A WRECK OF JUVENILE SOOTY SHEARWATERS (PUFFINUS GRISEUS) IN SOUTH CANTERBURY

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During the second and third weeks of May 1961, persistent easterly and south-easterly winds brought many hundreds of dead and dying Sooty Shearwaters *(Puffinus griseus)* to the beaches of southern Canterbury. Most, but not all, were thin and undersized, showing evidence of prolonged malnutrition in their muscles and bones. This paper reports the weight, measurement and condition of a sample of 73 birds collected from beaches near Ashburton (44° 05′ S, 171° 45′ E). For a discussion of the wreck and of beach-patrol recoveries in 1961 see Bull and Boeson (1963).

The birds, most of which were picked up dead at the high water mark, were waterlogged and slightly damaged from wave action and gull predation. Some were slightly decomposed, but none is likely to have been dead for more than a week when examined. Crops were empty, or contained small quantities of liquid, leaves, twigs or fragments of algae of negligible weight. Many of the bodies bore remnants of down on the head and nape, and a sample examined had small gonads and well-developed bursae fabricii. The primary feathers of nearly all were still growing and heavily vascular; their shortness is reflected in the standard-wing-measurement tables below.

Sixty-nine of the birds were light in weight, with little or no visceral or subcutaneous fat and undeveloped wing muscles (mean weight of pectoral muscles in a sample of 12: 45 gm). Four were larger and heavier, with considerable fat stores and solid, well-developed pectoral muscles (mean weight 80 gm). Richdale's account of breeding in this species (1944:103, 1954:590) suggests that unemployed birds (presumably including juveniles of two or more years) leave the breeding grounds in February and early March, and most breeding adults leave in April; only the chicks of the year remain as late as mid-May. It therefore seems certain that all the birds of the Ashburton sample, including the heavier ones, were juveniles hatched in the current season.

Standard measurements were taken of culmen (tip to base of feathering) and wing (carpal flexure to tip of longest feather). From the weight of each bird a standard 15 gm (obtained by drying a sample of 12) was subtracted to allow for the wetness of the plumage. Weights and measurements of the 69 lightweight birds are summarised in Table 1, and in Table 2 their means are compared with mean weights and measurements of adult and unfledged-juvenile Sooty Shearwaters recorded by Richdale (1944:106, 1945:61) on breeding grounds off southern New Zealand.

TABLE 1 — **Weights and Measurements of 69 Ashburton Juveniles**

	Mean	*Range*	*Standard Deviation*
Weight (gm)	370	290 - 430	35.0
Culmen (cm)	4.1	3.8 - 4.5	0.2
Wing (cm)	27.7	25.7 - 30.0	1.1

TABLE 2 — **Mean Weights and Measurements: Juveniles and Adults**

	Culmen (cm)	*Wing (cm)*	*Weight (gm)*
69 Ashburton Juveniles	4.1	27.7	370
35 Unfledged Juveniles (Richdale 1945)	4.2	29.6	659
100 Adults (Richdale 1944)	4.2	30.4	787

The 69 starvelings in the Ashburton sample were smaller, and very much lighter, than the unfledged nestlings which Richdale measured on breeding sites in the second and third weeks of May 1941, 1942 and 1943. Differences in mean length of culmen are not significant ($p. < .05$),* but differences in mean wing length and body weight are highly significant and underline the marked immaturity and emaciation of the birds. The four larger individuals in the Ashburton series had measurements: mean culmen 4.3 cm (range 4.1 - 4.4), mean wing length 29.7 cm (29.0 - 30.0), and mean weight 540 gm (475 - 675). Their flight feathers were almost completely grown. All exceeded the weight of 455 gm which Richdale (1945:592-3) suggested as a minimum required for survival on leaving the nest, and probably approached or represented the condition of normal, well-fed juveniles on their first northward migration. The presence of four such well-nurtured birds in a group of starvelings is not easily explained, but may suggest that a few well-fed chicks in a flock of starvelings stay with the majority and

TABLE 3 — **Weights and Measurements of Juvenile and Adult Sooty Shearwater Bones**

	18 Starvelings	36 Adults	1 Heavy Juvenile
Lengths (cm) of —			
Skull:			
Mean	9.0	9.7	9.2
Range	8.5 - 9.4	9.2 - 10.9	–
Std. dvn.	.26	.31	–
Humerus:			
Mean	10.5	10.9	10.5
Range	10.1 - 10.7	9.8 - 11.5	–
Std. dvn.	.18	.31	–
Sternum:			
Mean	6.2	7.0	6.7
Range	5.8 - 6.7	6.6 - 7.3	–
Std. dvn.	.22	.20	–
Weights (gm) of —			
Humerus:			
Mean	2.2	4.1	3.1
Range	1.8 - 2.7	2.8 - 4.9	–
Std. dvn.	.34	.42	–
Sternum:			
Mean	1.4	2.6	2.1
Range	0.9 - 1.9	2.1 - 3.0	–
Std. dvn.	.24	.26	–

* Using 5% probability as a criterion

share their fate when unfavourable winds are encountered on migration. The immediate cause of their deaths was probably exhaustion and subsequent drowning.

Skeletons of eighteen starvelings and one heavy juvenile were prepared by maceration, and compared with skeletons of 36 adult Sooty Shearwaters collected from Canterbury beaches between 1960 and 1963. Table 3 summarises differences in skull length, and in length and weight of sternum and humerus. The bones of the starvelings were lighter, thinner, and generally shorter than those of the adults: in the table all differences of means in measurements of starvelings and adults are highly significant. The bones of the heavier juvenile fell within the ranges of length of starveling bones, and were intermediate in weight between those of starvelings and of adults. Proportions of calcium salts soluble in dilute hydrochloric acid did not differ significantly in adult and starveling bones.

Sterna and skulls of the lightest starvelings were completely formed, with no unaltered cartilage remaining between centres of ossification. Their fabric was thin, however, and tended to wrinkle and distort on drying. Those of the heavier starvelings, and of the well-nourished juvenile, were more substantial and could not readily be distinguished on sight from skulls and sterna of adults.

The condition of the Ashburton birds suggested that food was extremely short toward the end of the 1961 breeding season. The suggestion is confirmed by press and other reports (e.g. Bell *pers. comm;* Christchurch "Press" May 16th, 1961); adults tended to leave their nests early, the young were smaller than usual, and many were seen starving in the nests. In view of their extreme emaciation and evident immaturity it seems remarkable that many of the Ashburton birds were able to leave their nests at all, yet it is possible that more favourable weather would have allowed them to complete their migration and fatten in the feeding grounds of the northern hemisphere. The weights and measurements of starvelings quoted in this paper must approach the minimum required by a fledgling to give it even a remote chance of survival during its first northward migration.

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ABSTRACT

The weights, measurements, and general condition of a sample of storm-wrecked juvenile Sooty Shearwaters *(Puffinus griseus)* are recorded. They are believed to approach the minimal limit which will allow a fledgling a chance of survival during its first northward migration.

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