Seasonal Appearances of Short-tailed (*Puffinus tenuirostris*) and Sooty (*Puffinus griseus*) Shearwaters on the Tokyo-Kushiro Line, Japan

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Abstract The short-tailed (*Puffinus tenuirostris*) and Sooty (*Puffinus griseus*) Shearwaters were counted from the ferry boat during eleven voyages between Tokyo and Kushiro from December 1982 to March 1984. More than 90 percent of both shearwaters were observed during the voyages from April to June, during their spring migration. The appearance of Sooty Shearwaters reached a peak in early May along the Pacific coasts of northern Honshu, one month earlier than Short-tailed Shearwaters. Their early occurrence suggests that these Sooty Shearwaters were adult birds. During the autumn migration season both shearwaters were observed to be limited in the waters off Hokkaido. Only a few birds of both shearwaters were observed in mid summer and winter. The emaciated birds of both species were observed during the voyages in mid June, 1983, but most of them were Short-tailed Shearwaters and they were also observed in late September to early October in that year.

Introduction

The migration route of Short-tailed Shearwaters, proposed by Serventy (1953), has been criticized by Shuntov (1972) and Guzman (1981). In 1983–85, we carried out 11 round trans-pacific surveys to find their actual migration routes in the temperate North Pacific. The above studies covered an extensive pelagic sea area, but include few coastal local information, other than Guzman (1981) who surveyed the local waters off Alaska and British Columbia. Along the Japanese Pacific coast, mortalities of this shearwater have occurred regularly from late May to mid June of every year (Oka *et al.* 1985), and those of high or middle magnitude have been reported with intervals of about 10 years (Oka & Maruyama 1986). However, few data on their migration routes were available for the Japanese waters. Therefore, Degawa & Watabe (1983) made pelagic counts from the ferries of the Tokyo-Ogasawara Line, March to July and the Tokyo-Kushiro Line, July, 1982. As a result, and considering other seabird watcher's data, they suggested that migration routes may pass east of 140°E and may differ by age.

The Sooty Shearwaters, a close relative of the Short-tails, breed in New Zealand and southeastern Australia (also southern South America) and are found off Japan during the northward migration, but with much less mortality than the Short-tails (Oka *et al.* 1985). A comparative analysis of data on these two shearwaters in the Japanese waters may help

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understand the real status of mass mortality of the Short-tails and their ecological segregation from the Sooties.

Here, we report the results of monthly counts of the two shearwaters made on offshore navigation course from Tateyama, central Honshu, to Kushiro, Hokkaido.

Study Area and Methods

The Short-tailed and Sooty Shearwaters were counted over the waters between Tokyo Bay and Kushiro Harbour by using regular ferry boats (9,000 t), cruising at about 20 knots per hour. Daytime counts were available on two sea sections: from Tateyama to Sendai, about 400 km, and from Cape Erimo to Kushiro, about 170 km, but data in

Fig. 1. Census route from Tokyo to Kushiro.
The broken line shows the portion traveled at night.

Sanriku sea area were lacking owing to night navigation (Fig. 1).

The counts were carried out almost monthly during 11 round voyages from late December in 1982 to early March in 1984. It took 15–24 hours from off Tateyama to Sendai and 5–8 hours from off Cape Erimo to Kushiro. Observations were made with binoculars ($\times 8$) from the lower deck about 8 meters above the water. All the visible birds from one side of the ship were recorded along with their behavior. The Short-tailed and Sooty Shearwaters were carefully identified according to the following criteria (Ogi 1982): the wing undercoverts are more whitish silver grey in the Sooty than in the Short-tail. The body shape is more stocky in the Sooty. The head looks smaller and more round in Short-tail than the other. The Short-tail flaps more rapidly and turns more quickly than the Sooty.

Results

The total numbers of the Short-tailed and Sooty Shearwaters counted during the whole voyage were about equal; 3,009 Short-tails and 3,089 Sooties. 2,895 (96.2%) Short-tails and 2,827 (91.5%) Sooties were observed on their spring migration from April to June (Table 1). In the sea area from off Tateyama to Sendai, the most of the Sooty, 2,683 birds, appeared on May 3–5, which was one month earlier than the Short-tail, 2,453 birds, recorded during June 15–17 in the same waters. The number of Sooties was more than 4.0/km which far exceeded the values in other months. On the other hand, in the waters from off Cape Erimo to Kushiro the number of Short-tails was 0.2/km and 1.5/km during the voyages of April 8–10 and June 15–17, respectively, while the Sooty was rarely seen.

In autumn migration, most of the 106 Short-tails recorded were observed only in the waters from off Cape Erimo to Kushiro, from the end of September to early November, and most of the 257 Sooties were also observed in the same waters from the end of August to early November. Both shearwaters showed the peak during the same voyage of September 30–October 2; 65 Short-tails (0.3/km) and 162 Sooties (0.8/km). Here, too, the Sooty occurred one month earlier than the Short-tail. In mid summer and winter only 8 Short-tails and 5 Sooties were observed.

Behavior of the birds approached by ship was an index of emaciation for migrating Short-tails (Nishigai *et al.* 1981). The birds observed in spring and autumn belonged to the following 2 groups; one, the floating birds and the other, flying or taking-off when the ship approached (Table 2). In the voyage of June 15–17, 1,468 birds were floating helplessly, and accounted for 54.9% of the total of Short-tails. On the other hand, only 17 Sooties were observed floating. Most (90.7%) of the emaciated Short-tails were observed in the waters of off Tateyama-Sendai, and the remaining 10% were observed in the waters of off Cape Erimo to Kushiro. In the voyage of September 30–October 2, only 65 Short-tails were counted in the waters of off Cape Erimo to Kushiro, and six (9.2%) of them appeared to be emaciated. However, no Sooty was observed emaciated in autumn.

Table 2. Numbers of floating birds for the two species, Short-tailed and Sooty Shearwaters, observed in the two sections, off Tateyama-Sendai and off Erimo Cape-Kushiro, of the Tokyo-Kushiro Ferry Line in spring.

	Off Tateyama-Sendai			Off Erimo Cape-Kushiro		
	Floating	In flight or taking off	Total	Floating	In flight or taking off	Total
Short-tailed Shearwater						
April 8-10	0 (0%)	26 (100%)	26 (100%)	0 (0%)	53 (100%)	53 (100%)
May 3-5	0 (0%)	123 (100%)	123 (100%)	0 (0%)	21 (100%)	21 (100%)
June 15-17	1,332 (54.3%)	1,121 (55.7%)	2,453 (100%)	136* (62.1%)	83 (37.9%)	219 (100%)
August 30-September 1	—	—	—	0 (0%)	1 (100%)	1 (100%)
September 30-October 2	0 (0%)	0 (0%)	0 (0%)	6 (9.2%)	59 (90.8%)	65 (100%)
November 6-8	0 (0%)	3 (100%)	3 (100%)	0 (0%)	38 (100%)	38 (100%)
Sooty Shearwater						
April 8-10	0 (0%)	50 (100%)	50 (100%)	0 (0%)	7 (100%)	7 (100%)
May 3-5	0 (0%)	2,683 (100%)	2,683 (100%)	0 (0%)	5 (100%)	5 (100%)
June 15-17	17 (20.7%)	65 (79.3%)	82 (100%)	—	—	—
August 30-September 1	—	—	—	0 (0%)	52 (100%)	52 (100%)
September 30-October 2	0 (0%)	1 (100%)	1 (100%)	0 (0%)	162 (100%)	162 (100%)
November 6-8	0 (0%)	1 (100%)	1 (100%)	0 (0%)	41 (100%)	41 (100%)

* including a dead bird.

Discussion

The first group of birds observed along the Japanese coast in the voyages of early April and early May were considered to be subadults and adults, because they are known to depart the breeding area from March to mid April, more than two weeks earlier than young of the year. They need, at least, two to four weeks to reach the Japanese shore. The birds found along the Japanese waters after about May 20 may be young of the year (Oka & Maruyama (1986) reported that more than 99% of dead birds found along the Japanese coast in this season were young of the year). Therefore, we consider that age composition of the birds migrating north off the Japanese coast in spring are mostly biased to young of the year. In the breeding areas, the total population of adults and subadults has been estimated at more than 13,000,000 individuals, in contrast to the population of young of the year, 3,250,000 (Naarding 1981). As suggested by Guzman (1981), Degawa & Watabe (1983) and our recent trans-pacific survey, the northward migration routes would be different by age. Most of the older birds would migrate through central pelagic sea areas, and most of young of the year should take more drifted routes closer to the Japanese coast.

The birds observed in the waters off Cape Erimo to Kushiro during the end of September and early November were regarded as nonbreeders migrating to the southern hemisphere, considering from their breeding schedule (Serventy 1967). The birds observed in winter may be nonbreeders and may include young of the year which may not necessarily return to the breeding area (Kuroda 1963, Shuntov 1974, Degawa & Watabe 1983). The summering waters of this species along the Japanese Pacific coast may be north of 44.0°N along Hokkaido (Oka 1986), where large numbers of the birds were feeding in early July there (Tanaka & Kajiwarra 1979). No bird was observed in the temperate waters along the Japanese Pacific coast in this season.

The year, 1983, is known by mass mortalities of this species in the temperate Japanese waters (Oka & Maruyama 1986). Accordingly, greater number of emaciated birds were possibly considered to be there in June of this year than in other years. Moreover in the voyage of September 30–October 2 of the same year, the emaciated birds were again observed. Gibson (1984) reported mass mortalities of this species off the Kodiak, Dutch Harbor of the Aleutian Islands and Seward Peninsula in Bering Sea from late August to late September in 1983. One of the possible causes may be abnormally high sea temperature reducing the food resource, as was reported by Gibson (1984).

Summering waters of the Sooty Shearwater in the northern North Pacific are situated south of those of the Short-tailed Shearwater (Ogi *et al.* 1980, Ogi 1984). Chu (1984) reported that many Sooties molting the wings were found in the Monterey Bay near San Francisco between May and August. Also in the waters off Sanriku, northern Honshu, Japan, some Sooty Shearwaters were observed molting the wings in late May (Kuroda 1954). Further, Kuroda (1954) suggested these molting birds fatty. This indicates that the waters off Sanriku would be a potential summer range of this species. Nevertheless, only a few birds were observed in the sea areas surveyed in mid summer. Therefore, the sea areas off northern Honshu may be the southernmost summering

waters for the Sooty, and the main populations probably migrate to the waters further north than Kushiro (43°N).

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東京-釧路航路におけるハシボソミズナギドリと ハイイロミズナギドリの出現の季節的变化

1982年12月から1984年3月にかけて東京-釧路間フェリー航路を、計11回往復し、ハシボソミズナギドリとハイイロミズナギドリの出現状況を調査した。両種とも全観察数の90%以上が4月から6月の春期航海に集中したものの、出現ピークは、ハイイロでは5月初旬、ハシボソでは6月中旬の調査時に認められた。この結果から、ハイイロでは少なからぬ成鳥群が、日本沿海部を通過することが示唆された。一方、盛夏、冬期間では、両種とも極めてわずかが観察されたにすぎなかった。6月中旬の調査時にハシボソでは出現鳥の50%を越える計1,468羽と、若干のハイイロに衰弱鳥がみられ、さらに、秋の渡り時の9月下旬から10月初旬の調査時にも出現鳥の10%近く(9羽)のハシボソに衰弱鳥がみられた。

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