Fish brought to young Atlantic Puffins *Fratercula arctica* on Burhou, Channel Islands

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Introduction

During the last 100 years breeding numbers of Atlantic Puffins *Fratercula arctica* (hereafter 'Puffins') in the Channel Islands and Brittany, the most southern colonies in the eastern Atlantic, have declined dramatically and in 2000 totalled less than 600 pairs (Harris & Wanless 2004). Most colonies now have trivial numbers and that on Burhou, Alderney, Channel Islands is one of only two remaining probably viable breeding populations south of the English Channel, and is therefore regionally of considerable conservation importance.

Burhou (49º44' N, 2º16 W) in the Alderney group is the most northerly Channel Island, about 760 m long by 300 m wide, 18 hectares in area, and 21 m above sea level at its highest point. Rabbits *Oryctolagus cuniculus* are common, having been introduced by the 14th century (Coysh 1985), the vegetation is short, but no other mammals are present. The island is uninhabited and now closed to the public from mid March to late July. Puffin numbers were estimated at 50,000 pairs in 1948–1949 (Lockley 1953), making it by far the largest colony on the southern side of the English Channel at that time. The population fell to c.350 individuals (but less than 100 breeding pairs) by 1980, through a combination of chronic oil pollution and major tanker sinkings, burrow trampling by unrestricted day-trippers, and changes in vegetation due to soil enrichment by gull faeces (Danchin & Cordonnier 1980; Hill 1989; Sanders 2007, 2005). The population almost stabilised after access to the island became restricted in the early 1980s (Sanders 2007), 120 burrows were occupied in three subcolonies in 2005 (L. Soanes pers. comm.), and a maximum of c.250 individuals was present in early July 2006 and 2007 (pers. obs.).

Between 1969 (Operation Seafarer) and 2005, breeding Lesser Black-backed Gulls *Larus fuscus* on Burhou increased from 70 to 1,102 pairs and Herring Gulls *Larus argentatus* from 87 to 202 pairs, while c.15 pairs of Great Black-backed Gulls *Larus marinus* also presently breed (L. Soanes pers. comm.). Interactions with Puffins include gulls loafing near Puffin burrows, kleptoparasitism by Lesser Black-backed and Herring Gulls, and predation by Great Black-backed Gulls, which became acute in the 1970s and 1980s but diminished after 1996 (Lockley 1953; Sanders 2007).

Nothing appears to have been known of the diet of Puffin chicks at Burhou and this note presents the results of an attempt to remedy this.

Figure 1. Puffin *Fratercula arctica* with Gadidae, Burhou, July 2006.

Figure 2. Puffin *Fratercula arctica* with sandeels, Burhou, July 2007.

Table 1. Fish carried by Atlantic Puffins *Fratercula arctica* on Burhou, 2006 & 2007.

Date in 2006	Time of photo	No. fish in load	Species of fish
01 July	12.22	5	Gadidae sp.
01 July	17.17	3	Gadidae sp.
02 July	07.58	12	Small sandeels
02 July	08.00	5	Gadidae sp.
02 July	08.04	4	Gadidae sp.
02 July	08.16	7	Gadidae sp.
02 July	08.21	3	Gadidae sp.
02 July	08.35	6	Gadidae sp.
02 July	08.57	4	Gadidae sp.
02 July	09.13	3	Gadidae sp.
02 July	09.17	4	Gadidae sp.
02 July	11.42	11	Small sandeels
02 July	11.47	4	2 small sandeels, 2 Gadidae sp
02 July	11.51	2	Gadidae sp.
02 July	12.12	2	Gadidae sp.
02 July	12.21	2	Gadidae sp.
02 July	12.31	4	Gadidae sp.

Total	81, of which:	Small sandeels	25
		Gadidae sp.	56

Date in 2007	Time of photo	No. fish in load	Species of fish
09 July	13.13	6	Large sandeels
09 July	13.13	6	Mixed-size sandeels
09 July	13.43	8	7 Large sandeels, 1 Gadidae sp.
09 July	13.44	7	Large sandeels
09 July	13.50	7	Small sandeels
09 July	13.56	8	Large sandeels
09 July	15.28	2	Large sandeels
11 July	09.56	6	Small sandeels
11 July	09.58	3	2 Gadidae sp,, 1 small sandeel
11 July	10.02	5	Large sandeels
11 July	10.02	6	Small sandeels
11 July	10.04	8	Large sandeels
11 July	12.25	10	Large sandeels

Total	82, of which:	Small sandeels	20
		Mixed-size sandeels	6
		Large sandeels	53
		Gadidae sp.	3

Methods

The usual method of assessing Puffin chick diet is to catch adults carrying fish as they come ashore. However, the Burhou population is very small and since mist-netting in the 1980s appeared to cause undue disturbance to the main colony (pers. obs.; M. G. Hill pers. comm.), it was decided instead to photograph Puffins carrying fish, a somewhat novel method.

On arrival at the main colony Puffins carrying fish usually circled a number of times partly over the burrow area and partly over the sea, and if there were loafing gulls near the burrows, as was often the case, they frequently landed on the water in the bay adjacent to the colony, from which they could see the location of their burrow. These rafting Puffins were photographed on 1 & 2 July 2006 and 9 & 11 July 2007 using a digital Nikon Coolpix 995 camera with a Leica APO 77 spotting telescope as lens. Taking the photos may in some cases have kept the Puffins away from their burrows for a slightly longer period than usual, but at other times it was possible to photograph without observer disturbance.

Of many hundreds of photographs taken, only those clearly showing the fish carried by individual Puffins were selected for this study. To prevent double-recording, identification of individual Puffins in the photographs was ensured by comparing the number, size, position and distribution in the bill of the fish carried by each Puffin. Fish were identified to species by M. P. Harris, and their size and number were noted. This was helped by there usually being several photos of the same bird.

Results

Photographs taken in 2006 showed 17 Puffins with a load of fish. Two were carrying only small sandeels *Ammodytes* sp. (probably 0-group, young of the year), 14 carried fish of the cod family Gadidae, most likely Whiting *Merlangius merlangus*, and one load contained some of each. Average load was 4.8 fish, and of the 81 fish in total, 25 (31%) were sandeels, and 56 (69%) were gadids. (Table 1).

In the 2007 photographs, three and seven of the 13 Puffins were carrying only small and large sandeels, respectively. One Puffin had seven large sandeels and one probable gadid, one carried a mixture of small and large sandeels (mixed-size sandeels), and one carried a small sandeel and two gadids. The average load (6.3 fish) was not significantly greater than in 2006 ($t = -1.617$, $P = 0.117$). Of the total of 82 fish, 20 (24%) were small sandeels, 53 (64%) were large sandeels, six (7%) were mixed-size sandeels, and three (4%) were gadids. On 23 July, all 25 loads seen clearly through a telescope appeared to contain only sandeels, some of which were large (M. P. Harris & S. Wanless pers comm.).

Discussion

Puffins returning to the colony with fish for their chick normally enter their burrow as quickly as possible to prevent the catch being stolen (Harris 1984). Where they are prevented from doing so by gulls loafing near the burrow entrance and have to stand around for a while, or in the case of Burhou raft on the sea, digital photography can be a useful and non-invasive tool for assessing chick diet, given that the fish are large and reasonably easy to identify. It does, however, have its limitations on Burhou in that calm conditions are needed to get good pictures. Of the three days that photographs were taken in 2007, one day produced no useable photographs due to the movement of the birds in rough seas.

All Puffins photographed appeared to be carrying as many fish as they could cope with. All the fish were of good size, and the overall size of the loads was at least as good as is currently seen at most northern British colonies (M. P. Harris pers. comm.). Generally, gadids are not considered as good food for young seabirds since they are generally of lower calorific value than other more oil-rich species such as sandeels, and Sprats *Sprattus sprattus* and Herring *Clupea harengus* (Harris & Hislop 1978). However, the gadids photographed in 2006 were substantially larger than those normally fed to Puffin chicks and this will at least in part have compensated for their low energy density.

Chick diet at a colony can change dramatically within a season and between years (Harris 1984), and the difference between 2006 (predominantly gadids) and 2007 (predominantly sandeels) at Burhou was striking. Around Guernsey, 28 km from Burhou, where there is a small-scale fishery for sandeels, fishermen reported the sandeel cycle of 2006 to be late, and abundance the lowest for a long time, with none caught on some traditionally productive grounds (M. Roger pers. comm.). This would suggest that sandeel abundance around Burhou in 2006 was also lower than in most years, and the 2007 observations give rise to some optimism on the state of the recent summer food supply for Puffins on Burhou.

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