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ABSTRACT

Historically otters were regarded as a coastal species in Cornwall. After many years of absence they are increasingly recorded around the coasts and estuaries. These animals may be using the coast to move between river catchments or taking advantage of marine resources. The Cornwall Mammal Group organised a citizen science project to collect and analyse otter spraints from around the coastal fringe. Marine prey was shown to constitute a large part of the diet of animals close to the coast but coastal spraints also included remains of freshwater prey. Otters were feeding on a broad range of prey including many smaller items. Demonstrating the dependence of otters on coastal resources will be important in informing conservation of the coastal fringe of Cornwall.

This report is dedicated to the memory of Rebecca Smith who died in December 2019.

INTRODUCTION

The population of the Eurasian otter (*Lutra lutra*) in England declined dramatically in the mid-20th century (Chanin & Jeffries 1978) although it has since recovered much of its range (Crawford 2010). Despite the importance of Cornwall as a refuge for the otter during this period little is known about their habitat use in the county.

Otters in Cornwall, and indeed most of England are considered riparian mammals whose behaviour differs notably from the otters of Scottish coasts and islands. These Scottish 'coastal' otters tend to occupy smaller, less linear ranges, exhibit more diurnal activity and appear less likely to be solitary (Kruuk 2006). Similar use of coastal habitats by Cornish otters was recorded before their decline (e.g. Carew 1602, Couch 1838, Stephens 1957).

Since the advent of organised recording most observations have been from sites on, or adjacent to freshwater. However, otters are increasingly recorded in the sea off the coast or in the estuaries of Cornwall (Strachan et al. 1990, Simmons 2000, Pountney et al. 2009, Crawford 2010, Environmental Records Centre for Cornwall and the Isles of Scilly and National Biodiversity Network Data). Live sightings may also indicate a change from predominantly nocturnal activity. Similar behaviour has been reported in Wales (Parry et al. 2011) and Suffolk (Woolnough 2016). However, there are few other reports of otters using both marine and freshwater habitats (Beja 1991, Clavero et al. 2006). Stomach analysis of otter road casualties from England and Wales have shown marine fish remains in only about 1% of cases (Britton et al. 2006, Moorhouse-Gann et al. 2020). It is unclear if otters in Cornwall are moving between freshwater and marine habitats or if some of them are behaving as 'coastal' otters. The objective of the current study was to look for evidence of otters using marine resources in Cornwall.

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METHOD

The Cornwall Mammal group (CMG) engaged and trained 30 volunteer surveyors. Potential survey sites on the coastal fringe were identified using previous records, National Otter Survey sites and suitable geography. Spraint samples were collected between May 2018 and May 2020.

Samples were processed by soaking in biological detergent (Biotex) and rinsing in a 0.5 mm sieve. Identifiable remains were separated, photographed and allocated to prey categories using a range of reference samples, guides and keys along with expert advice. Fish remains were categorised to family or species level where possible and classified as marine or freshwater according to Wheeler (1969). Other marine prey included crustaceans, primarily shore crab (*Carcinus maenus*), and molluscs (mussel and chiton). Other freshwater prey remains included insects (great diving beetle (*Dytiscus marginalis*), orthoptera and terrestrial coleoptera), birds (feathers, claws and beaks), mammals (teeth, fur or intact limb bones) and amphibia (anuran or newt jaws and vertebrae). As part of the project a reference manual was prepared (Groves, 2020). The presence of any identifiable prey category was recorded for each sample, but no attempt was made to quantify occurrences or to determine prey sizes. Sites were classified as coastal (open coast sites), estuarine (tidal water bodies) and inland (rivers and lakes). Inland Sites were further classified by their approximate straight line distance from the nearest coastal or estuarine shore measured from Mean High Water (MHW). Results are expressed as Frequency of Occurrence (FO%) – number of samples containing the prey category/total number of samples analysed x 100.

RESULTS

Surveyors collected 223 samples from 111 sites in 26 areas around the county (Figure 1). The frequencies of occurrence of the main prey categories found in each type of site are shown in Table 1. Fish remains were identified in 90.1% of samples. Forty-one per cent of samples contained only freshwater fish remains, 19% contained only marine fish remains and 26% contained fish remains from both marine and freshwater species. The remainder were fish of unidentified origin. Ten per cent of spraint contained only non-fish remains. Most individual fish identified from remains would have been 10 cm or less in length and remains from larger prey were often masticated beyond recognition. Seventeen per cent of spraints contained the remains of large fish.

Of samples collected from coastal sites, 44% contained marine prey but 79% contained freshwater prey remains. Marine prey were more commonly found (82%) in spraints from estuarine sites and also identified in 30% of samples from inland sites (Figure 2). The proportion of marine prey declined with increasing distance from MHW and that of freshwater prey increased. Only goby and flatfish remains were identified further than 1 km from MHW and only one sample of 28 collected further than 1.6 km from MHW contained marine fish remains (goby). An indication of dietary diversity was obtained from the number of prey categories which were identified in samples. Samples contained between zero and six identified prey categories with an average of 2.1 categories/sample (1.8 fish categories/sample). Eleven of the 24 prey categories were present in 10% or more of the samples.

Table 1. Frequency of Occurrence (FO%) of main prey categories in spraint samples.

Prey Category	All Sites (N=223)	Coastal Sites (N=58)	Estuarine Sites (N=61)	Freshwater Sites (N=104)
European eel (FW)	35.4	36.2	37.7	33.7
Salmonid (FW)	31.8	19.0	29.5	40.4
Goby species (M)	28.2	10.3	60.7	20.2
Bullhead (FW)	19.3	22.4	8.2	24.0
Flatfish species (M)	17.0	5.2	39.3	10.6
Anuran species (FW)	15.7	13.8	8.2	21.2
Blenny species (M)	15.2	31.0	18.0	4.8
Bird (FW)	13.9	24.1	3.2	14.4
Newt (FW)	13.5	13.8	18.0	10.6
3-Spined stickleback (FW)	12.1	8.6	6.6	17.3
Cyprinid species (FW)	11.2	6.9	4.9	17.3
Crustacean (M)	8.1	5.2	6.6	10.6
Insect (FW)	7.5	5.2	0.0	13.5

FW – Freshwater prey categories, M – Marine prey categories (Wheeler 1969)

Figure 1. Location of sample collection areas around Cornwall.

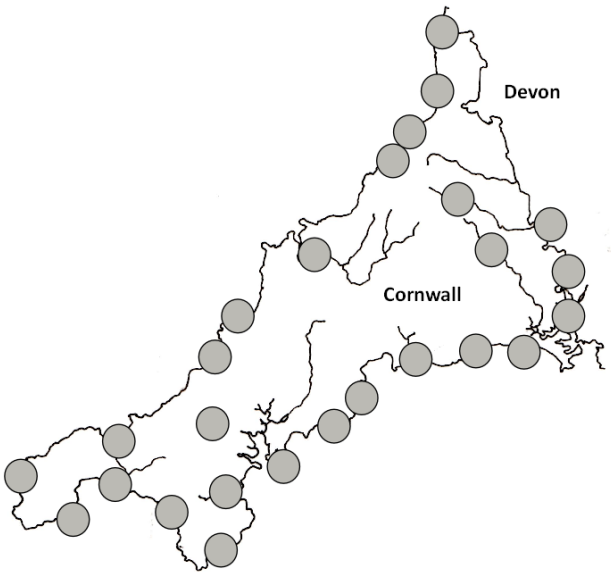
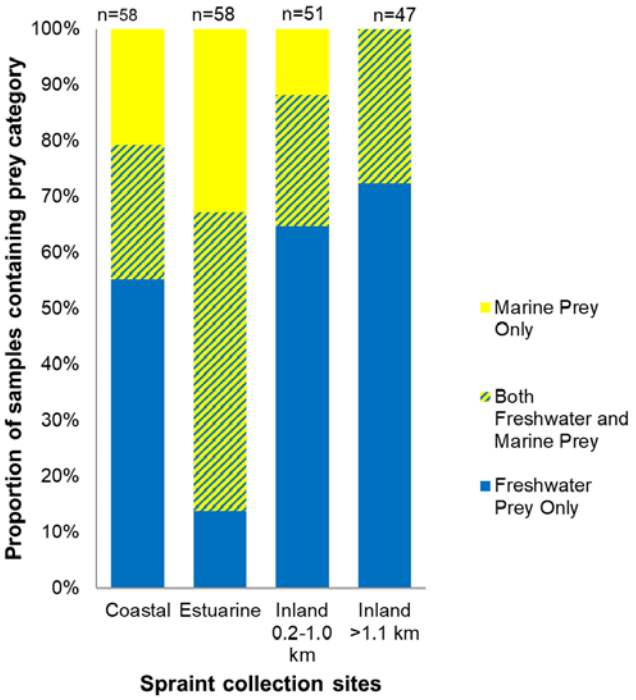


Figure 2. Origin of prey remains from coastal, estuarine and inland sites.



DISCUSSION

Otters are using coastal and estuarine habitats and resources in Cornwall. Marine fish remains were identified in 62% of spraints collected from coastal and estuarine sites. In contrast to findings from most studies of diet in coastal habitats, individual otters in Cornwall are moving between coastal and freshwater environments as 79% of coastal spraint samples also contained freshwater fish or terrestrial prey remains.

The division of fish prey into freshwater and marine origins is not absolute. Eel (*Anguilla anguilla*), some salmonids and 3-spined stickleback (*Gasterosteus aculaeatus*) all move between fresh and sea water during their lifecycle. Some goby, mullet and flatfish species can tolerate very low salinity and flounder (*Platichthys flesus*) can be found in freshwater. Palmate newts (*Lissotriton helveticus*) have been recorded in coastal pools in Scotland (Ullman-Smith, 2012). Amphibians occurred in almost one third of all samples irrespective of location, roughly half of these being newts. However, wrasse, rockling, and 15-spined stickleback (*Spinachia spinachia*) are not found in freshwater habitats while cyprinids (with the possible exception of minnow, *Phoxinus phoxinus*) and bullhead (*Cottus gobio*) occur only in freshwater, as do diving beetles and anuran amphibians.

Eel, blenny, bullhead and salmonid were the most commonly recorded fish prey from coastal sites but birds and amphibians also occurred in almost a quarter of samples. Samples collected from estuarine sites were dominated by gobies, flatfish, eels and salmonids. Inland freshwater samples featured salmonids and amphibians with eel and bullhead. Marine prey featured most prominently in samples collected from estuarine sites and this may indicate that otters in estuaries spend more of their time feeding in marine habitats, perhaps because they are less disturbed by tides and adverse weather, than animals feeding on exposed coastal sites(Stephens 1957). Anuran remains were identified in 16% of all samples but also newt (presumably palmate newt, Nicolson 2009) remains were found in 13% of samples, comparable to the results of Parry et al. (2015) with Welsh otters. It was noticeable that despite the well-documented and dramatic decline in eel populations, eel remains were found in more than a third of samples at all locations.

Otters are highly mobile animals. Typical linear ranges can extend to 80 km depending on gender and habitat (Chanin 2013). Dietary evidence presented here demonstrates that individuals are moving between marine and freshwater habitats. Many of the smaller streams running into rocky or sandy coasts are relatively unproductive but provide washing sites and access to undisturbed resting places. Although all but one of the 104 samples from inland sites were collected more than 0.1 km from MHW, 30 were within 0.5 km of the shore and 68 were within 1.5 km., often in estuarine wetlands with no barriers to animals moving between marine and freshwater habitats. Individual samples rarely represent a single meal. Although the prey remains are typically excreted between three and 24 hours after ingestion (Jurisch & Geidezis 1997), a single prey item may be spread between 10 or more spraints (Carss & Parkinson 1996). Otters are certainly capable of travelling well in excess of 1 km in 24 hours (Chanin 2013), the paucity of marine prey remains further inland strongly suggests individual animals are not travelling long distances every day to the coast to feed but are remaining within about 1 km of their feeding sites.

The relative importance of marine and freshwater prey cannot be determined for many of the reasons discussed by Carss & Parkinson. (1996). Although many smaller prey items are ingested entire, larger prey may be only partly consumed and remains, where they occur, are often damaged beyond identification. In most samples it was not possible to determine the number or size of prey with any accuracy. However, 17% of spraints contained remains of 'larger' fish which could not all be identified. The vast majority of fish prey items identified were of small fish and some samples contained very large numbers of individuals (identified from paired otoliths or jaw bones) indicating the importance of small prey items, one sample containing remains of at least 65 gobies. Otters inhabiting the coastal fringe (considered to be within 1 km of MHW) are making use of both freshwater and marine prey. Although they have potential to move considerable distances into catchments it is apparent that individuals that have consumed marine prey are generally hunting within a short distance of the coast. Woolnough's 2016 studies found marine prey remains in spraint collected 10 km from the mouth of the river Alde in Suffolk. DNA studies on the River Camel catchment (Pountney et al. 2009) identified 16 individual otters from spraint but with little evidence that animals identified in the estuary were moving further into the catchment, which supports our interpretation.

Spraint studies around the Scottish Highlands and Islands (Kruuk 2006, Yoxon 2008, McMahon & McCafferty 2006), the coasts of Ireland (Murphy & Fairley, 1985), Portugal (Beja, 1991), and Norway (Heggberget & Moseid, 1994) all indicated a predominantly marine diet. These locations may differ from the Cornish coast in a number of respects including anthropogenic factors, productivity of both marine and freshwater environments, and the deep coastal inlets forming most Cornish estuaries which may result in less clearly defined separation of freshwater and marine habitats. While we do not yet have evidence that Cornish otters are behaving in the same way as these 'coastal' otters in their relatively undisturbed locations we have shown the importance of marine prey, and therefore marine and coastal habitats to the Cornish otter population. Results from the range of survey sites prove that otters are using marine habitats around the peninsula. This is the first definitive evidence of otters feeding in marine habitats in Cornwall and complements the sightings of animals at, and off, the coast. The otter population in Cornwall may already be at or approaching the carrying capacity of the relatively unproductive inland river system (Crawford, 2010). The combination of this with an extensive coastline and our demonstration of otters using the coast underlines the importance of considering their requirements for coastal management planning. The regular movement between coastal and freshwater habitats also requires consideration of connectivity to ensure the important Cornish otter population is safeguarded.

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