The Brent Geese of France, with special reference to the Golfe du Morbihan

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The Dark-bellied Brent Goose *Branta bernicla bernicla* is an example of an ecologically specialized species: it breeds on the arctic coast of Western Siberia (Uspenski 1960) in extreme climatic conditions (two months' thaw); its wintering area is confined to a small number of estuaries and bays in Western Europe (Ogilvie & Matthews 1969).

A recent spectacular increase in numbers may eventually result in competition for space on the wintering grounds. The few zones suitable as wintering areas for Brent Geese are threatened by man, either through changes following development for industry or for oyster- and mussel-breeding, or, more insidiously, through chronic pollution.

Brent Geese in France

The first estimates of total numbers of Brent Geese wintering on French coasts go back to 1960–1961 (Roux 1962). Coverage of the French coast has since improved under the stimulus of the International Waterfowl Research Bureau (IWRB). The results are published in annual reports (Spitz 1965; Roux, Spitz & Tamisier 1967; Brosselin, Roux & Tamisier 1968; Roux & Tamisier 1969; Brosselin 1975) and have been included in overall studies of wintering Brent Geese in Europe (Burton and Boyd 1963; Ogilvie & Matthews 1969).

Geographical range

Brent Geese are found on the French coasts of the western part of the English Channel and the Atlantic (Figure 1). They occur regularly in only a score of sites, especially the following: Baie de la Somme (Picardy); Baie des Veys (Normandy); Baie du Mont St Michel, Baie de St Brieuc, Jaudy estuary, Baie de Morlaix, Baie de Quiberon, Golfe du Morbihan, Vilaine estuary, Baie du Crosic (Brittany); Baie de Bourgneuf and Baie de l'Aiguillon (Vendée); Ile de Ré and Ile d'Oléron, and Baie d'Yves (Charente); and Bassin d'Arcachon (Aquitaine).

Wintering areas are more or less sheltered bays, generally receiving an inflow of fresh water. The accumulation of fine sediments forms vast banks uncovered at low tide. The physico-chemical and hydrological conditions in these bays govern the establishment and the maintenance of the flora which varies in quantity from one place to another and from one year to another.

As shown by Ranwell & Downing (1959) and Burton (1960) for Britain, and by Wolff *et al* (1967) for the Netherlands, there is, in France too, a close relationship between the existence of vegetation cover made up of *Zostera, Enteromorpha* and *Ulva* and the presence of Brent Geese. However Brent Geese are not found in all areas which appear suitable (Brosselin 1968). Suitable areas are not used because at least one ecological requirement is not fulfilled-either lack of food, lack of shelter, or excessive disturbance (fishing, hunting).

Numerical distribution

Among the regular stations, only ten hold more than 100 Brent Geese. In view of the results already published it seems worthwhile considering only the most recent data from 1973–1974 and 1974–1975 (Figure 1). Trends in numbers wintering in France correspond fairly closely to trends in the world population: 38% (average of winters 1964–1965 to 1974–1975) of the total spend the winter in France. The Golfe du Morbihan in Brittany appears to be the main wintering zone, followed by Charente (Oléron, Baie d'Yves). Vendée (Baie de Bourgneuf) and the Bassin d'Arcachon. The striking increases noted at Baie de Bourgneuf and Oléron in 1974–1975 corresponded with a considerable decrease at the Ile de Ré; the reasons for this redistribution are as yet unknown. Like other geese, Brent Geese are generally faithful to their respective winter quarters, as recent observations by St Joseph (1976) show.

Relative importance of the Golfe du Morbihan

Brent Geese wintering in the Golfe du Morbihan represent between 28% and 58% of the total French population. This percentage has tended to increase from 38% (average for 1964–1965 to 1967–1968) to 42% (average for 1968–1969 to 1970–1971) and to 52% (average for 1971–1972 to 1974–1975).

The percentage of first winter birds, which reflects the breeding success rate, may be compared with the index of usage of the Golfe

Wildfowl 27 (1976): 55–62

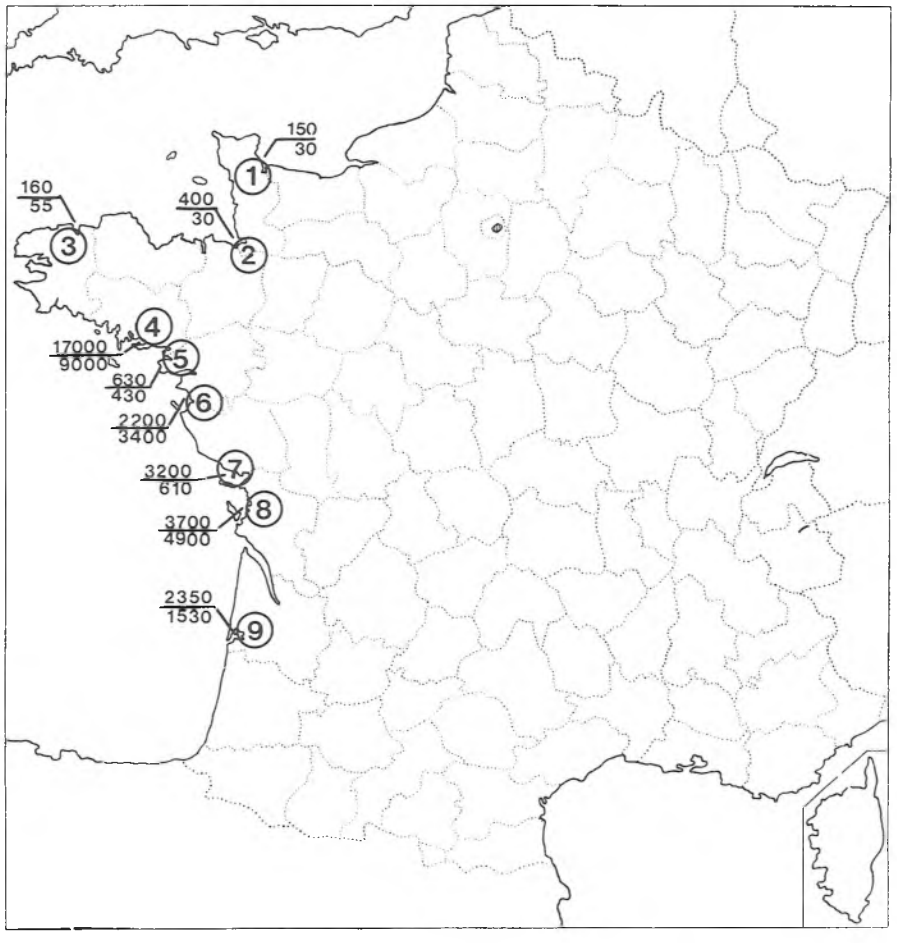

Figure 1. Brent Goose winter distribution in France (principal areas). The numerical data refer to IWRB censuses in January 1974 (upper figure) and January 1975 (lower figure).

1. Baie des Veys; 2. Baie du Mont Saint Michel; 3. Baie de Morlaix; 4. Golfe du Morbihan; 5. Baie du Croisic; 6. Baie de Bourgneuf; 7. Baie de l'Aiguillon and Île de Ré; 8. Baie d'Yves and Île d'Oléron; 9. Bassin d'Arcachon.

du Morbihan (Table 1 and Figure 2). There is a general correlation suggesting that a higher proportion of the French birds use Morbihan when there are many young in the population. The Golfe may therefore have conditions which are particularly attractive to family parties.

Brent Geese in the Golfe du Morbihan

The Golfe du Morbihan

The biological wealth of the Golfe, one of the ten principal waterfowl wintering sites in Western Europe, is demonstrated by the presence in winter of 60–100,000 Brent Geese, ducks, waders, gulls and Coot. It results from its geomorphological and hydrological structure, its climate, the presence of vast mudflats, coastal marshes and inland marshes, where ducks can feed at night and where waders can roost at high tide (Mahéo 1973 and in press; Mahéo & Constant 1971). For the Brent Geese two factors appear to be vital; firstly its structure. The Golfe du Morbihan covers an area of 35,000 ha, about a third being open sea (see Figure 5). It is connected with the Atlantic by a narrow channel (800 m wide) and resembles a small inland sea divided into two basins. The western basin has a number of underwater reefs, with fierce currents around the numerous rocks and islands. The eastern part

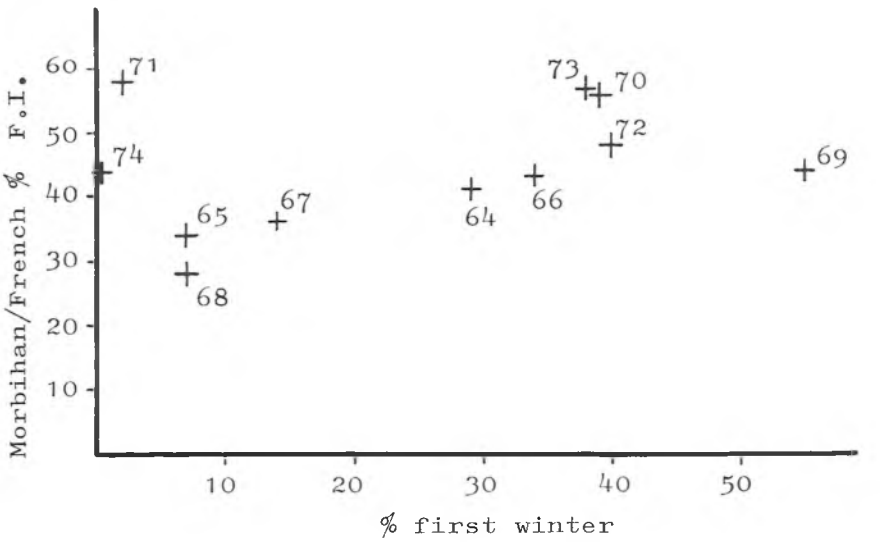

Figure 2. Brent Geese in the Golfe du Morbihan. Relationship between the percentage of first winter birds and the numbers in the Golfe as a percentage of the total in France.

Table 1. Trends in numbers of Dark-bellied Brent Geese from 1964–1965 to 1974–1975 (according to censuses by IWRB).

Season	World population	Peak French population	Peak Golfe du Morbihan population	$\frac{\text{Morbihan}}{\text{French}}$ %	% 1st winter at Morbihan
1964–65	25,600	13,500	5,500	41	29
1965–66	27,300	11,000	3,800	34	7
1966–67	31,500	11,500	5,000	43	34
1967–68	31,000	8,600	3,100	36	14
1968–69	27,600	8,900	2,500	28	7
1969–70	36,300	13,300	5,800	44	55
1970–71	40,800	13,300	7,500	56	39
1971–72	34,000	12,200	7,100	58	2
1972–73	51,800	18,000	8,600	48	40
1973–74	84,500	30,000	17,000	57	38
1974–75	71,300	20,500	9,000	44	0·1

is characterized by a smaller number of outcrops and by less violent currents which favour sedimentation. With its decreased force of wave action, and the inflow of fresh water bearing a large amount of material, the Golfe functions almost like an estuary. Secondly, the extensive, finely particulate, mudflats which cover the higher part of both basins have allowed the considerable beds of *Zostera,* essentially *Z. angustifolia* with *Z. noltii* at the edges, to develop or re-develop (Voisin 1968).

The intertidal mudflats, which are drained by a large number of creeks, are uncovered for between eight and twelve hours in every twenty-four. The period and area of emergence vary with the tide and wind conditions. In the eastern part of the Golfe (the sector mainly used by the geese), the area of *Zostera* beds which can be directly exploited has been calculated as 1,700–2,100 ha.

Annual cycle from 1960–1961 to 1974–1975

Censuses (from one to three per week) are carried out throughout the wintering period from October to April. Almost all the censuses are carried out by the author, apart from the 1964–1965 season which was

specially studied by Voisin (1968) and the month of February 1975 (only one census). For clarity and in view of the regular trends in numbers throughout each winter, all census figures are presented as bi-monthly averages (Figure 3).

The first Brent Geese (a few odd birds or small groups) are regularly observed in October (earliest arrival four on 1st October 1973, latest 45 on 2nd November 1966). More arrive subsequently, in bigger and bigger groups (each group numbering between 800 and 2,000 in November), and numbers reach their peak from late December to early January (lowest peak 2,700 on 5th January 1969; highest 17,300 on 17th January 1974). The length for which the peak numbers remain varies considerably from one year to another; from two weeks, in December 1967, to six weeks, December

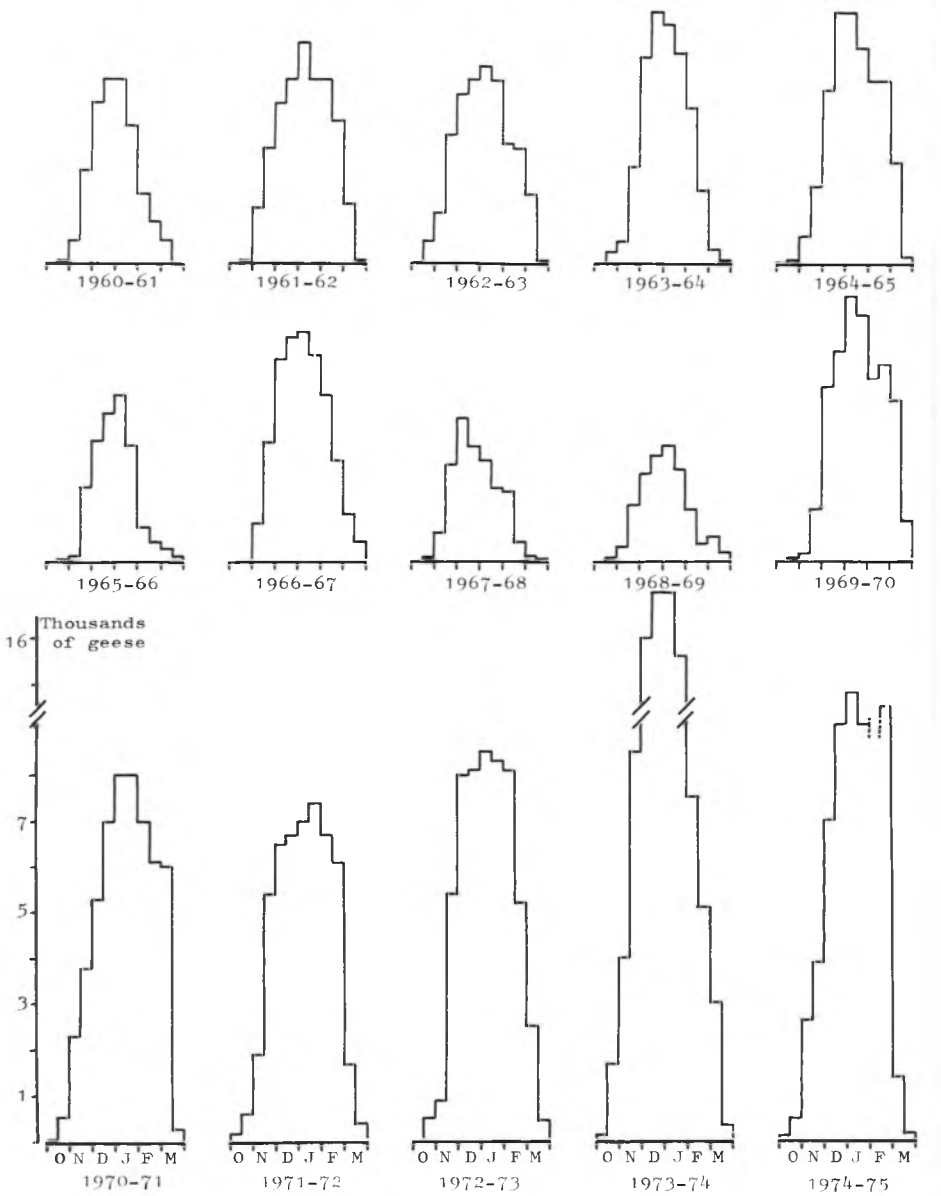

Figure 3. The annual cycle of Brent Geese in the Golfe du Morbihan. Bi-monthly averages from October to March 1960–1961 to 1974–1975.

1973 to January 1974. Departures are spread from late January to late March with however two marked declines. One, quite important, in February, another, very important, between 5th and 25th March. Some geese remain sporadically in the Golfe until the end of April.

The Golfe du Morbihan is thus essentially a wintering area. But some of the arrivals in late October and November may only make a temporary stay, before continuing on to wintering areas further south. This is more obvious on the return migration in late winter, particularly in 1968–1969, 1969–1970 and 1974–1975. Thus, as well as its major role as a wintering area, the Golfe probably also acts as a migration stop.

Annual fluctuations (Figure 4)

Trends in numbers over the last fifteen years show the direct influence of the breeding success on the number of Brent Geese wintering in the Golfe. The increase in numbers between 1960 and 1964 however corresponds with a progressive re-occupation of the Golfe following the establishment in 1958 of a wildfowl refuge in the principal area used by the geese. Usage of the area had deteriorated seriously as a result of excessive shooting pressure (Brosselin 1968). Numbers decreased from 1965 to 1968 but have increased spectacularly since 1969 (the increase has continued in 1975–1976: 23,000 geese were counted in December 1975).

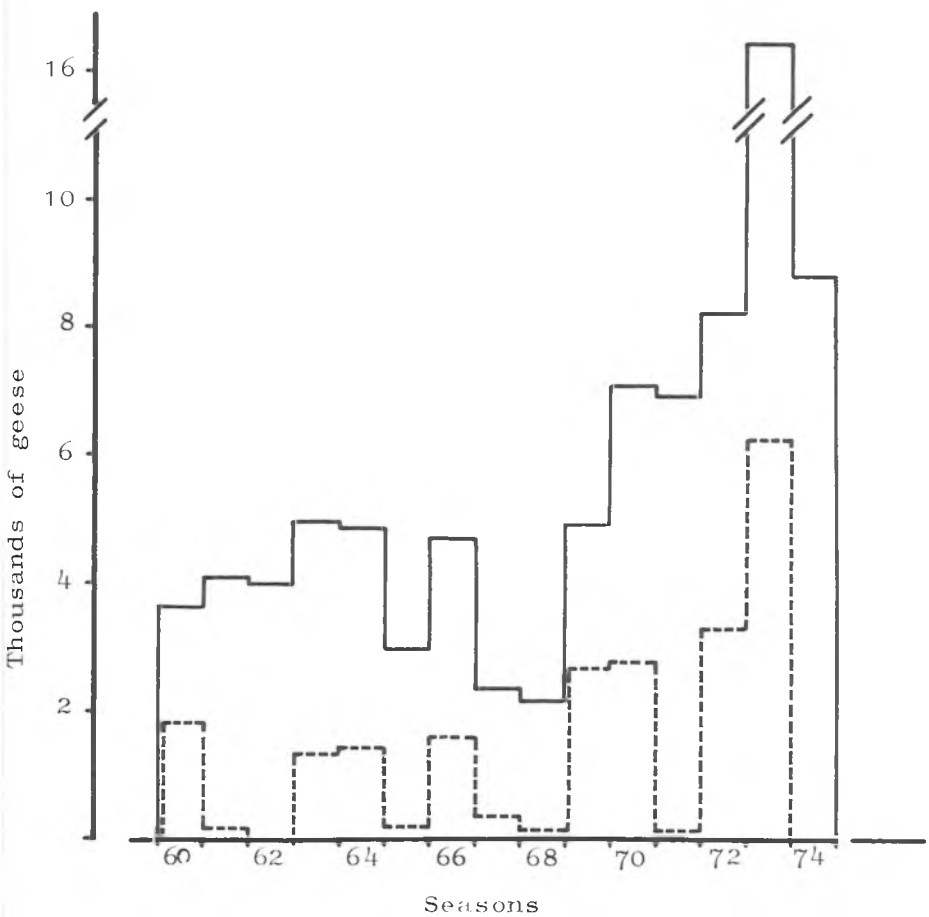

Figure 4. Brent Geese in the Golfe du Morbihan. Trends of average annual numbers from 1960–1961 to 1974–1975, calculated from December and January counts. The dotted line refers to the number of first winter birds.

Origin of the populations

The details, in time and space, along the main migration routes, are beginning to be known (Ogilvie & Matthews 1969; St Joseph 1976). The breeding area of the Dark-bellied Brent Goose is on the arctic shores of Siberia on the Taimyr Peninsula. The coasts of Denmark and Germany act as pre- and post-wintering stations. In autumn the geese spread from this area to winter quarters in England and France, as is shown by the recoveries of birds ringed in Denmark (Fog 1967).

Brent Geese were colour-marked in England, mainly on the coasts of Essex, in 1973–1974 and 1974–1975. In the first winter there were 12 observations of yellow-dyed geese, referring to at least four different birds, in the Golfe between 11th December and 26th February. In 1974–1975 there were 20 observations of yellow-dyed birds, concerning at least another four individuals, plus a bird whose ring indicated it had been marked the previous winter.

An analysis of the arrival of Brent Geese in the Golfe, compared with the earliest dates on which yellow-dyed birds were observed, suggests that the great majority take direct route between the pre-wintering station and the Golfe and that the later arrivals are geese which have passed through the east coast of England.

Local distribution and daily activity (Figure 5)

Almost all the Brent Geese remain in the eastern part of the Golfe du Morbihan. As the numbers increase, they always split during November into three groups, which share the available space between them until the end of the wintering period. Variations in the number of birds in each group of the localities used have been described (Mahéo 1971). No differences in behavioural requirements, or in the rhythm of activity, of these three groups were found.

Daily activity can be divided into two essential types of activity—feeding and 'comfort' activities (sleep, preening, swimming). Some two to three hours after high tide, the geese flight from the roosting area to the feeding area; they then swim to the places where their food (almost exclusively *Zostera*) will first be accessible, about three or four hours after high water. The search for food continues while the *Zostera* beds remain accessible, on an average for four to six hours on each tide. The geese move about as the tide falls, either walking or swimming, and frequently change feeding grounds once or twice during the tide cycle. 'Comfort' activities take place at high tide, with frequent preening, followed by swimming. At dusk, the geese leave the water's edge to gather on the water in three or four roosting areas.

When low water coincides with sunrise and sunset, the geese begin feeding earlier, at first light, and in the evening continue feeding until absolute darkness. In the same way, at the end of the winter, when the *Zostera* beds are beginning to be exhausted, or perhaps in response to changes in physiological requirements, the geese are often seen feeding at night when the moon is up.

Conclusion

The Golfe du Morbihan represents a wintering site of international importance for the Brent Goose holding more than 20% of the world population and more than 50% of the Brent Geese wintering in France in recent years. It appears a site particularly favoured by family groups, and is used for as much as six months (October to March), during three of which more than 60% of maximum numbers are present. While present, the geese have all their requirements met and remain within the Golfe, mainly at its eastern end.

The maintenance of this wintering area is thus closely connected to developments in the Golfe du Morbihan and in particular to the future of the *Zostera* beds. Before 1930, the *Zostera* (then *Zostera marina*) covered a much wider area than nowadays. There are unfortunately no data on the past status of Brent Geese in the area. Numbers were certainly much higher; several sources suggest that the flock in the St Armel area (see Figure 4) about 1930 was 20–25,000 whereas at present this flock numbers at most 9,000.

The disappearance of the *Zostera* beds in the 1930s led to a considerable decrease in the number of Brent Geese, and also encouraged the development of oyster-breeding; 2,000 ha in the intertidal zone are now used for this purpose. The concessions cover a number of mudflats particularly in the western sector of the Golfe, which means a corresponding decrease in potential feeding areas. The *Zostera* beds were in fact only able to grow again in areas not being developed for oyster-breeding, which interfered with the pedological and hydrological conditions favoured by the plants.

Pollution also plays a part. Its origin is essentially urban (domestic waste) and agricultural (chemical fertilizers and biocides), and results in greater turbidity (preventing photosynthesis by the *Zostera*)

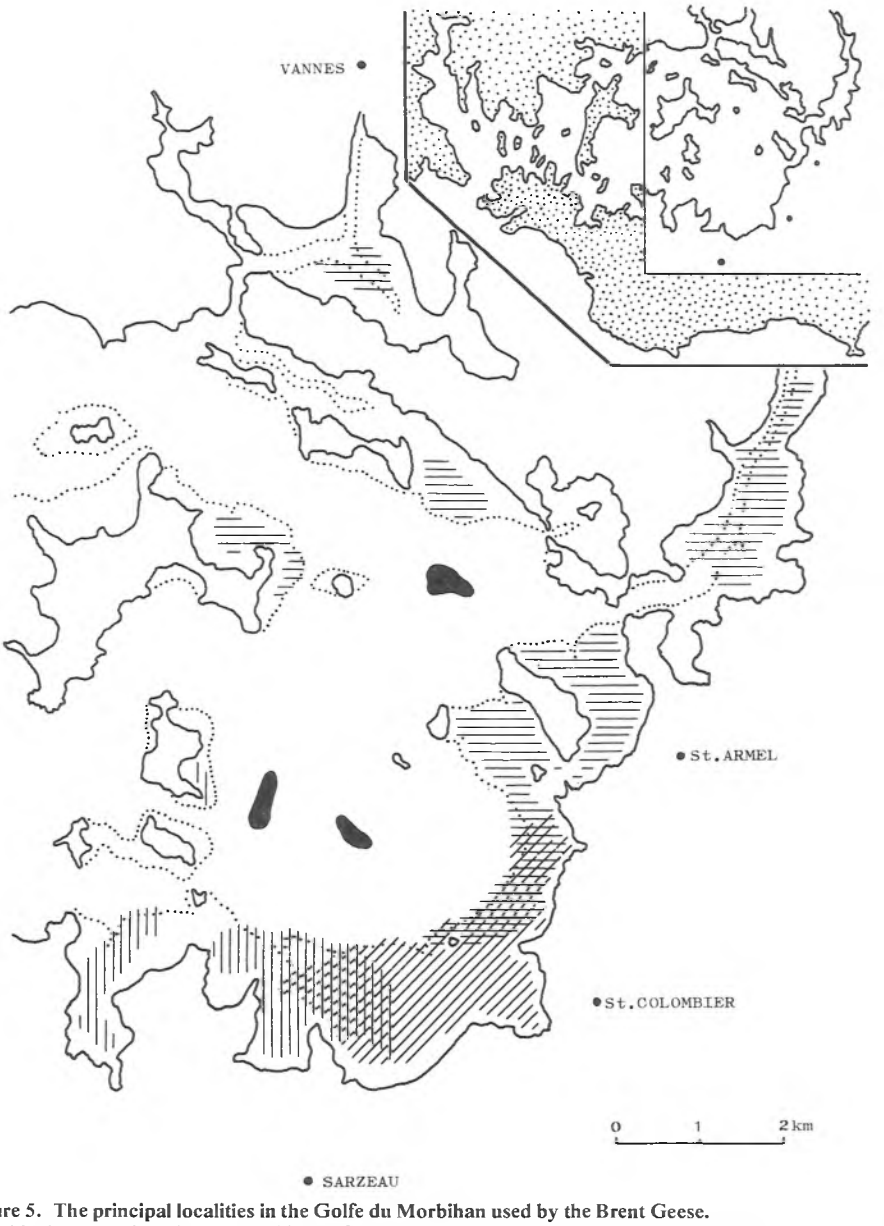

Figure 5. The principal localities in the Golfe du Morbihan used by the Brent Geese.
In black = roosting places. Hatching = feeding areas; the horizontal, vertical and oblique hatching indicate the three groups of geese. Dotted line = low water mark of average tides.

and in outbreaks of algal blooms which stifle the *Zostera*. The density of the *Zostera* (and the amount of food available to the Brent Geese) therefore undergoes fluctuations and has a tendency to diminish.

The bird has always been considered a quarry species in the area. The considerable downward trend in the total population of the Brent Geese (Atkinson-Willes and Matthews 1960), and also the constant increase in hunting pressure in the Golfe, led to a progressive decrease in the number of geese there: from a few hundred in 1953 down to an almost complete desertion (Brosselin 1968). The establishment of a wildfowl refuge in 1958, followed by protected status for the Brent

Goose in France, enabled the wintering area in the Golfe du Morbihan to be reconstituted quickly. But the difficulty of applying these regulations means that the geese still feel the effects of hunting; some 300–500 Brent Geese are killed or wounded each winter. The hunting disturbance is such that a coastal strip of about 150 ha of mudflats remains unused.

However the notable and continuing increase in Brent Goose numbers in recent years poses the problem of when the carrying capacity of the Golfe du Morbihan will be reached. It must be hoped that nothing will be done to reduce that carrying capacity. The planners must be made to recognize the ecological value of the Golfe du Morbihan (in particular for birds) and to take this into consideration in any development projects.

Acknowledgement

I am grateful to Mr M. Smart of the IWRB for translating my draft paper.

Summary

The status of the Dark-bellied Brent Goose *Branta b. bernicla* wintering in France is outlined. There are 20 to 25 sites in the main bays of the western English Channel and the Atlantic: only ten sites carry more than 100 geese; the main ones being Golfe du Morbihan, Ile d'Oléron-Baie d'Yves, Baie de Bourgneuf, Bassin d'Arcachon.

Observations from 1960–1961 to 1974–1975 in the Golfe du Morbihan show that Brent Geese are present from October to March, with a winter peak in January now exceeding 17,000. The numbers in the Golfe represent about 20% of the world population and more than 50% of those wintering in France. The Golfe is primarily a wintering area and secondarily a migration stop. It has a vital role as a wintering area for family parties.

The Brent Geese only use the eastern part of the Golfe, feeding over some 2,000 ha of *Zostera* beds uncovered at low tide and resting on open water nearby.

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