ground during boat shoreline surveys at northern Montague Island and during ground surveys at Unakwik Inlet (Fig. 5). At both sites personnel used a handheld yagi antenna and a receiver (model R-1000, Communications Specialists Inc., Orange CA) and scanned every ground flock observed. No aerial telemetry surveys were flown due to budget constraints.

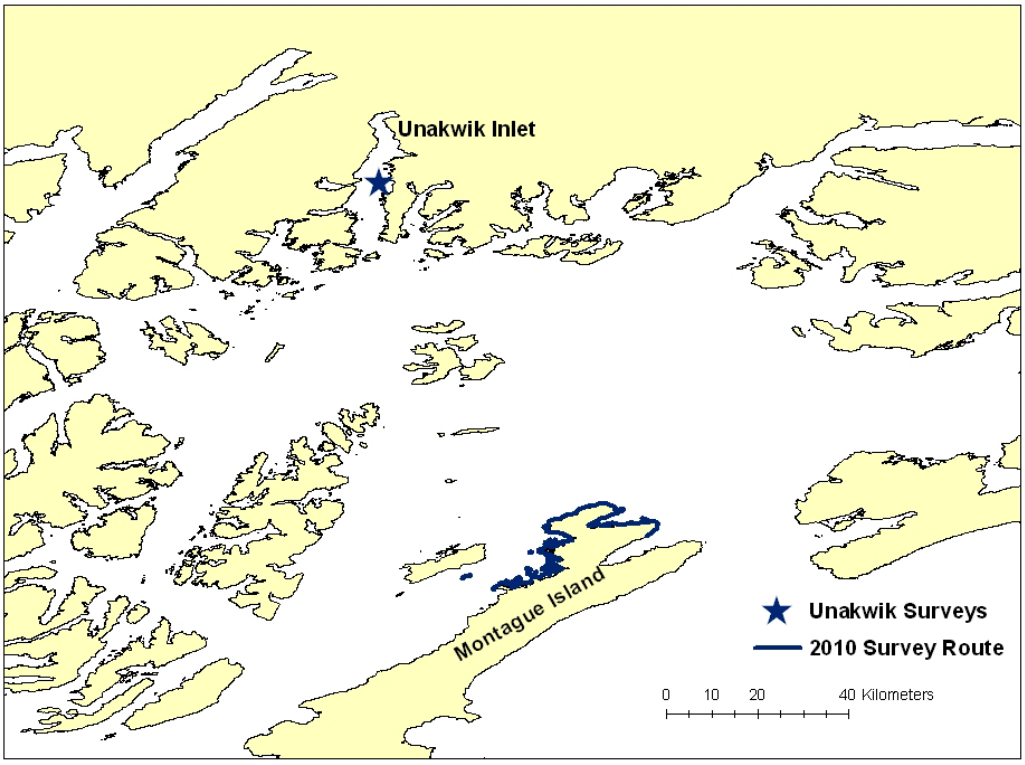

Fig. 5. Location of Prince William Sound spring shorebird surveys for Black Turnstone and Surfbird. Northern Montague shoreline survey route was ~85 km. At Unakwik Inlet, the survey covered the intertidal glacial moraine located near the Cannery Creek Hatchery.

Data Analyses

For Montague Island, we utilized the ShoreZone dataset to examine bird distribution in relation to habitat characteristics within the survey area. ShoreZone is a mapping and classification system that interprets low-altitude, geo-referenced aerial- video imagery of the intertidal zone and nearshore environment. The ShoreZone system divides the surveyed shoreline into discrete segments in lengths typically on the scale of ~100m, and classifies these segments by their geomorphic features (e.g., exposed rocky reefs vs. boulders vs. cobble) and biological features (Harney et al. 2008). The information was made available to the public as a geodatabase.

We identified habitat types used according to the type of shoreline geomorphology, oil residence time and other potentially relevant habitat characteristics. We first examined bird distribution in relation to biological wave exposure. This attribute is determined by ShoreZone using the presence and abundance of biota as a proxy for the energy conditions within the shoreline unit (Harney et al. 2008). For wave exposure, habitats were classified as protected, semi-protected, semi-exposed, and exposed. We also examined shorebird distribution in relation to the shore type. Referred to as the BC Class, there are 35 classes based primarily on substrate type, across-shore width, and slope (Harney et al. 2008). We grouped the 35 shore types into seven classes based on substrate type. Some of the offshore habitats (rocks and reefs) used by birds were outside of the bays and were not classified in the ShoreZone database because they did not occur on the aerial trackline. We used ShoreZone protocol to classify these habitats.

A Chi-square test for goodness-of-fit was used to test whether Surfbird or Black Turnstone habitat use occurred in proportion to the available wave exposure habitat types and shoreline types. For these analyses, use per habitat was the proportion of all birds observed in each habitat. When a statistical difference of $P < 0.05$ in usage versus availability was detected, Bonferroni 95% confidence intervals were used to determine which habitats were preferred (use exceeded availability) or avoided (habitat underutilized in relation to availability; Neu et al. 1974; Byers et al. 1984, McClean et al. 1998). We then used habitat preference results, historical observations, and the location of breeding grounds to predict other habitats in Prince William Sound where both Black Turnstone and Surfbird would likely be found in spring.

Results

Capture, Detections, Length of Stay & Population Estimate from Radiotagged Birds

We captured and radiotagged 3 Surfbird and 1 Black Turnstone at Pacific Rim National Park in British Columbia on 17 March 2010 and 7 Surfbird and 34 Black Turnstone at Oak Harbor WA (Whidbey Island) over 8 days between 27 March and 10 April 2010. At Whidbey Island, based on detections at the Oak Harbor public marina on 4 days between 28 March and 12 April, most Black Turnstone and Surfbird appear to have migrated north between 8 and 12 April. By 12 April no birds (radio-marked or not) were observed roosting at high tide in Oak Harbor, and only 3 radio-marked individuals (1 Black Turnstone and 2 Surfbird) were heard faintly from the capture site.

Of the 45 radio-marked shorebirds that we potentially could have detected, none were relocated during 19 days of monitoring at Montague Island in conjunction with boat shoreline surveys nor were radios heard during 23 days of monitoring during ground surveys at Unakwik Inlet.

I had planned to calculate a population estimate of the birds stopping at northern Montague Island. However, the population estimate required two calculations based on detections of radiotagged birds: an average length of stay, and a detection probability (based on comparing radiomarked birds detected during shoreline surveys at Montague Island with detections from aerial surveys; Bishop et al. 2000). Field personnel detected no radiotagged birds during our thorough surveys of northern Montague Island and the Cannery Creek spit in Unakwik Inlet. In addition, budget constraints prevented aerial telemetry surveys. Therefore I was not able to calculate a population estimate, and instead can only report total numbers of birds observed during shoreline and ground surveys.

Survey Outcomes Abundance and Phenology

Montague Island. At northern Montague Island we conducted surveys between 21 April and 10 May on 19 days for a total of 1,504 km. One survey day was cancelled due to high winds and hard rain. Weather conditions also prevented surveying Rocky Bay on 5 of the 19 survey days. We also surveyed Channel Island, a small island near Green Island on three occasions (5, 7, and 8 May; Fig. 6). In all, we recorded < 7,800 shorebirds in 148 flocks over the 19 survey days. These included 3,535 Black Turnstone, 3,294 Surfbird, and 930 unidentified shorebirds in flight that were Black Turnstone and/or Surfbird (Fig 7).

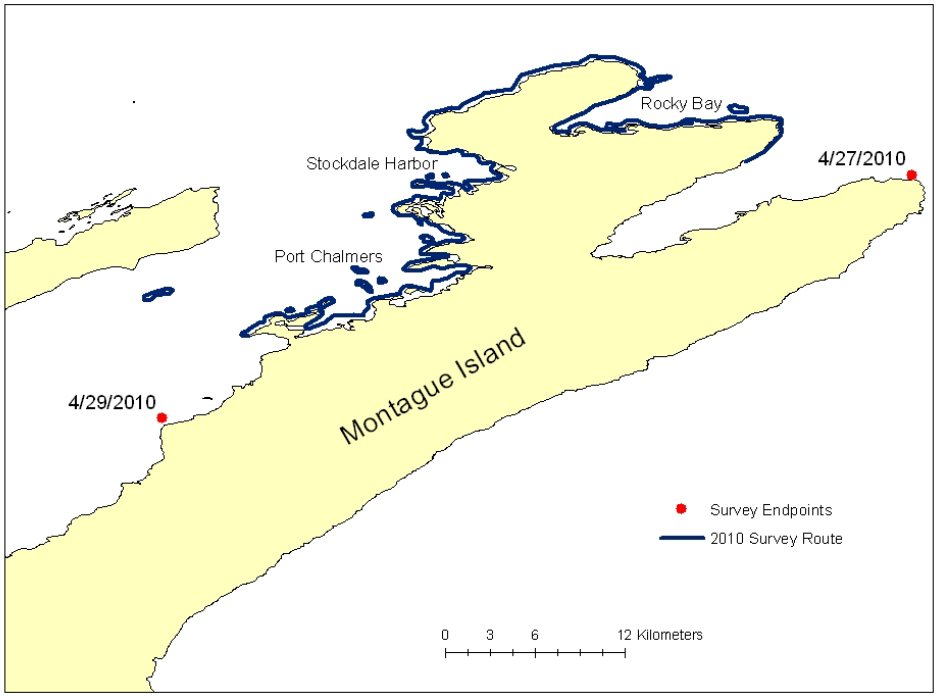

Fig. 6. Boat shoreline survey coverage at Montague Island. Rocky Bay area surveyed 14 of 19 survey days. Survey endpoints indicate date and location of maximum coverage. Spring 2010.

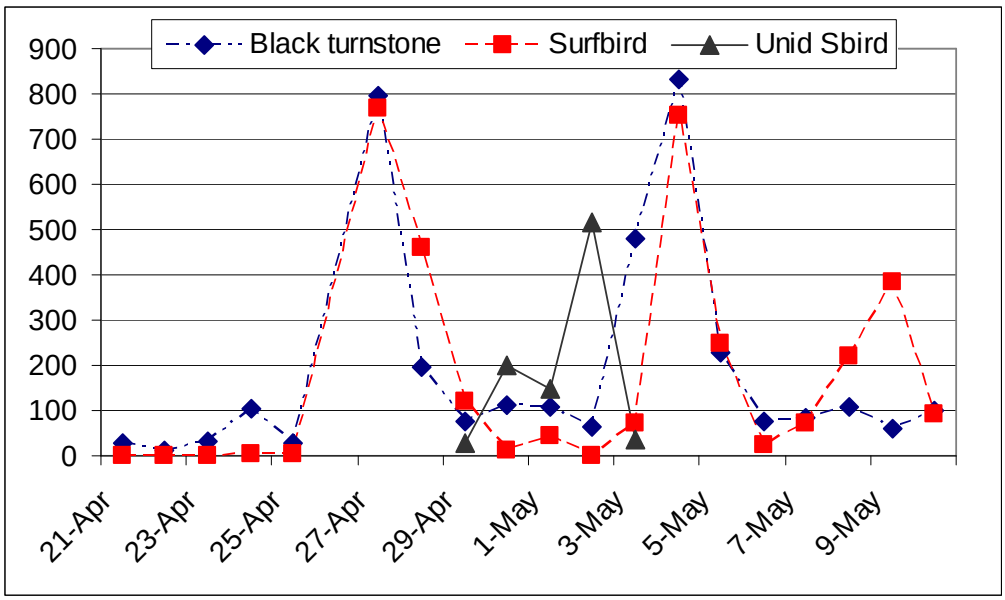

Fig. 7. Phenology and relative abundance of Black Turnstone and Surfbird, including birds in flight. Montague Island, spring 2010. Unid Sbird = Unidentified Shorebird (flock in flight that could not be identified).

Migrant flocks tended to be relatively small, with 82% of black turnstone, 73% of surfbird, and 21% of all mixed flock observations numbering ≤ 15 birds (Figs. 8, 9). The largest flock observed, 520 black turnstones and 30 surfbirds, was associated with the presence of herring spawn.

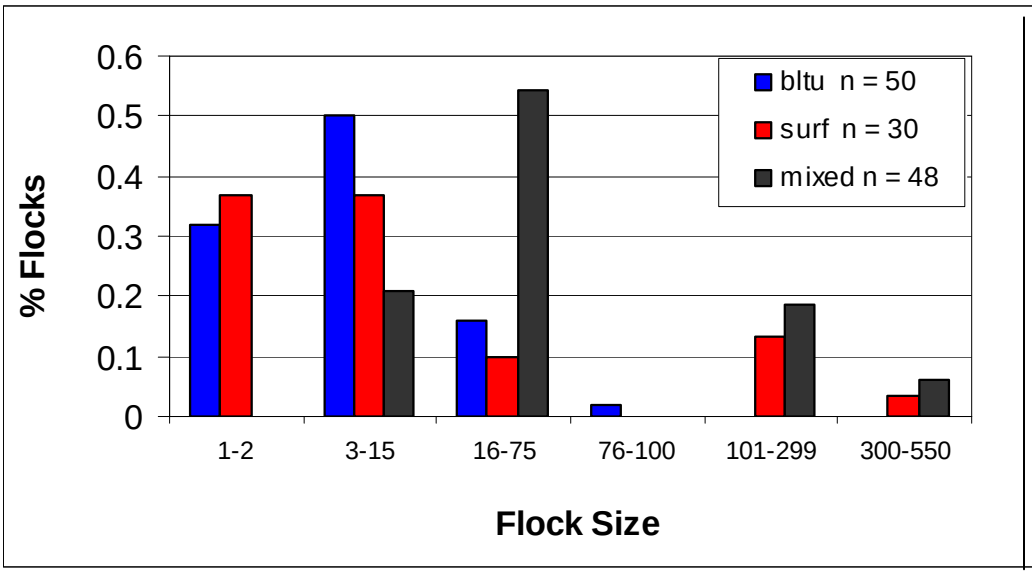

Fig. 8. Percent of flocks observed by flock size and species. Flocks in flight (n = 20) excluded. Bltu = Black turnstone; Surf = Surfbird; mixed = flocks with both Black turnstones and Surfbirds. Montague Island, spring 2010.

Fig. 9. Mixed flock of Surfbird and Black Turnstone (left) and Black Turnstone (right), Montague Island, spring 2010. Single and two-bird flocks were the most common flock size observed.

Unakwik Inlet. Daily ground surveys for shorebirds were conducted at the glacial moraine (Fig. 10) from 23 April-14 May and 18 May 2010 for a total of 23 surveys. More than 10,600 shorebirds were observed at this site in northern Prince William Sound (Figs. 11, 12). Surfbirds, but no Black Turnstones were identified, although there may have been small numbers of Black Turnstones mixed in with flocks.

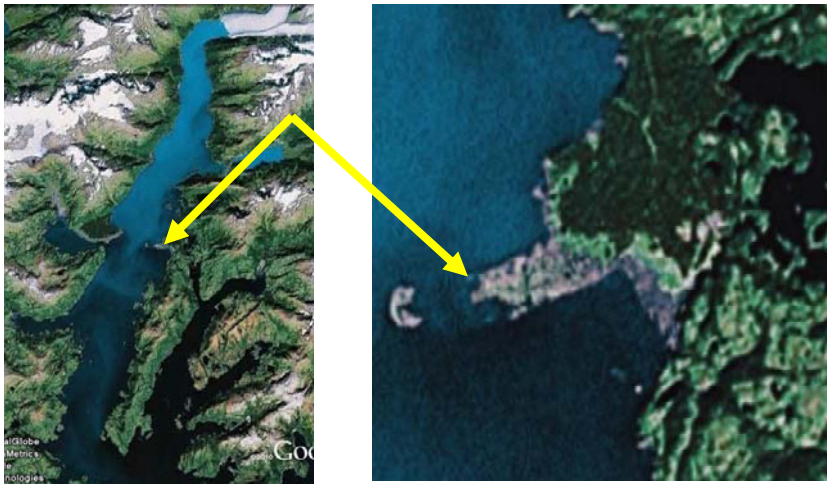

Fig. 10. Location of ground surveys at Unakwik Inlet (left), and close-up of island and intertidal glacial moraine spit (right near Cannery Creek hatchery). Satellite photos from Google Earth.

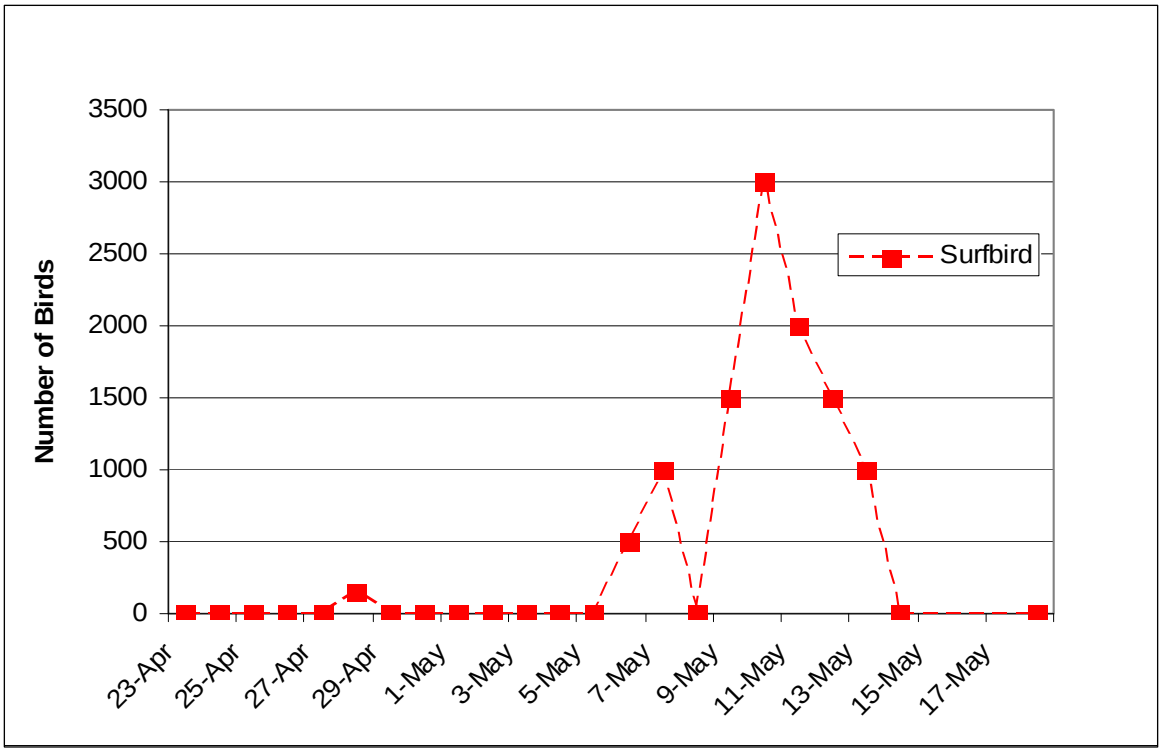

Fig. 11. Phenology and relative abundance of migrant Surfbird, including birds in flight. Cannery Creek Hatchery, Unakwik Inlet. Spring 2010.

Fig. 12. Surfbird flock near Cannery Creek hatchery, Unakwik Inlet. Prince William Sound, spring 2010.

Shorebird Distribution

At northern Montague Island, both shorebird species were observed primarily on offshore rocks, reefs, spits, and islands (Fig. 13). A ~850m stretch of Pacific herring (*Clupea pallasii*) spawn appeared on 24 April just south of Stockdale Harbor. Along with hundreds of gulls, the spawn attracted mixed flocks of both Black Turnstone and Surfbird, primarily between 27 and 29 April.

Biological Exposure. Most of the northern Montague Island shoreline was classified in ShoreZone as semi-protected (66%), with equal amounts of protected shorelines (primarily at the heads of bays) and semi-exposed shorelines (primarily near the mouth of Rocky Bay and along the northwest shoreline near Montague Point). Offshore rocks and reefs not in the ShoreZone database were classified as semi-exposed and occurred primarily outside of the bays on western Montague Island.

Both species used habitats disproportionately ($P < 0.001$) to their availability. Surfbird preferred semi-exposed habitats and underutilized in relation to availability the protected and semi-protected habitats. Black Turnstone preferred semi-protected habitats and underutilized in relation to availability the protected and semi-exposed habitats (Fig. 14).

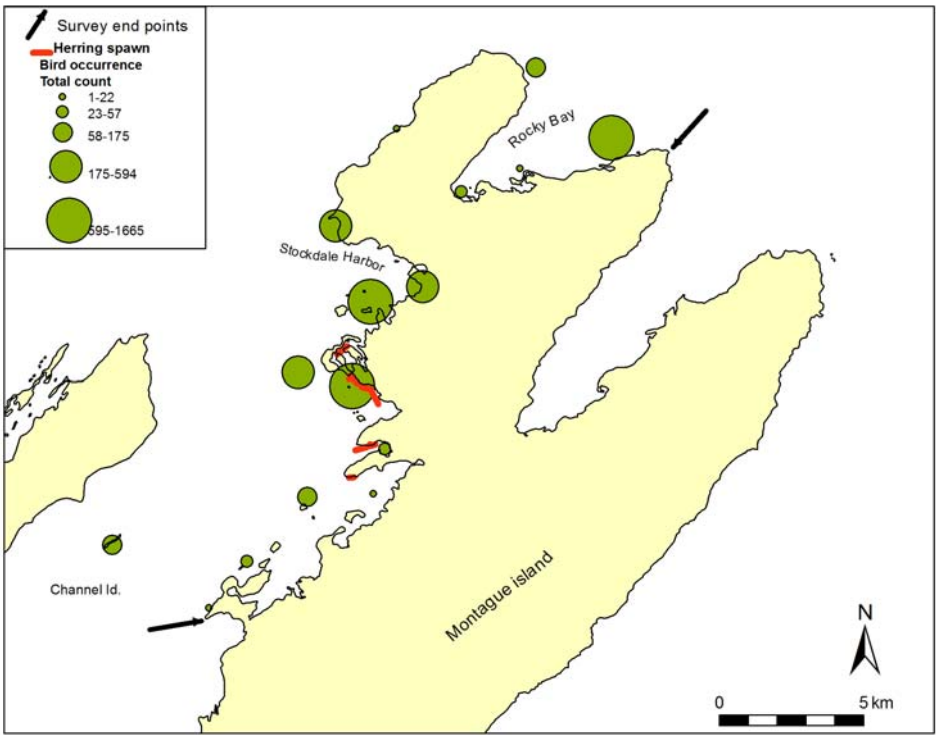

Fig. 13. Distribution of Black Turnstone and Surfbird, excluding flocks in flight. Montague Island, spring 2010.

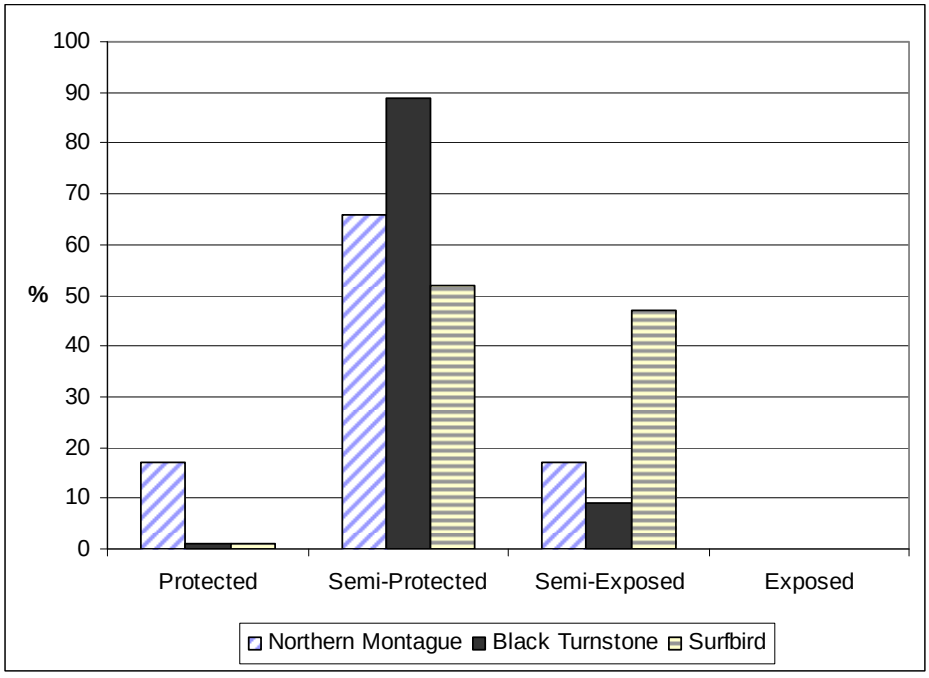

Fig. 14. Habitat selection by biological wave exposure at northern Montague Island. Northern Montague Island = % shoreline habitat in survey area by wave exposure (protected, semi-protected, semi-exposed, or exposed). % Black Turnstone and % Surfbird = % of total birds observed at northern Montague Island in wave exposure types.

Shore Type. Chi-square analyses indicated that both species used habitats disproportionately ($P < 0.001$) to their availability at northern Montague Island. Black Turnstone and Surfbird preferred rock substrates (such as a ramp, platform, or cliff; ShoreZone classes 1-5) and rock substrates with a gravel beach (where gravel includes boulder, cobble or pebble; ShoreZone classes 6-10). All other shore types were used significantly less than their availability (Table 1). At Unakwik Inlet, the glacial moraine and island used by migrant Surfbirds was classified in ShoreZone as a wide (>30m) sand and gravel flat (ShoreZone class no. 24).

Table 1. Habitat selection by shore type for shorebirds stopping at northern Montague Island, spring 2010. Bltu = Black Turnstone and Surf = Surfbird. Selection: + indicates use exceeded availability, – indicates habitat underutilized in relation to availability. SZ = ShoreZone coastal class number. Gravel includes boulder, cobble, and pebbles.

Substrate (SZ)	% Available	% Use Bltu n = 2,908	Bltu Selection	% Use Surf n = 2,980	Surf Selection
Rock cliff, ramp or platform (1-5)	<1	3	+	9	+
Rock cliff, ramp, or platform w gravel beach (6-10)	16	43	+	64	+
Rock cliff, ramp or platform w sand & gravel beach (11-15)	21	13	–	11	–
Gravel flat, fan, or beach (21-23)	4	0	–	0	–
Sand & gravel flat, fan, or beach (24-26)	49	38	–	17	–
Sand & mud (27-30)	6	2	–	<1	–
Estuary (31)	2	0	–	0	–

Oil Residence Index. We examined habitats used by Black Turnstone and Surfbird in relation to the ShoreZone Oil Residence Index (ORI; Table 2). This index defines the persistence of oil residence on the basis of substrate type on a scale of 1 to 5, in which 1 reflects probable short term oil residence (days to weeks) and 5 reflects the potential of long term oil residence (months to years; Harney et al. 2008). For example, rocks that are very exposed, exposed and semi-exposed are ranked 1, while a semi-exposed boulder, cobble, or pebble substrates are ranked 5. The high use of offshore rocks in semi-exposed areas (rank = 1) and offshore rocks in semi-protected areas (rank = 2) resulted in 48% of all Black Turnstone and Surfbird observations occurring in habitats where oil spill persistence was considered short (Table 2). The remaining 52% of the observations occurred in habitats ranked as having a moderate persistence (44%) or long persistence (9%).

Table 2. Oil residence index (ORI) definitions and percentage of Black Turnstone and Surfbird observations at northern Montague Island by ORI. Definitions of ORI (columns 1-3) from Harney et al. (2008) ShoreZone Protocol for the Gulf of Alaska. Percent shoreline northern Montague Island based on ShoreZone database.

Persistence	ORI	Estimated Persistence	% Shoreline N. Montague	% Shorebird Obs n = 128
Short	1	Days to weeks	0	23
	2	**Weeks** to month	<0.1	25
Moderate	3	Weeks to **months**	20	4
	4	**Months** to years	43	40
Long	5	Months to **years**	37	9

Predicted Use Areas in Prince William Sound

Based on the habitat use observed for Surfbird and Black Turnstone during 2010 at northern Montague Island (Fig. 14, Table 1), we predict that Surfbirds stopping in Prince William Sound will use rock substrates (Shorezone coastal classes 1-15) that are located in semi-exposed waters (high potential) and semi-protected waters (medium potential; Fig. 15). Observations during this study at Unakwik Inlet along with historic observations suggest that Surfbirds will use these semi-exposed and semi-protected habitats throughout the Sound. For Black Turnstone, we predict this shorebird will stop in Prince William Sound on rock substrates (ShoreZone coastal classes 1 – 15) that are located in semi-protected waters (Fig. 15). Based on historical observations and the location of their breeding grounds (coastal western Alaska; Fig. 16) we also predict that during spring migration Black Turnstone will be found primarily in southern Prince William Sound.

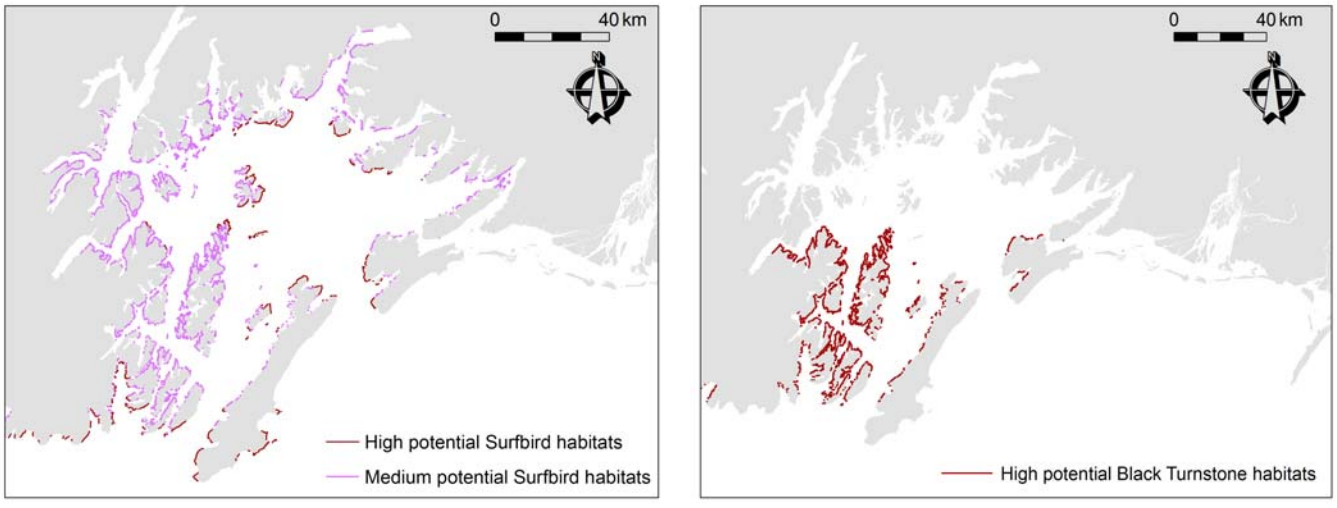

Fig. 15. Surfbird (left) and Black Turnstone (right) potential habitats based on ShoreZone habitat classifications and 2010 shorebird observations at northern Montague Island. Surfbirds high potential habitat = rocky substrate in semi-exposed waters; medium potential habitat = rocky substrate in semi-protected waters. Black Turnstone high potential habitat = rocky substrate in semi-protected waters in southern Prince William Sound.

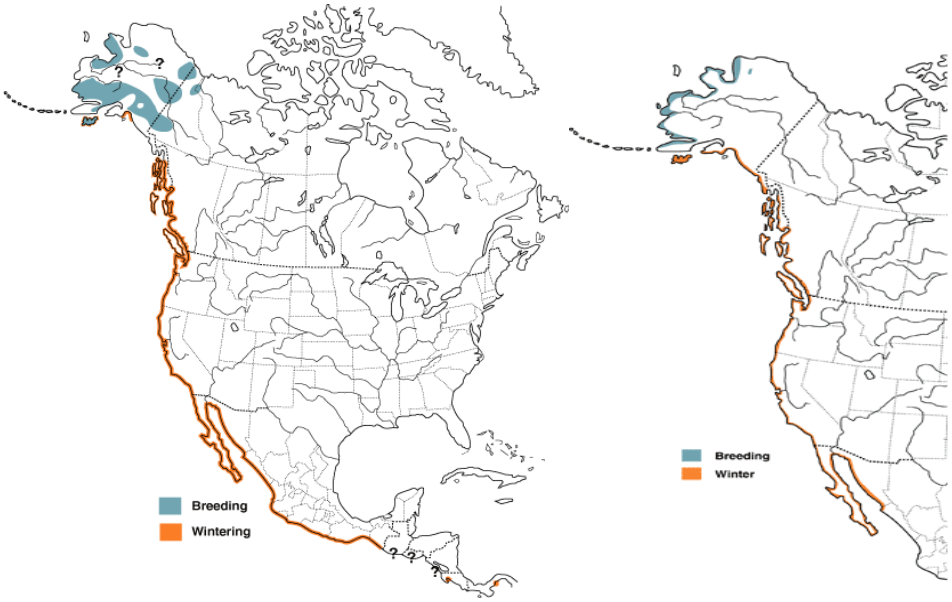

Fig. 16. Breeding and wintering distribution of Surfbirds (left) and Black Turnstones (right). Sources: Senner and McCaffrey (1997) and Handel and Gill (2001).

Discussion

Our study revealed for the first time the importance of Unakwik Inlet in northern Prince William Sound as a stopover site for Surfbirds during the latter part of migration (9 -13 May). The high numbers of Surfbird observed during 2010 at Unakwik Inlet suggest that this bay is a stopover for a subpopulation of late migrating Surfbirds that "hop over" the Chugach Mountains en route to interior breeding areas (Fig. 16). Notably, no Black Turnstones were observed during the 21 days of surveys at Unakwik, suggesting that Black Turnstones stop in the more southern parts of the Sound on their way to their coastal breeding grounds in western Alaska.

At Montague Island, our extensive surveys documented drastic reductions in numbers of both Black Turnstones and Surfbirds. Prior to this study, the most recent survey data were from spring 1997 when a one-day, survey covering an area comparable to the 2010 surveys, recorded ~ 11,300 Black Turnstones and 7,600 Surfbirds (Bishop, unpubl. data). The low shorebird numbers recorded across the 19 surveys in 2010 suggest either altered migration behavior or population declines by Black Turnstone and Surfbird, and highlight the need for a better understanding of their migratory pathways.

None of the radio-tagged individuals were detected during daily boat (Montague Island) or ground (Unakwik Inlet) surveys. Although not observed at either of the Prince William Sound monitoring sites during spring 2010, 10 banded and/or radio-tagged Black Turnstone and Surfbird were later resighted at the Oak Harbor Washington trapping site in October 2010. Banded birds were also resighted at Oak Harbor during April 2011 and July 2011 suggesting that mortality during migration was not a factor in the lack of sightings in Prince William Sound.

Timing and quantity of herring spawn at Montague Island may be driving habitat selection and numbers of Black Turnstones and Surfbirds stopping over in spring. For example, in 2010 we observed Black Turnstone and Surfbird primarily on offshore rocks, reefs, and spits in semi-exposed and semi-protected waters. These results are in contrast to observations from the 1990's when either species were found primarily along shorelines with sand or gravel (includes

boulders, cobble, pebbles) where Pacific herring spawn was present (Bishop unpubl. data). Similarly, in 2010, observations on 27 April, a peak number day, recorded the largest shorebird flock for the field season - 550 shorebirds. This flock included 520 black turnstones and 30 surfbirds and was associated with herring spawn that had been laid along a gravel shoreline just south of Stockdale Harbor (Fig. 13).

Herring spawn deposition has been steadily declining at Montague Island. In 2010, <1 mile of herring spawn was deposited at Montague Island compared with 10-35 miles of spawn deposited during 1989-1997, when spring bird studies were conducted (Fig. 17). Concurrent with the decline at Montague Island, the adult Pacific Herring population has shifted its distribution within Prince William Sound. Adult Pacific Herring are now more likely to spawn in southeast and northeast Prince William Sound (Bligh Island east to Simpson Bay) during early April, or in the case of Simpson Bay in June. In areas where herring spawn is laid down in early April, spawn is likely to hatch and/or have been consumed by predators such as gulls (*Larus* spp.) and offshore diving ducks (Bishop and Green 1999, 2001) before ~23 April, when turnstones and surfbirds begin to arrive in Prince William Sound.

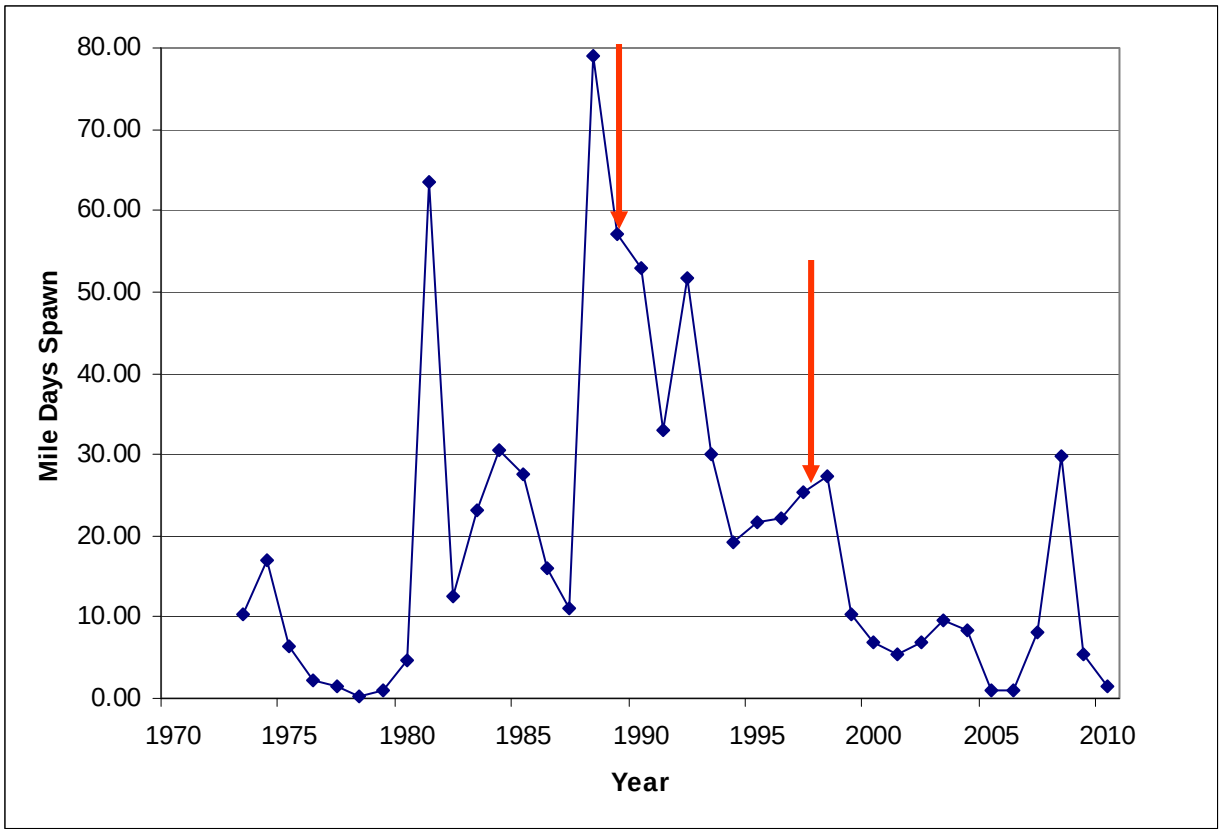

Fig. 17. Mile days of spawn in the Montague Island area, including Green Island. Arrows denote interval with shorebird studies at Montague Island (1989-1997). Data from Alaska Department of Fish and Game, Cordova office.

The importance of herring spawn as a food source for migrant Black Turnstones and Surfbirds should be taken into account for conservation planning. Work conducted by J. Harney et al. (2009) has identified two, high-frequency (>20 observations over a 35 year period) spawning

areas at northern Montague Island: 1) northern Stockdale Harbor and Graveyard Point; and, 2) the head of Rocky Bay. In the case of an oil spill, these two high-frequency spawning areas should be given high priority for protection to prevent shorebirds from being contaminated through either oiling of feathers and/or the transfer of hydrocarbons through the food chain.

Conclusions

The drastic reduction in numbers of Black Turnstone and Surfbird using Montague Island during spring 2010 as well as the large numbers of Surfbird at Unakwik Inlet towards the end of migration suggests that migration pathways for these two species may be flexible across seasons and years. Therefore, monitoring abundance at a single site may lead to erroneous conclusions regarding population trends if alternate sites exist that are used by a substantial proportion of each species' population in a given year. Additionally, without knowledge of the specific timing, routes, and stopover sites used by these species, we lack the information necessary to protect and restore critical habitat on a flyway scale.

Northern Montague Island has been identified and designated as an Important Bird Area based primarily on the numbers of Black Turnstone and Surfbird stopping over during spring migration. However, other locally important spring stopover sites may exist that also warrant identification as Important Bird Areas or should be recognized under other programs such as Western Hemisphere Shorebird Reserve Network (WHRSN) or the State of Alaska's Refuge, Sanctuary, and Critical Habitat Areas. Thus, determining migratory pathways and assessing pathway flexibility through time and space is essential to making informed management and conservation decisions throughout the range of these species. We propose future work using light-level geolocators to investigate use of alternate stopover locations to inform our understanding of the connectivity of locations used throughout their annual cycle, and whether migration routes and timing for these species may be flexible in the light of changing environmental conditions.

Outreach

Radio Programs

Marquette, A. 2011. Field Notes: Black Turnstones, a Shorebird Species of High Concern, parts 1 &2. Broadcast on KCHU Terminal Radio (the public radio station for Greater Prince William Sound). Part 1 aired week of June 20, 2011; Part 2 week of June 27, 2011. Available online http://www.pwssc.org/education/community/community_radio.shtml

Popular Press Articles

Bishop, M.A. 2011. Rocky Coast Aids Shorebird Migration. *Delta Sound Connections*, p.4. Available online: http://www.pwssc.org/dsc/index.shtml

Marquette, A. 2011. Black Turnstones, A shorebird species of high concern, difficult to study. *The Cordova Times*. Aug 8, 2011: 12.

Presentations at Scientific Meetings

Bishop, M.A. and A.R. Taylor. 2010. Shifts in spring stopovers for Surfbirds and Black Turnstones. 14th Alaska Bird Conference, Anchorage Alaska, Nov. 16-18, 2010. Poster.

Bishop, M.A. and A.R. Taylor. 2011. Surfbirds and Black Turnstones populations in Prince William Sound, Alaska: a case of frame bias during spring migration? 4th Western Hemisphere Shorebird Group Conference. 11-15 August 2011, Vancouver BC Canada. Oral presentation.

Local Public Presentations

Bishop, M.A. 2011. Surfbird & Black Turnstone populations stopping over in Prince William Sound. Public meeting of the Prince William Sound Oil Spill Recovery Institute. 23 September 2011, Cordova, Alaska. Oral presentation.

Published Abstracts.

Bishop, M.A. and A.R. Taylor. 2010. Shifts in spring stopovers for Surfbirds and Black Turnstones. Abstract published in J. Leibezeit, ed. Summaries of ongoing or new studies of Alaska shorebird during 2010. No. 9. Alaska Shorebird Group. available online at at http://alaska.fws.gov/mbsp/mbm/shorebirds/working_group.htm

Project web site:
http://www.pwssc.org/research/biological/rockyshorebird.shtml

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