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Recent changes in the summer distribution of the Balearic shearwater *Puffinus mauretanicus* off western France*

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SUMMARY: Surveys carried out in the 1980s showed that 8,000-10,000 Balearic shearwaters regularly gathered in inshore waters of central and northern Biscay, particularly off the coast of Vendée and in the Mor-Braz area, western France. This distribution, apparently linked to particular oceanographical conditions (thermal front), was strikingly overlapping with that of clupeid fish, particularly anchovies. Recent surveys (1999-2000) have shown that the species has become far less numerous in these "traditional" haunts. Conversely, its abundance has increased in the western Channel, some hundreds of kilometres to the North, during the 1990s. Reasons for this northward shift (e.g. changes in prey distribution due to fishing activities or water warming in Biscay) remain hypothetical and further study is needed.

Key words: Atlantic Ocean, Balearic shearwater, clupeid fisheries, distribution, English Channel, long-term changes, *Puffinus mauretanicus*, thermal front.

RESUMEN: NUEVOS CAMBIOS EN LA DISTRIBUCIÓN ESTIVAL DE LA PARDELA BALEAR *PUFFINUS MAURETANICUS* FRENTE A LA COSTA OCCIDENTAL DE FRANCIA. – Inspecciones realizadas en los años 1980 mostraron que unas 8.000-10.000 pardelas baleares se congregaban regularmente en aguas interiores del centro y norte de la Bahía de Vizcaya, particularmente frente a Vendeé y la zona de Mor-Braz, en el oeste de Francia. Esta distribución, aparentemente ligada a condiciones oceanográficas particulares (un frente térmico), se solapa notablemente con la de peces clupeidos, en particular anchoas. Seguimientos recientes (1999-2000) han mostrado que la especie se ha vuelto bastante menos numerosa en estos lugares. Por el contrario, su abundancia se ha incrementado en el canal de la Mancha, varios cientos de kilómetros al norte, durante los años 1990. Las razones de este traslado hacia el norte (por ejemplo cambios en la distribución de las presas debidos a las actividades pesqueras o al calentamiento del agua en la Bahía de Vizcaya) son hipotéticas y es necesario un mayor estudio.

Palabras clave: cambios a largo plazo, canal de la Mancha, distribución, frente térmico, océano Atlántico, pardela balear, pesquerías de clupeidos, *Puffinus mauretanicus*.

INTRODUCTION

A major part of the population of the Balearic shearwater *Puffinus mauretanicus* leaves the Mediterranean to the Atlantic each year, mostly from June to October (a minority from May, early returns from September). This exodus is well documented (for a review see Mayol-Serra *et al*., 2000), and inshore waters along the French coast of northern Biscay are usually given as the species main oversummering haunts. However, the shearwater distribution in northern Biscay is known mostly from surveys carried out in the 1980s, while more recent records from the western Channel have suggested that the species distribution could be changing off western France (Mayol-Serra *et al*., 2000).

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New surveys have been carried out in 1999 and 2000 in order to update our knowledge on the species distribution and abundance in this area. This work reports on the results of these censuses.

METHODS

Data for the period 1999-2000 were collected within the framework of the LIFE project "Recovery plan of *Puffinus puffinus mauretanicus* in Special Protected Areas", which included the survey of the two areas previously known for holding large numbers of shearwaters off western France, namely the coast of Vendée and the Mor-Braz (Fig. 1). To allow the comparison of results obtained more than 10 years apart, survey protocols used in these areas in the 1980s were used.

In Vendée, birds resting in groups ("rafts") close (200-1,000 m) to the shore were censused during one hour before dusk, from precisely identified vantage points along 30 km of coast between the fishing harbours of Les Sables d'Olonne and Saint-Gilles-Croix-de-Vie, following Yésou (1984, 1993). Censuses were repeated from May (2000) or mid-June (1999) to September, each census requiring at least six experienced observers equipped with telescopes, and calm sea conditions.

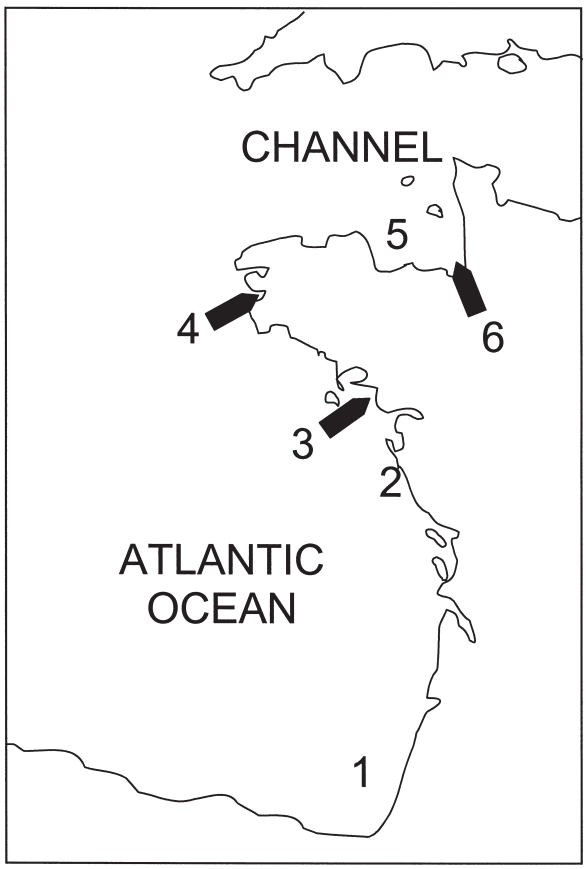

FIG. 1. – Balearic shearwater *Puffinus mauretanicus* off western France: main areas quoted in the text. 1: southern Biscay. 2: coast of Vendée. 3: Mor-Braz. 4: Baie de Douarnenez. 5: Baie de Saint-Brieuc and Cap-Fréhel area. 6: Baie du Mont-Saint-Michel.

Shearwaters were not known to regularly raft close to the shore in the Mor-Braz area, a "closed sea", north of the Loire estuary. Information was initially collected during vessel-born surveys organised over the period 1984-1995, according to the protocol described by Hémery *et al*. (1986) and Recorbet (1998), and occasionally from sea-watching (Recorbet, 1992, 1998). In the course of the present study, the area was surveyed only in 2000. Vessel-born surveys were organised as part of a monitoring programme of the effects of the *Erika* oil spill; moreover, the area where shearwaters were occurring in the 1980s (as mapped in Recorbet, 1998) was surveyed by helicopter on 4 September, at the expected peak of abundance (Le Mao and Yésou, 1993; Recorbet, 1998). Additionally, sea-watching routines were set up from mid-August to late September.

Information from the western Channel was collected from the regional ornithological societies, which paid particular attention to the species in 2000 and were prompted to publish detailed summaries of the species status in their respective areas (Liéron, 2000).

RESULTS

Vendée

Six censuses of rafting shearwaters were organised in 1999, and nine in 2000, at dates depending on both availability of observers and sea conditions (Table 1). Although census coverage was partial in some cases, experience from previous years strongly suggests that no important concentration was missed. Observed numbers were usually much lower than in the 1980s. Whereas over 1,000 individuals formerly used to be recorded in June, with a sharp increase at the end of the month or in early July (Yésou, 1986; Le Mao and Yésou, 1993), June-July censuses gave an average of only 340 individuals in 1999-2000, with a maximum of 830 in June 1999. Also, the July-August maximum counts repeatedly reached between 5,000 and over 7,000 individuals in 1982-1985 (*ibid.*), but only 2,550 and 1,500 in 1999 and 2000 respectively. However, at least 4,000

TABLE 1. – Results of the 1999-2000 censuses of Balearic shearwaters *Puffinus mauretanicus* rafting near the coast of Vendée, western France.

Date	No of shearwaters	Sea conditions	Census quality
17 June 1999	530-830	waves	not precise
15 July 1999	650-700	rather calm	quite good
5 August 1999	2400-2550	rather calm	good
26 August 1999*	> 725-880	waves	partial
2 September 1999**	> 3500-4000	rather calm	partial
16 September 1999	2030	waves	quite good
18 May 2000	0	waves	quite good
1 June 2000	60-100	rather calm	good
21 June 2000	40	waves	partial
4 July 2000	270-300	waves	partial
18 July 2000	80	calm	quite good
1 August 2000	490-600	waves	quite good
15 August 2000	130-250	calm	good
29 August 2000***	1100-1500	calm	good
21 September 2000	14	rather calm	quite good

* The northern part of the area, which held no shearwater on 29 and 30 August 1999, was not censused on 26 August.
** Only the northern part of the area was covered on that day.
*** Also, 1,450 were recorded in sea-watching at Les Sables d'Olonne on 4 September 2000.

shearwaters occurred in early September 1999, and ca. 2,000 were still present in the area a fortnight later.

Mor-Braz

Similarly, the numbers observed during the study period were much lower than in the 1980s, when the species occurred at a frequency of over 10 birds per hour at sea from July to September (Recorbet, 1998), and occasionnally gathered in rafts close to the shore (up to 4,000 ind., *ibid.*). The average frequency was less than 5 individuals per hour during five surveys at sea (26 August to 22 September 2000), with a maximum of ca. 100 birds counted on a single day; only 165 birds were observed from the coast (six sea-watch sessions, 17 August to 27 September). We found 720 shearwaters along the transects censused from helicopter on 4 September 2000; an extrapolation from this transect suggests that 800 to 1,500 shearwaters (the latter figure being optimistic) were present that day over the whole area where Balearic Shearwaters occurred in greater numbers (1,600-4,000 ind.) in the 1960s-1980s (Recorbet, 1992, 1998).

Western Channel

The Balearic shearwater regularly occurs along the north-eastern coast of Brittany, particularly in the area going from Baie de Saint-Brieuc to Cap Fréhel. Numbers, which rarely exceeded 200 in the 1980s, increased during the 1990s up to 2,150 in 1996, 2,250 in 1997, 500 in 1998 and 725 in 1999 in Baie de Saint-Brieuc alone (Liéron, 2000). However, no more than 170 were counted there between 11 June and 3 September 2000 (V. Liéron, *in litt*.).

The species also regularly occurs off the western coast of Normandy, particularly in Baie du Mont Saint-Michel where roosts totaled 250-300 shearwaters in the early 1980s, 350 in 1996, up to 2,000 in 1997, 4 in 1998, 100-150 in 1999 and 5 in 2000 (M. Beaufils *fide* G. Debout, *in litt*.). Despite the limited census efficiency (i.e. shearwaters, which sometimes roost in rafts close to land, can also stay well offshore where they are not easily censused), local observers think that marked interannual variability in shearwater abundance occurs, with a peak in 1997 (G. Debout *in litt*.). The Balearic Shearwater, although regularly reaching the North Sea, was never numerous east of Baie du Mont-Saint-Michel (Mayol-Serra *et al*., 2000). It remains uncommon in eastern Normandy (G. Debout, *in litt*.) and further north along the French coast (Dubois *et al*., 2000).

Balearic Shearwaters are now only occasionally present in the areas were they used to be very regular off the French Atlantic coast 12-15 years ago (Le Mao and Yésou 1993), and they are far less numerous there. Maximum counts were only 1,900-3,000 birds on 29 August - 4 September 2000, whereas 8,000-10,000 occurred over the same area in the 1980s (Le Mao and Yésou 1993). On the other hand, their abundance has increased markedly in the western Channel.

DISCUSSION

Change in distribution

Mayaud (1936) gave the first description of the Balearic Shearwater distribution off western France: "*a regular common migrant from Arcachon* [southern Biscay] *to the eastern Channel, but mostly off southern Brittany* [i.e. the Mor-Braz area, where the species was already regular and fairly abundant in the late 19th century]*, from June to September-October, rarely in winter*" (my translation). Mayaud (1936, 1953) was not aware of the presence of summering birds off Vendée, possibly because his main informers for the region were collectors, not active at sea and living a distance from Les Sables d'Olonne, where the species was already regular in

the 1930s-1940s according to local fishermen (A. Brunet and F. Kirié, pers. comm.).

The species seems to have been regular in summer off the point of Brittany during the 1940s-1960s, and groups of a few hundred moulting birds have been reported in Baie de Douarnenez in the 1960s at least, although observations stopped when the local pilchard fishery collapsed (Leopold *et al*., submitted). The development of birdwatching showed its regular presence off northern Brittany from the late 1960s onwards, the species regional status being better known from the 1980s. This shearwater has long been considered a regular migrant in low numbers in Normandy; its summer presence, which soon proved to be regular, was discovered in Baie du Mont Saint-Michel in 1982.

The distribution observed in 1999-2000 thus holds within the limits already known more than 60 years ago. However, the centre of gravity of its distribution, still on Vendée and southern Brittany in the 1980s, appears to be shifting northwards. Despite year-to-year variations, which can be marked in any area, a decrease obviously occurred in the Mor-Braz (where no four-figure record has been obtained since September 1986, after Recorbet, 1998) and Vendée areas (this study), whereas numbers have increased in the western Channel where the maximum record (4,250 in two sites in September 1997) largely exceeded the September 2000 highest estimate for northern Biscay (1,900-3,000 in Vendée and Mor-Braz). In addition the number of Balearic shearwaters recorded off southern Britain has markedly increased during the 1990s (Fraser *et al*., 2000), emphasising the changing status of the species in the western part of the Channel.

Oceanographic parameters

Shearwaters distribution, as known in the 1980s, was seemingly linked to an oceanographic thermal front, characterised by cold (16-18°C) surface water masses occuring discontinuously from the tip of Brittany to Vendée (Hémery *et al*., 1986). The cold front off Vendée is a trophic-rich area attractive to a variety of seabirds (Yésou, 1989), but favourable frontal conditions can disappear when warm water masses from southern Biscay expand to the north (Hémery *et al*., 1986; Le Mao and Yésou, 1993). Such a situation occurred e.g. in 1989, when the frequency of Balearic shearwaters at sea fell from 29 birds per hour in early August to 5.5-13 birds per hour from mid-August to early September, and in 1991 when the frequency fell down to 1-8 per hour (Yésou, 1993); in this context, it is significant that low numbers were recorded in August 1999, when sea surface temperature was over 20 °C. Also, the frequency of Cory's shearwater *Calonectris diomedea*, a warm-water species, increased markedly in inshore waters of northern Biscay in the late 1990s (Guérin, 1999), with a maximum in 1999 in Vendée (D. Desmots, pers. comm.). This suggests that the occurrence of warm-water masses became more frequent in this area, in agreement with the recent overall increase of sea water temperature in Biscay (P. Lazure, pers. comm.). Sea surface temperature was below 19°C off Les Sables d'Olonne in July 2000, and Cory's shearwaters were almost absent. However, Balearic shearwaters were also scarce.

Fish stocks

The distribution of Balearic shearwaters in Biscay has also been related to that of fish prey, mostly clupeids, particularly pilchard *Sardinus pilchardus* and anchovy *Engraulis encrasicolus* (Le Mao and Yésou, 1993), species accounting for a large part of the catches in the harbours of Les Sables d'Olonne and Saint-Gilles-Croix-de-Vie (Vendée) and La Turballe (Mor-Braz). Both species are known to play an important role in the diet of shearwaters (Le Mao and Yésou, 1993, Mayol-Serra *et al.*, 2000), particularly fish of juvenile age classes (A. J. Aguilar, pers. comm.). Because of their feeding habits these birds were coloquially known as "pilchard shearwater" by fishermen in Vendée. The case of Baie de Douarnenez, where shearwaters disappeared when the local pilchard fishery collapsed, exemplified the fact that the birds distribution was seemingly dependent on the distribution of such fish species. Fish stocks have decreased, particularly that of anchovies, for which the implementation of a moratorium in Biscay has been recently suggested. Also, there are indications that trawlers, which tended to fish close to the harbours in the mid-1980s, now have to travel a greater distance away, suggesting that fish distribution is changing. Variations in fish stocks are not yet fully understood, however. In the case of anchovies, important year-to-year variations could be linked to environmental parameters influencing reproduction rate, much more than to fishing effort. Also, the distribution of this clupeoid species could be rapidly changing in relation to the water temperature increase in Biscay, and IFREMER, the

French sea research institute, is planning to study these aspects in the near future (J. Bertrand, pers. comm.); the expected results could shed new light on the changing status of the Balearic shearwater in Biscay.

Where are the missing birds ?

A northward shift of the Balearic shearwater distribution is occurring in Biscay and in the Channel. However, numbers counted in the western Channel were far from compensating the lost in Vendée and Mor-Braz in 2000. At best 3,000 Balearic shearwaters were found in western France that year, compared to an estimated 8,000-10,000 in the 1980s. Clearly, most missing birds are not to be found further north: even if the species frequency is increasing off southern Britain, the overall increase does not account for more than 1,000 birds (Fraser *et al*., 2000), and the species remains uncommon along the well-surveyed shores of the eastern Channel and North Sea.

A possibility is that fewer birds now reach the Gulf of Biscay, provided that they have found favourable conditions further south (e.g. 3,450 Balearic shearwaters were counted off Peniche, Portugal, on 19 September 1999). However, more studies are needed before the abundance of the species is known all along its range (Mayol-Serra *et al*., 2000). Meanwhile, the suggestion that its distribution may have shifted both northward and southward remains hypothetical. Alternatively, a change in the behaviour of shearwaters might have occurred. Balearic shearwaters tended to stay close to the coast (usually within the first 15 km, Mayol-Serra *et al*., 2000) and, at least in Vendée, roosted at the proximity of fishing harbours. This was possibly linked to the fact that many of these birds were following trawlers for foraging on fish discards (Le Mao and Yésou, 1993), so their distribution in time and space was linked to the daily activity of the trawling fleet. However, trawlers now fish at greater distances from the harbours, and possibly shearwaters obtain no benefit from following boats all the way back to the coast, so they wait for the boats closer to the fishing grounds. If they now stay further offshore they can no longer be censused from the coast. In fact, shearwaters have been observed regularly in Vendée flying at great distance from the coast during the 1999-2000 censuses, suggesting that a proportion could be missed. Also, observations off the Ebro delta, Spain (Abelló and Oro, 1998), have shown that Balearic shearwater can fish farther offshore than the 11 km limit previously given by Gutiérrez and Figuerola (1995). If a similar situation occurred in the Atlantic (e.g. as a consequence of changing fish and/or trawlers distribution), then the birds would remain unnoticed from the coast.

In summary, further studies are needed to improve our understanding of the changing status of the Balearic shearwater off western France. This must include surveys at sea in areas where the trawler fleet fish for clupeids, and must be connected to other environmental studies carried out in Biscay, particularly those linked to marine climate and fish populations.

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