



Black Oystercatcher Chick Diet and Provisioning

2014 Annual Report

Natural Resource Data Series NPS/KEFJ/NRDS—2015/749





ON THIS PAGE

Nest camera captures a black oystercatcher provisioning chick on Notoa Island.
Photograph Courtesy: NPS/Kenai Fjords National Park

ON THE COVER

Black oystercatchers at nest in Aialik Bay, Kenai Fjords National Park
Photograph by: NPS/Katie Thoresen

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Abstract

Black oystercatchers are important members of intertidal community in Kenai Fjords National Park (KEFJ); they structure the nearshore marine environment through predation, are completely reliant on nearshore marine habitats for breeding and foraging, and are a visible bird species. For these reasons, black oystercatchers are vital signs for long-term monitoring at KEFJ. However, data collected during the first few years of monitoring raised questions about possible limitations of the monitoring protocol and identified gaps in breeding ecology knowledge. To address these questions, we conducted a collaborative two-year study, building on previous studies of black oystercatcher breeding productivity in Alaska. Our goal was to examine the role of intertidal invertebrates in the diet of black oystercatcher chicks to assess the influence of these prey items on their body condition and survival. In summer 2014, we conducted systematic boat-based surveys of historically known nesting sites in Aialik Bay, the Chiswell Islands and Northwestern Fjord to locate active black oystercatcher breeding territories. When territorial pairs were found, we searched the area to locate the nest and deployed a Reconyx digital infrared remote-camera near the nest. We monitored 25 nests throughout the breeding season, 60% of which hatched at least one chick. Once eggs hatched, we captured chicks every three days to determine growth rates and body condition and to collect blood plasma for stable isotope analysis of diet. We captured 30 individual chicks repeatedly for a total of 104 captures. We conducted observations of adults with chicks to determine the rate of provisioning and the type and size class of items provisioned. We observed adult black oystercatchers in 12 territories delivering a wide variety of invertebrate prey to their chicks. Of the chicks that hatched, 60% survived to fledge. Apparent nest success of black oystercatchers in this study was comparable to previous studies conducted in KEFJ. This was the second and final year of this study; analysis of data and samples collected will take place over the next year.

Acknowledgments

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Introduction

The black oystercatcher (*Haematopus bachmani*) is a large shorebird and a conspicuous member of intertidal marine communities along the Pacific Coast. It is completely dependent on nearshore marine habitats for all critical stages of its life history including foraging and breeding (Andres and Falxa 1995). It serves as a “keystone” species that is important in structuring nearshore systems (Power et al 1996) and is highly susceptible to human disturbance (Lindberg et al. 1998, Verhulst et al. 2001). Black oystercatchers may live more than 15 years (Andres and Falxa 1995), during which time they establish and defend both nest and forage territories that they may show fidelity to for many years (Groves 1984, Hazlitt and Butler 2001). Nest sites occur in territories occupied by a single pair in a variety of shoreline types, including consolidated and unconsolidated sediments, usually just slightly above the high-high tidal level (Vermeer et al. 1992, Andres 1998). Black oystercatchers prey on a variety of intertidal invertebrates but in many areas their diet consists primarily of mussels (*Mytilus* spp.) and a variety of limpet species (*Lottia* spp.; Andres and Falxa 1995).

The black oystercatcher is a species of concern nationally (Brown et al. 2001), and regionally (Alaska Shorebird Working Group 2000) and is widely recognized as a species representative of nearshore habitats. Kenai Fjords National Park (KEFJ) was established in 1980 by the Alaska National Interest Land Conservation Act (ANILCA) in part "to protect...marine and other birds and to maintain their... breeding areas in their natural state", and black oystercatchers are a Species of Management Concern (GRPA Goal 1A2b) for the park. In recognition of the important ecological role black oystercatchers play in the nearshore zone and their recognized susceptibility to human disturbance, it is considered a “vital sign” in the long-term monitoring program for parks in the Southwest Alaska Network (SWAN) which includes KEFJ (Bennett et al. 2006, Dean and Bodkin 2011). The Black Oystercatcher Conservation Plan (Tessler et al. 2007) listed predation, petroleum contamination, flooding, recreational disturbance, and climate change as the most immediate threats to black oystercatchers across their range. The plan recommends, as immediate population objectives for managing agencies, evaluating limiting factors and initiating effective local conservation.

Predation of eggs and young has been shown to be the greatest limitation in oystercatcher breeding success (Morse et al. 2006, Tessler et al. 2007). The fluctuation of predator communities or introduction of new predators can have profound effects on local oystercatcher populations (Andres and Falxa 1995). Examining predation rates and the type of predators impacting oystercatcher breeding success is critical to their long-term management and protection (Tessler et al. 2007), especially given the potential for ecosystem wide shifts in marine community assemblages with climate driven change (Harley et al. 2006).

The Exxon Valdez oil spill (EVOS) in 1989 killed 4-20% of black oystercatchers in affected areas, disrupted nesting, and decreased chick survival (Andres 1994, Sharp et al. 1996, Andres 1997). Liver biopsies from oystercatchers nesting in areas oiled during EVOS showed evidence of continued trophic uptake of oil residues over 15 years later suggesting oystercatchers may be sensitive to contaminants in the intertidal (Tessler et al. 2007). The coastline of KEFJ was extensively damaged

by the spill, and ongoing monitoring of intertidal species, like black oystercatchers, is critical to ensure their full recovery and to maintain a baseline for reference in case of future catastrophic perturbations.

At a global scale, intertidal communities have been impacted by human activities (Kingsford et al. 1991, Povey and Keough 1991). Because of the critical nature of intertidal habitats for both breeding and foraging, black oystercatchers are particularly sensitive indicators to disturbances in the intertidal (Lindberg et al. 1998). Recognized sources of disturbance include oil spills (Andres 1997, 1999, Irons et al. 2000, Weins et al 2004) and presence of domestic animals and humans (Ainley and Lewis 1974, Andres and Falxa 1995, Lindberg et al. 1998). Black oystercatchers actively incubate and care for young in a habitat that affords little protection from human induced disturbances during the four months when human presence in nearshore habitats in Alaska is highest.

As a “keystone” species (Power et al. 1996), the black oystercatcher has a large influence on the structure of intertidal communities disproportionate to its abundance. The black oystercatcher receives its recognition as a keystone species through a three-trophic-level cascade initiated by the black oystercatcher as a top level consumer in the nearshore (Marsh 1986a and b, Hahn and Denny 1989, Falxa 1992) whose diet consists largely of gastropod (limpets) and bivalve (mussels) mollusks that are ecologically important in the intertidal community. As a consequence of oystercatcher foraging, large numbers of herbivorous limpets can be removed (Frank 1982, Lindberg et al. 1987), resulting in shifts in limpet species composition and reduced size distribution (Marsh 1986a, Lindberg et al. 1987). As a consequence of reduced limpet densities and the diminished grazing intensity that results, algal populations respond through increased production and survival, resulting in enhanced algal populations (Marsh 1986a, Meese 1990, Wootton 1992, Lindberg et al. 1998). Because the oystercatcher brings limpets, mussels, and other prey back to its nest to provision chicks (Webster 1941, Frank 1982, Hartwick 1976, Lindberg et al. 1987), collections of those shell remains at nests provide an opportunity to obtain a sample of the species composition and size distribution of common and important nearshore invertebrate prey species selected by oystercatchers and compare them to invertebrates directly estimated as part of monitoring at SWAN parks including KEFJ (Coletti et al. 2010). The collection of black oystercatcher diet and prey data offers a unique perspective into processes structuring nearshore communities (Marsh 1986a and b, Lindberg et al. 1987), including the potential consequences of anticipated increases in human presence and disturbance (Lindberg et al. 1998). Contrasting relative abundances and size-class composition of invertebrates collected from two or more areas potentially increases our understanding of the processes responsible for change in nearshore ecosystems.

The Nearshore Monitoring Protocol that SWAN and KEFJ have implemented incorporates annual monitoring of black oystercatcher population abundance, nest density and productivity, and prey species and sizes provided to chicks (Dean and Bodkin 2011). However, each of these metrics is estimated from a single visit to KEFJ annually. Additionally, the collection of prey remains brought to nest sites to provision chicks can only reflect what was provided prior to the collection date and does not include data about soft bodied prey, prey items brought to chicks away from the nest site, or prey items brought to the area by other birds such as gulls and crows (Webster 1941). To address

these issues, we initiated this study to examine black oystercatcher nests, diet, and chick provisioning to ensure robust interpretation of trends observed in long-term monitoring data collected for this species (Robinson and Phillips 2013).

The research objectives of this study are to: 1) build on previous studies of black oystercatcher breeding productivity in Alaska; 2) examine the role of intertidal invertebrates in the diet of black oystercatcher chicks; and 3) assess the influence of these prey items on body condition and chick survival.

Methods

Study Area

From mid-May to early-August 2014, we conducted field work in Aialik Bay and Northwestern Fjord of KEFJ and the Chiswell Islands and Granite Island of the Alaska Maritime National Wildlife Refuge (AMNWR) in south-central Alaska (Figure 1). Aialik Bay and Northwestern Fjord are deep, glacially-forged inlets, 35 and 25km in length respectively. They are in-cut by smaller coves, and bounded by steep mountains which extend to 1478m in height (Cook and Norris 1998, Spencer and Irvine 2004). Shoreline topography varies from gravel beaches of low-wave energy to rocky cliffs of high-wave energy with a mean tide range of 1.7m (NOAA 2008). The Chiswells and Granite Island are nearshore islands made of rocky cliffs up to 480m tall. They have no beaches and experience high wave energy due to exposure to the Gulf of Alaska.

Nest Monitoring

On May 14, we commenced systematic boat-based surveys of historically known nesting sites to locate active breeding territories. When breeding pairs could not be visually located in historic nesting areas we utilized a firestorm™ game caller by FOXPRO™ playing an adult territory display call to determine if there were any undetected territorial adults in the area. Upon detecting a territorial pair, we searched the surrounding area extensively on foot. When a nest was found, we recorded the clutch size and floated the eggs to determine the stage of incubation and estimate hatch date (Mabee et al. 2006). We monitored all active nests every five days throughout the nesting period, weather and logistics permitting. We examined shell fragments, searched for signs of predators, and looked for displaced eggs around failed nests to determine the potential cause of failure. Throughout the course of the breeding season we periodically revisited sites where nests had failed, sites where territorial pairs were observed but had yet to initiate a nest, and historical breeding sites to detect new nests. We considered a nest successful if at least one chick was observed. We considered chicks to have fledged once they were capable of flight. We defined fledging success as the number of nests that fledged at least one chick per number of nests hatched.

We deployed Reconyx digital infrared remote-cameras (Reconyx, Inc.) at 16 nest sites to identify sources of disturbance and mortality to eggs, chicks, and adults. We installed cameras ≤ 5 m from the nest on tripods stabilized with burlap sacks of gravel or rock available at the site. Previous research found that remote-cameras at oystercatcher nests do not alter the behavior of breeding pairs or attract animals to the territory (Spiegel et al. 2012). Once a nest failed or hatched, we moved cameras to an occupied nest to maximize remote-camera monitoring efforts.

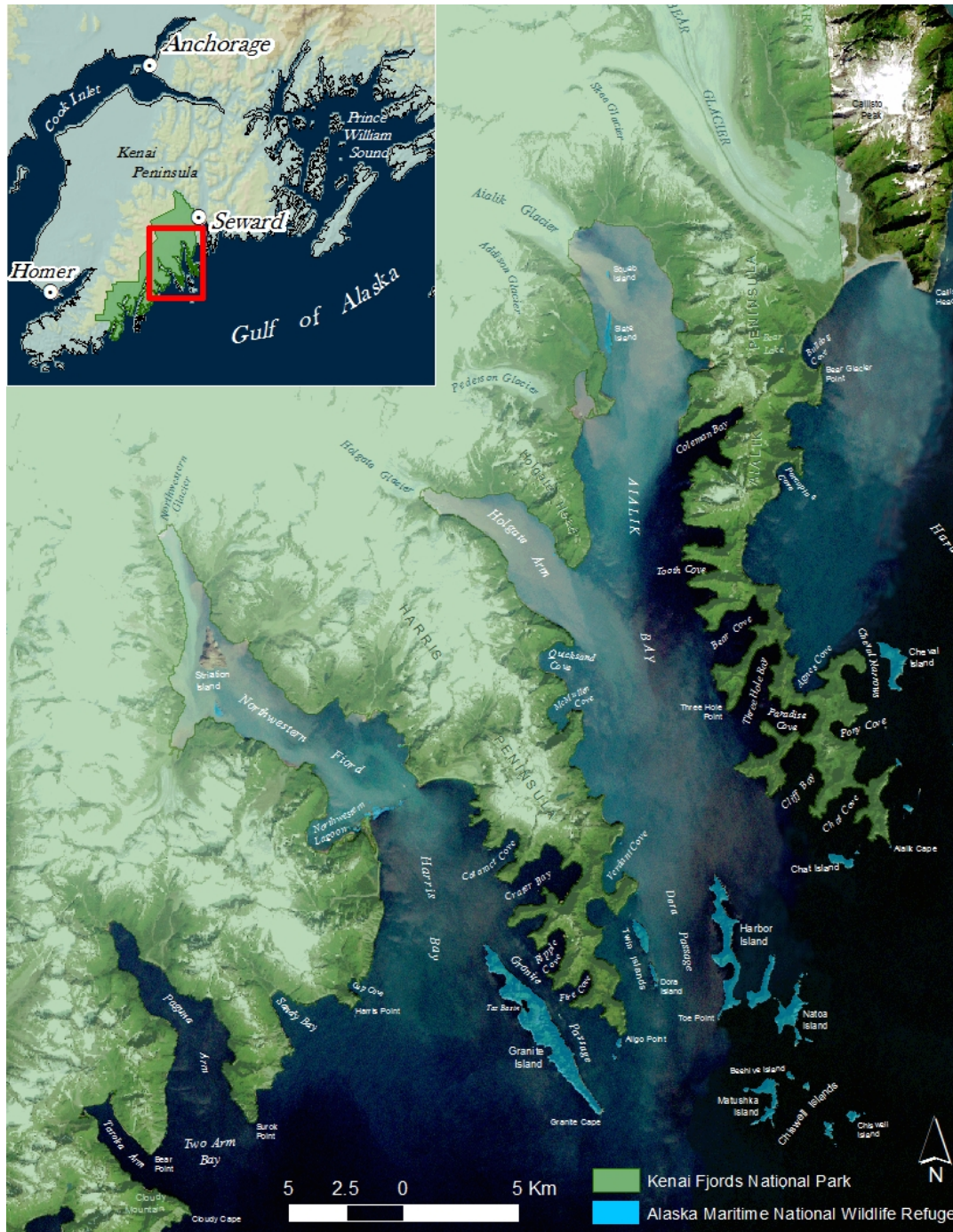


Figure 1. Location of 2014 study area in Kenai Fjords National Park and Alaska Maritime National Wildlife Refuge.

Captures

We captured chicks by hand within one day of hatching and then weighed and measured each chick. Young chicks were marked with colored tape or colored plastic bands until they were big enough to be banded with a U.S. federal metal band and two plastic alpha numeric bands. To determine growth rates and body condition, we recaptured chicks by hand every three days, weather and logistics

permitting, to measure body mass and the length of relaxed wing, exposed culmen, total head, and diagonal tarsus. We conducted captures within one hour of high tide when intertidal feeding areas had been submerged for several hours which reduced disturbance to foraging and the contribution of a recently filled crop to body mass (Groves 1984). All captured birds were placed in cotton bags and kept warm underneath a researcher's jacket during cold days. Captures were not done in the rain. Birds were typically released less than 20 min after being captured. Upon release we observed the chicks to make sure they were behaving normally and that their parent returned to them. In all cases the chicks behaved normally and were attended by a parent within minutes of release. We captured three adults at nest sites by hand. We banded these adults with federal metal and alphanumeric bands for identification during provisioning observations and for demographic information on the Aialik Bay nesting population.

We collected blood samples from chicks during the early brood-rearing phase (~10 days after hatch) and again during the late brood-rearing phase (20-30 days after hatch). Ten microliters of blood were drawn from the tarsal vein with a sterile 27-gauge hypodermic needle for analysis of stable isotopes ^{15}N and ^{13}C and measuring hematocrit. The blood was collected in a heparinized microcapillary tube, capped, and stored in a vacuum vial for transportation to our field station for centrifuging. Within four hours of drawing blood we separated plasma from red blood cells with a Fisher Scientific Mini-Centrifuge by centrifuging for 10 minutes at ~6,200 rpm. Hematocrit, a metric used to assess a bird's nutritional state, was calculated by dividing the height of the packed red blood cells by the height of the entire blood sample in the microcapillary tube as measured with digital calipers (Amand 1986, Owen and Moore 2006, Owen 2011). The separated plasma was then transferred to cryogenic vials and stored in a freezer for the duration of the field season. We used blood plasma for stable isotope analysis because it yields short term dietary information reflecting integration over approximately a week (Hobson and Clark 1993). At the conclusion of the field season, we transported frozen blood plasma samples on ice to the Alaska Stable Isotope Facility for analysis.

Provisioning Observations

We conducted observations of black oystercatchers to identify the type and size classes of prey items provisioned and to determine the rate of provisioning (defined as number of prey items fed by parent to offspring per unit time). We conducted observations when feeding grounds became exposed approximately one hour before low tide until one hour after low tide. Upon arriving at a territory, we set up a camouflaged blind in a vantage point less than 50m from the location of the birds. Once we were inside the blind, the birds would continue foraging undisturbed. Observations began when behavior returned to undisturbed state. One observer watched the adults and chicks with a 20-60x spotting scope and vocally stated the actions of the adult(s) (searching, handling, feeding, provisioning, resting, vigilant, etc.) and the actions of the chick(s) (resting, standing, walking, etc.) while the second individual recorded the actions and time at which they occurred. If a provisioning event occurred, the parent and chick involved were noted as well as the type of prey and the size class. We assigned items to a size class based on their size in relation to the adult's bill (Goss-Custard et al. 1987). The classification scheme we used is as follows: Size Class 1 = less than $\frac{1}{8}$ length of parent's bill, Size Class 2 = $\frac{1}{8}$ - $\frac{1}{4}$ length of bill, Size 3 = $\frac{1}{4}$ - $\frac{1}{2}$ length of bill, Size Class 4 =

greater than $\frac{1}{2}$ length of bill. We conducted observations on broods every five days, weather permitting, until chicks fledged or disappeared.

For one to two days after hatching, chicks remain at the nest area while they are provisioned by their parents (Andres and Falxa 1995, Robinson unpublished data). During this early brood-rearing phase, we utilized remote cameras to monitor chick provisioning. However given the brief time black oystercatcher chicks spend at the nest scrape, we captured very few provisioning events on camera. Additionally we searched the nest area during nest visits to collect the discarded shells of provisioned prey items within 10m of the nest scrape.

Invertebrate Sampling

We collected intertidal invertebrates to estimate the caloric value of the available invertebrate prey provisioned to chicks and provide a reference for stable isotope analysis. We collected invertebrate samples that represented the taxa and size class of prey items observed during provisioning events. We sampled during low tide at five oystercatcher feeding territories during late July. Five samples per prey item were collected at each site to have sufficient dry mass for assays and a sufficient sample size for robust statistical analyses. We collected samples by hand and stored them frozen in resealable plastic bags.

Calorimetry and Stable Isotope Analyses

Chick plasma and soft tissue of invertebrate prey will be processed at the Stable Isotope Facility at UAF this fall 2014.

Permitting

This study was conducted under approved UAF Institutional Animal Care and Use (IACUC) protocol # 43591-2 and concurrent NPS IACUC protocol # AKR_KEFJ_.Phillips.Powell_BlackOystercatcher_2013.A2. All associated data and products for this study will be accessioned by the NPS under #KEFJ-00319.

Results

Nesting Monitoring

In 2014, we monitored 25 black oystercatcher nests at 23 occupied territories (Figure 2). Black oystercatchers at two sites renested after original nest failure. Average clutch size was 2.6 eggs (SD ± 0.78) with a range from 1- 3 eggs per nest. Fifteen of 25 nests hatched at least one chick (apparent nest success of 60%) with peak hatch taking place on 10 June (SD ± 4.9 days). These nests produced 34 chicks with an average of 2.3 (SD ± 0.751) chicks per nest hatched. Nest cameras identified depredation of nests by black bear (*Ursus americanus*) and fledglings by peregrine falcon (*Falco peregrinus*). Of 15 nests which hatched, 9 fledged young (60%). Sixteen young survived to fledge with peak fledging taking place on 17 July (SD ± 3.5 days).

Table 1. Nest and chick fate of black oystercatchers monitored in Kenai Fjords National Park and Alaska Maritime National Wildlife Refuge, 2014

Nest ID	Nest Location	No. Eggs	Nest Success	No. Chicks	Fledge Success	No. Fledged	Cause of Failure	Predator
01AB	N. ABRS	3	Y	3	Y	1	NA	NA
02AB	Slate Beach	3	Y	3	N	0	unknown	NA
03AB	N. Tooth Bolder	3	Y	3	Y	2	NA	NA
04AB	McMullen Cove	3	Y	2	Y	2	NA	NA
05AB	N. Verdant	3	N	0	N	0	depredated	black bear
06AB	Pederson	3	N	0	N	0	depredated	black bear
07AB	Tooth Cove	1	N	0	N	0	abandoned	NA
08AB	Holgate Glacier Rock	3	Y	3	N	0	unknown	unknown
09AB	N. Holgate	3	Y	2	Y	1	NA	NA
10AB	N. Coleman	3	N	0	N	0	unknown	unknown
11AB	Abra	2	Y	1	Y	1	NA	NA
12AB	Matushka Island	3	Y	1	N	0	unknown	unknown
13AB	Natoa Island	3	Y	3	Y	3	NA	NA
14AB	Harbor Island	3	Y	3	N	0	depredated	peregrine falcon
15AB	S. Verdant	3	Y	2	Y	2	NA	NA
16AB	Tsunami Beach	2	N	0	N	0	Flooding	NA
17AB	Kadabra Cove	3	Y	2	N	0	unknown	unknown
18AB	Tooth Cove	1	N	0	N	0	unknown	unknown
19AB*	Bulldog	3	N	0	N	0	unknown	unknown
20AB*	Porcupine	3	N	0	N	0	unknown	unknown
21AB	Granite Island	3	Y	2	Y	2	NA	NA
22AB*	Erratic Island	3	Y	2	N	0	unknown	unknown
23AB	N. Verdant	1	N	0	N	0	unknown	unknown
24AB	N. Beach	1	N	0	N	0	addled	NA
25AB	N. Abra	Unk	Y	2	Y	2	NA	NA

* denotes reduced monitoring effort at site due to remoteness of location.

Chick Captures

We captured 30 black oystercatcher chicks from 14 nesting territories (Table 2). We capture chicks 1-7 times each for 104 captures. In addition to morphometric data, we also collected 38 blood samples from chicks at 12 nest sites.

Table 2. Record of observations, captures and blood samples of black oystercatchers in Kenai Fjords National Park, 2014.

Nest ID	Location	Observation Days	Observation Hours	Chick Captures	Blood Samples
01AB	N. ABRS	7	16.17	11	2
02AB	Slate Beach	4	7.66	12	4
03AB	N. Tooth	4	6.33	13	4
04AB	McMullen Cove	4	6.33	7	3
08AB	Holgate Glacier	3	5.34	11	4
09AB	N. Holgate	2	4.00	9	3
11AB	Abra Cove	4	9.05	7	2
12AB	Matushka			1	
13AB	Natoa Island	1	3.00	8	2
14AB	Harbor Island			1	
15AB	S. Verdant	4	7.34	10	6
17AB	Kadabra Cove	4	8.00	6	3
21AB	Granite Island	4	9.95	4	3
25AB	N. Abra Cove	3	4.70	4	2
Total		44	87.87	104	38

Provisioning Observations

We conducted 87.87 hours of provisioning observations between 6 June and 29 July at 10 nesting territories within KEFJ and 2 territories on islands within AMNWR. We observed adult black oystercatchers delivering a wide variety of invertebrate prey to chicks including Pacific blue mussels (*Mytilus trossulus*), black katy chitons (*Katharina tunicata*), limpets (*Lottia* spp., *Acmaea mitra*), rock louse (*Ligia pallasii*), Aleutian moonsnails (*Cryptonatica aleutica*), thatched barnacles (*Semibalanus cariosus*), Alaska jingles (*Pododesmus macrochisma*) and dogwinkles (*Nucella* spp.).



Figure 2. Location of black oystercatcher nests in Kenai Fjords National Park and Alaska Maritime National Wildlife Refuge, 2014.

Discussion

Nest Monitoring

Apparent nest success of black oystercatchers in KEFJ was 20% greater in 2014 (60%) compared to 2013 (40%, Robinson and Phillips 2013). This increase may be attributed to a number of factors. After the 2013 field season, we expanded our study area to include six rocky island sites. At these sites black oystercatchers tended to place their nests higher above sea level than on cobbled beach sites, therefore they are less subject to inundation by salt water during large spring tides. Morse et al. (2006) found that nest survival was lower during period of extreme high tide. We also observed the effect of tides on nest survival in 2013 when three nests were inundated and failed during one large tidal event (Robinson and Phillips 2013). Inclusion of these rocky island sites combined with a lack of extreme high tides during black oystercatcher nesting may be partially responsible for the increase in nest success we observed. We did observe evidence of nest inundation in 2014, but it was due to compounding effect of high tide and wave caused by the calving of a tidewater glacier. An additional explanation for the increase in nest success in 2014 may be the low number of replacement clutches. In Prince William Sound, nest success of pairs that laid replacement clutches was lower than that of pairs that retained initial clutches (Andres and Falxa 1995). In our study site, nest success of replacement clutches was also lower than that of initial clutches; however, eight of 15 nests were replacement clutches in 2013 while only two of 25 nests in 2014 were replacements. This difference in replacement clutches between years may be another factor contributing to differences in apparent nest success.

Fledging success of black oystercatchers in KEFJ was 46% present greater in 2014 (60%) compared to 2013(16%, Robinson and Phillips 2013). This may appear to be related to an expanded study area and inclusion of more isolated island sites which have been found to be correlated with higher fledging success (Morse et al. 2006). However, in 2014, fledging success on the mainland was 70% while on islands it was only 40%, suggesting other factors at play beyond a landform effect. The low number of replacement clutches in 2014 and an associated earlier mean hatch date may also be partially responsible for the higher fledging success we observed. Energetic demands of raising young increase over the course of the breeding season for peregrine falcons and other predators, therefore oystercatcher chicks that fledge earlier in the season may experience less predation pressure leading to higher fledging success in the population. Additionally, chicks that fledge earlier are less prone to human recreational disturbance which peaks in KEFJ at the end of the fledging period (Morse et al. 2006).

Black bears were the only predators we observed depredating eggs in nests in 2014. We were unable to identify causes of nest failure at six other nests which did not have cameras. Although we observed domestic dogs running loose on beaches within oystercatcher nesting territories in 2014 nesting season, we did not identify them as a source of egg or chick mortality during that time.

Fledgling mortality is common (40-84% mortality, Morse et al. 2006, Robinson and Phillips 2013) among black oystercatchers; however, identifying the sources of mortality is often difficult after chicks leave the nest at 2-3 days old. Once chicks leave the nest, predation events can no longer be

effectively captured by nest cameras. In the two seasons of this study (2013 – 2014), our cameras detected only one event of chick predation. A nest camera captured a peregrine falcon depredating the brood before they were able to leave the nest scrape. Though peregrine falcons have been identified as predators of black oystercatchers (Bechaver and Gehrig 2011, Tessler et al. 2007), this is the first evidence of falcons preying on black oystercatchers in the Kenai Fjords area. Oystercatchers nesting on rocky sites, such as the Chiswell Islands, may be at increased risk of predation by peregrine falcons due to their proximity to falcon nesting habitat (White et al. 2002).

Provisioning Observations

In addition to limpets, mussels, chitons and dogwinkles, which have been most frequently collected at nest sites (Coletti et al. 2009, 2010, 2012), we also observed black oystercatchers provisioning their chicks with thatched barnacles, rock louse and Aleutian moonsnails which have not been recorded by SWAN monitoring previously. Current SWAN diet monitoring may be unable to detect these prey items as protocols for prey collection include only a single visit to nest sites and therefore sampling only represents the diet of black oystercatcher prior to date of collection and items which remain in the vicinity of the nest scrape.

Monitoring protocols may be unable to detect prey types for various reasons. Barnacle's soft-body parts are often removed from the shell prior to delivery to chicks. The shells are typically left attached to the substrate and are not brought to the nest (Robinson unpublished data). Rock louse have keratinous exoskeletons that are much lighter than the dense calcareous shells of other black oystercatcher prey species. After black oystercatchers remove the soft-body parts, rock louse exoskeletons may be easily blown from the nest area by wind. We observed black oystercatchers provisioning Aleutian moonsnails at one nest site within Aialik Bay and found a large number of shells at an additional nest site. These black oystercatcher territories were situated in areas with fine sediment and higher Aleutian moonsnail abundance. Monitoring protocols that do not survey a variety of intertidal habitats may miss prey species with small, patchy distributions.

Black oystercatcher diets in Kenai Fjords appear to mainly consist of mussels, limpets, and chitons; however, black oystercatchers also opportunistically feed on many other prey species. Many of these prey items occupy the same trophic level and may not be isotopically distinct. This may confound efforts to establish prey ratios in black oystercatcher diet using stable isotope signatures (Carney 2013).

We will continue our analysis of oystercatcher provisioning using a multi-level modeling approach to examine factors (chick age, brood size, weather, tide, etc.) that influence provisioning rates.

Stable Isotopes and Invertebrate Sampling

This winter we will continue to analyze our data and complete necessary lab work. Blood samples and a subset of prey samples will be processed at the Alaska Stable Isotope Facility for analysis of stable isotopes of ^{15}N and ^{13}C . Prey remains collected will be analyzed to provide additional information on species composition and size distribution of black oystercatcher prey.

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