Food of Eurasian Oystercatcher (*Haematopus ostralegus*) chicks raised on rocky shores in Southern Norway

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In the archipelago between Lista and Lindesnes on the southern coast of Norway, we found that Eurasian Oystercatchers, *Haematopus ostralegus*, chose the prey types that were most abundant within their breeding territories although periwinkles, *Littorina littorea*, were selected against. This indicates short foraging excursions. The archipelago is divided into three topographical sections that roughly reflect the degree of wave action. Based on differing wave action, food availability for oystercatchers differed in the three sections in the following manner: the inner-section (little wave action) easily available food (sessile blue mussels, *Mytilus edulis*), the middle-section (intermediate wave action) mixed food availability with a dominance of periwinkles, and the outer-section (much wave action) different prey types dominated by limpets, *Patella vulgata*. We observed more predation by mink, *Mustela vison*, in the outer section of the archipelago. The risk of predation from the larger gulls, *Larus* spp., seemed to be similar throughout the archipelago. Oystercatchers breeding in the inner- and middle-sections were more influenced by human activity and boat traffic than birds in the outer-section of the archipelago. The oystercatchers seemed to adapt to human disturbance thereby improving feeding conditions for both themselves and their offspring.

Key words: Eurasian Oystercatcher, *Haematopus ostralegus*, prey types, chicks

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INTRODUCTION

In an attempt to understand and conserve birds, many studies have been carried out to determine the quantity and type of food required by different species, e.g. Barrett *et al*. (2002), Brenninkmeijer *et al*. (2002), and Verhulst *et al*. (2004). Some families, for example oystercatchers (Haematopodidae) have a global distribution in species and the different species show similarities in foraging choices and techniques (del Hoyo *et al*. 1996). Oystercatchers feed on a variety of intertidal prey such as oysters *Ostea edulis*, limpets, *Patella vulgata*, mussels, *Mytilus edulis*, periwinkles, *Littorina littorea*, and polychaetes (Polychaeta) (Hockey 1981, Safriel 1985, Ens *et al*. 1992, Lauro & Nol 1995, Pacheco & Castilla 2001). These different prey types require different feeding techniques and may give a different energetic rewards in relation to their foraging effort (Lauro & Nol 1995, Pacheco & Castilla 2001). Food availability and territory quality influences not only the survival of the parents but also that of their offspring during the prefledging period (Ens *et al*. 1996, Tjørve *et al*. 2007). Pairs breeding in sub-optimal territories may find it beneficial to travel to feeding areas away from the breeding territory in order to hunt

for sufficient prey (Ens *et al*. 1992). Therefore, food availability and feeding activities are crucial to energy budgets, survival and breeding success. We carried out a pilot study on the feeding preferences of pairs of chick-rearing Eurasian Oystercatchers *Haematopus ostralegus* on the southern coast of Norway in an attempt to understand the influence of food availability on food choice. This area is dominated by rocky coastlines, small islands and skerries, and the tidal range is small, a very different situation compared to many areas in Europe where the feeding behaviour of oystercatchers has been studied (e.g. Wadden Sea, the Netherlands, and the Wash, SE England; Goss-Custard 1996, Beukema *et al*. 1993, Atkinson *et al*. 2003).

During the spring and summer, chick-rearing Eurasian Oystercatchers are common along the whole coast and at a few specific inland regions of Norway (Gjershaug *et al*. 1994). They breed on both the mainland and small offshore islands on sandy, rocky and pebble shores (Gjershaug *et al*. 1994). In the region between Lista and Lindesnes on the southern coast of Norway, few pairs attempt to breed on the mainland; most pairs are found on small islands and skerries within the archipelago. The tidal range in this region is usually ≤ 30 cm (when not affected by storm surges), thus food availability for oystercatchers is relatively constant throughout the day, and restricted to a narrow zone along the shores. The archipelago can be coarsly divided into three roughly equally-sized sections based on topography and degree of wave action. Due to the different degrees of wave action within the archipelago, the different sections are dominated by different oystercatcher prey types (Denny 1987, 1994). The inner-section of the archipelago is most sheltered and is dominated by the blue mussel. The middle-section experiences an intermediate degree of wave action and consequently the invertebrates are a mixture of limpets and mussels with a dominance of periwinkles. The outer-section of the archipelago is open to the sea and experiences the greatest wave action. Therefore the invertebrate fauna is dominated by limpets, which, due to their structure, can withstand heavy wave action. The three sections of the archipelago can also be identified according to the pressure of both leisure tourism and development: the inner-section has the greatest number of summer homes, boat houses, piers and moorings, boat traffic, and greatest human disturbance whereas the outer-section of the archipelago has the least. There are varying degrees of vegetation on the small islands and skerries but from our observations chicks remained on the exposed rocky areas and hid in crevices between rocks (they are perfectly camouflaged for this habitat). Predation pressure within the archipelago can negatively influence breeding success of oystercatchers and we observed larger numbers of mink, *Mustela vison*, in the outer archipelago and fewer in the inner archipelago. The larger gull species, *Larus* spp., were evenly distributed throughout the archipelago and oystercatchers breeding near their colonies in the inner and outer sections of the archipelago successfully raised chicks to fledging. This may have been a consequence of reduced disturbance by humans as the presecnece of gulls at their colonied discourages landing. There are therefore more factors influencing breeding success and feeding behavior than just food availability. The proportion of the coastline influenced by second homes and other buildings in this archipelago between Farsund and Lyngdal is lower than in archipelagos in other municipalities along the south coast (Statens kartverk 2001, Thomassen 2006). Despite this, house building within the 100-meter belt is accelerating with less concern to the environment within this region than in other parts of the southern coastline (Thomassen 2006). This study and others like it are thus important to enable us to determine whether stricter building restrictions are required for the conservation of the fauna and flora of the region.

We hypothesized that pairs of chick-rearing Eurasian Oystercatchers choose to feed their chicks prey types that are found within or near their territories, thus reducing parental energy expenditure during foraging.

METHODS

We studied the food types Eurasian Oystercatchers fed to their offspring in the archipelago between Lista and Lindesnes, on the southern coast of Norway, over two breeding seasons, 2006 and 2007. Breeding activities within the region were monitored throughout the spring and summer (April to September). Numbers of nesting attempts, and hatching and fledging success were recorded, and the time adults and their chicks remained in the nesting territory after fledging was noted.

Oystercatchers breeding on rocky shores feed predominantly on prey with shells (due to the lack of soft-bodied prey in their habitat) and feed their chicks at distinct sites in their territories, resulting in a collection of discarded shells from chosen prey (feeding middens) (Hockey & Bosman 1987). Only pairs that hatch and feed young create clearly defined feeding middens. We collected food remains from all such middens in the different areas of the study site. Pairs that raised fledglings in both seasons were sampled in only one of the seasons such that the study was limited to 15 pairs that successfully hatched young (five in each of the three sections of the archipelago). Territories of pairs that were studied were classified according to the geographic position of the nesting territory within the archipelago and the type of food available in that area (Fig. 1).

We compared the contents (using Chi-squared and percentage composition) of feeding middens produced by families with chicks that were close to fledging to that of the food type available in and near the study family's territory. Only fresh middens were collected.

RESULTS

The breeding success of Eurasian Oystercatchers in the archipelago where we conducted this study was lowest in the outer-section and better in the inner- and middle-sections (Tjørve & Tjørve unpubl. data). Despite 52 breeding attempts in 2006 and 31 in 2007, only 16 and eight pairs hatched chicks in the two seasons, respectively. We monitored the choice of food provided to offspring in 15 successful breeding pairs which, all except for one pair in the outer section of the archipelago that lost chicks just before they fledged, hatched and raised at least two chicks to fledging. These pairs laid an average of three eggs in the different parts of the archipelago, and hatched and fledged an average of two chicks per breeding attempt in each section. See Table 1 for more detailed results. The fifteen breeding attempts described in this study was thus only a small portion of the oystercatcher breeding attempts monitored in this region over the study period.

The composition of the middens differed between the outer-, middle- and inner-sections of the archipelago (Chi-square: $\chi^2 = 1062$, df = 4, $P<0.0001$). On average, the middens collected from the inner-section of the archipelago contained mostly mussels (60%; compared to 14% limpets and 25% periwinkles), the middle-section of the archipelago contained a combination of limpets (40%) and mussels (36%) and fewer snails (24%) and the outer-section contained mostly limpets (93%, compared to 2% mussels and 5% snails).

We observed that some pairs raising chicks on small skerries moved their chicks up to 500 m from their breeding territories when the chicks were close to fledging or had fledged. For example, a pair raising chicks in the inner section of the archipelago moved their chicks onto the mainland and down the coast shortly before they fledged and a pair in the outer archipelago moved their chicks to the middle section of the archipelago after they had fledged.

DISCUSSION

Oystercatchers rearing young need to forage for sufficient food for both themselves and their offspring (Ens *et al*. 1992, Tjørve *et al*. 2007).

Table 1. Breeding statistics for 15 pairs of Eurasian Oystercatchers successfully breeding in inner, middle and outer zones of the coastal archipelago in S. Norway.

Pair	Number of eggs	Number of chicks hatched	Number of chicks fledged
Inner 1	4	2	2
Inner 2	3	2	2
Inner 3	4	3	1
Inner 4	3	2	2
Inner 5	3	3	3
Middle 1	3	3	3
Middle 2	2	2	2
Middle 3	*	2	2
Middle 4	2	2	2
Middle 5	3	2	1
Outer 1	3	2	2
Outer 2	2	2	2
Outer 3	2	2	2
Outer 4	3	3	2
Outer 5	3	2	0

* found as chicks

Food choice is vital to energy balance and survival of both the parents and offspring. Pairs may feed within their breeding territory or, if the food resources there are insufficient they may be forced to fly to other feeding areas to obtain food (Ens *et al*. 1992). The Eurasian Oystercatchers in this study seem to feed on their territories because the diet spectrum evident from the middens was the same as one would expect from the sections of the archipelago in which their territories were found. For example, pairs in the inner-section of the archipelago fed mostly on blue mussels and pairs in the outer-section fed mostly on limpets. Pairs in the middle-section seemed to prefer blue mussels and limpets despite the greater abundant of periwinkles.

All but one pair in the study successfully raised chicks to fledging. The pair that lost their chicks did so just before the chicks fledged. This pair had a territory in the outer-section of the archipelago. We observed mink throughout the archipelago but we noted that the greatest degree of predation was in the outer section. This corresponds to results reported by Nordström *et al*. (2002, 2003) who found that mink predation on bird populations was greatest in the outer section of the Finnish archipelago. They proposed that the mink population fed predominantly on field voles, *Microtus agrestis*, but that vole abundance in the outer archipelago was too low to sustain the mink population and alternative food sources (wader and gull populations) were preyed upon. Mink are known to be aggressive and the corpses of two large Lesser Black-backed Gull, *Larus fuscus*, chicks (displaying wounds typical of mink) were found in 2007 in the outer-section of the archipelago.

Oystercatcher breeding attempts are negatively influenced by human disturbance (e.g. Hockey 1987, Sabine 2005, Tjørve & Underhill 2008, Tjørve & Tjørve 2010). In our study, the inner section of the archipelago is under the greatest pressure from development (summer homes) and leisure tourism (boat traffic and people

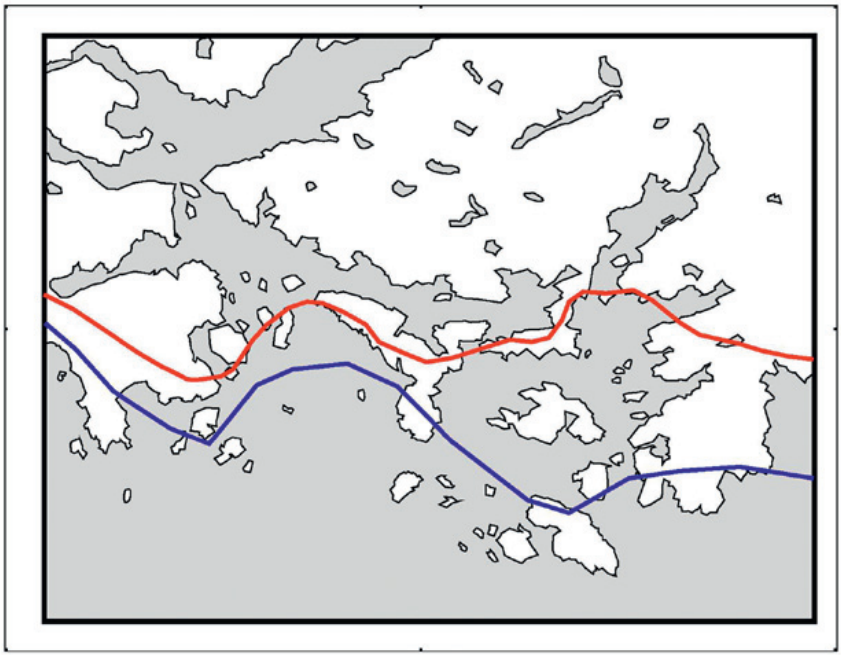

Figure 1. Food type availability for oystercatchers within the archipelago between Lista and Lindesnes, southern Norway. The two lines separate the coast and the archipelago into three zones, based on food availability: the inner- (dominated by mussels, Mytilus edulis*), middle- (a mixture of limpets,* Patella vulgata*, and mussels dominated by periwinkles,* Littorina littorea*) and outer-sections (dominated by limpets).*

going ashore) (Tjørve & Tjørve unpubl. data). The middle section of the archipelago is under less pressure from development but is greatly influenced by leisure tourism.

Human disturbance can negatively influence the time available for feeding and the breeding success of oystercatchers in the archipelago. This can potentially make one re-evaluate the quality of oystercatcher territories in the archipelago within this region. The inner section of the archipelago has a higher abundance of food items (less wave action) and seemingly lower predation but the greatest level of human disturbance whereas prey is more difficult to capture in (due to greater wave action) the outer section where there is also a greater risk of predation but less human disturbance. Observations of adult behaviour around chick fledging showed that some pairs move their chicks away from the breeding territory shortly before or after fledging. This deserves further research to determine what factors prompt the movement of families from the breeding territories.

Based on the breeding success of oystercatchers in our study site, the inner and middle sections of the archipelago are, in our view, optimal in food availability and might have lower predation pressure than the outer section. The outer section of the archipelago is relatively unattractive to leisure tourists due to the greater exposure of the islands to the weather and wave action of the open sea. The inner and middle sections of the archipelago are more influenced by the affect of people going ashore. This results in only the islets and skerries that are unattractive for humans to go ashore for leisure purposes being places

where oystercatchers successfully rear chicks (pers. obs.), but further studies are required to confirm this.

We conclude that oystercatchers on the south coast of Norway choose prey types that are dominant within their breeding territories although periwinkles are selected against. Also, within the archipelago between Lista and Lindesnes, breeding oystercatchers seem to adapt to certain types of human disturbance thereby improving feeding conditions and reducing predation risk compared to pairs in the outer-section of the archipelago.

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SAMMENDRAG

Vi fant at i skjærgården mellom Lista og Lindesnes, i Vest-Agder, velger tjelden, *Haematopus ostralegus*, de byttedyrene som finnes i størst antall innenfor hekketerritoriet, selv om strandsnegler, *Littorina littorea*, er mindre preferert. Dette indikerer korte næringssøk. Skjærgården ble delt inn i tre soner som grovt sett gjenspeiler bølgepåvirkningen. Denne inndeling følger i hovedsak de to indre båtleiene langs kysten. Ut fra forskjeller i bølgeslag bør fødetilgangen for tjelden variere mellom sektorene på følgende måte: den indre sonen drar fordel av lite bølgeslag og lett tilgjengelig næring (fastsittende blåskjell, *Mytilus edulis*); den midtre sonen har noe mer bølgeslag og en mer sammensatt næringstilgang med hovedvekt på strandsnegl, og den ytre sonen har mye bølgeslag, en annerledes type av byttedyr (albuesnegl, *Patella vulgata*). Vi observerte mest predasjon fra mink, *Mustella vison*, i den ytre sonen av skjærgården. Predasjonsrisken fra stormåkene, *Larus* sp., syntes å være den samme i hele skjærgården. Tjeld som hekket i den indre og midtre sonen var mer påvirket av menneskelig aktivitet, folk som går i land, enn fugler i den ytre sonen i skjærgården. Disse tjeldene synes å dra fordel av å kunne tilpasse seg menneskelig forstyrrelser (spesielt blir ikke båttrafikk oppfattet som en trussel) for å kunne framskaffe nok næring for både seg selv og avkommet sitt.

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