A NOTE ON THE ECOLOGY OF THE FAIRY PENGUIN

Eudyptula minor novaehollandiae (Forster 1781) in Southern Tasmania

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ABSTRACT

The ecology of the fairy penguin *Eudyptula minor novaehollandiae* is being studied in southern Tasmania. Three breeding grounds, one on a rocky shore and two in sandy situations, have been selected for investigation. Twenty-one nesting and moulting holes have been found in the former, while a total of 88 burrows has been pegged at the latter. Regular visits are being made and informatiton is being collected from these nests. Overlapping aluminium flipper rings proved unsatisfactory for banding adult and fledgling penguins and butt-ended stainless steel rings are now being tested. Young chicks are marked by punching the web of the foot. Mated pairs and birds keeping company are being sexed by the method of cloacal examination and the results indicate that the bill depth measurements of adult birds may also be used to distinguish the sexes.

INTRODUCTION

1. Aims

An extensive programme of banding and observation of the fairy penguin *Eudyptula minor novaehollandiae* is planned to cover a period of several years, with the object of studying, in southern Tasmania:

(*a*) The general breeding biology and moult,
(*b*) The seasonal movements and migratory status,
(*c*) The food cycle relationships,

of this subspecies.

2. Selection of Breeding Areas

To compare the behaviour of populations of this penguin occupying contrasting types of habitats, two separate breeding grounds, one on a rocky and the other on a sandy coast, have been selected as main study areas.

A. Breeding Grounds on the Western Shore of the River Derwent

A brief preliminary survey of the rocky coastline of the western shore of the River Derwent, between Blinking Billy Point and Lucas Point, resulted in the discovery of only two areas with a sufficiently high density of penguin nesting holes to warrant the use of the term " rookery ".

One of these breeding grounds lies at the base of the Alum Cliffs at Taronga. However its relative inaccessibility, coupled with the extensive rock-falls to which the overhanging mudstone cliffs are subject, renders this area unsuitable for detailed study.

The second breeding ground is situated at Boronia Bay, Kingston. Along a stretch of rocky shore less than a quarter of a mile long, a total of twenty-one nesting and moulting holes has so far been noted. At the time of their discovery, these contained either eggs, chicks or moulting birds and were therefore definitely occupied by penguins.

They occur as follows:

1. Between or beneath some of the larger dolerite or mudstone boulders.
2. In eroded hollows at the base of the mudstone cliffs.
3. In crevices in the cliff face.
4. At the base of a small low cove.
5. Below a fallen eucalypt.

Some are devoid of any surrounding vegetation, whilst others occur among patches of creeping plants such as *Tetragonia implexicoma* (Moq.) Hook, *Acaena anserinifolia* (Forst.) Druce and *Rhagodia baccata* (Labill.) Moq., or in thickets of the grass *Dactylis glomerata* Linn. and the shrub *Senecio lautus* Sol*.

B. Breeding Grounds on Bruni Island

1. *On the " Neck ".*

The breeding ground here extends for several miles along and beyond the narrow strip of sand dunes, which constitutes the tide-bar connecting the two halves of the island and separating the Tasman Sea from the D'Entrecasteaux Channel. The whole area is traversed by a complicated network of tracks, worn by the penguins in their continual pilgrimages to and from their burrows. These occur in large numbers, both on the actual dunes and on the relatively flat stretch of foreshore situated above the tideline on the western side and are dug out of the sand to form tunnels up to six or seven feet long. They usually extend more or less horizontally and may exhibit a pronounced right or left hand bend.

2. *On Cape Queen Elizabeth.*

In order to investigate the interspecific relationship between *Eudyptula minor novaehollandiae* and *Puffinus teniurostris* (Temminck), the mutton bird rookery on Cape Queen Elizabeth, at the north end of Adventure Bay has also been selected as a subsidiary study area.

* The nomenclature given in Curtis (1956) and Black (1929 et seq.) is followed here.

This rookery covers the lower slopes of the hillside on the south-western side of the Cape. The whole area is honeycombed with mutton bird and penguin burrows. As on the "Neck", these may be found under thickets of *Pteridium aequilinum* (Linn.) Kuhn, *Lomandra longifolia* Labill. and *Eleocharis acuta* R.Br., or among patches of *Carpobrotus rossii* Swantes, *Tetragonia implexicoma, Acaena anserinifolia* &c. Large numbers also occur in wide eroded areas, which are almost bare of any vegetation.

METHODS

1. Visits to the Study Areas

1958-59 Breeding Season and 1959 Winter Period.

A. Boronia.

After the first discovery of occupied nests in this area on January 19th, 1959, regular visits were made twice or thrice weekly and sometimes daily, to the Boronia breeding ground, up till the time of departure of the last pair of fully fledged chicks, between the 7th and 12th of April. On 14 occasions, namely on: January 19th and 31st; February 6th, 9th, 12th, 13th, 15th, 18th, 23rd and 27th; March 6th, and April 5th, 7th and 12th, the bay was reached about an hour before dusk and was left at 10.30-11.00 p.m. A number of daytime trips were also included on the following dates: January 25th and 27th; February 7th, 10th, 14th, and 28th; March 8th, 14th and 22nd; and April 4th.

Throughout the subsequent winter period visits were made to this area at infrequent intervals, mostly during the daytime, as follows: May 23rd; June 20th, August 15th (at night) and 27th, and September 13th.

B. Bruni Island: Neck.

The rookery on the Neck at Bruni Island was visited twice in January, principally for the purpose of collecting specimens for an osteological study. One trip, on January 14th, was made in the daytime, whilst the other, on January 21st-22nd, involved a stay overnight. The June long-weekend (June 13th-15th) was also spent on the island, and further observations were made both in the daytime aid at night. Another day trip was made on August 22nd.

1959-60 Breeding Season.

A. Boronia.

Since October 4th the Boronia breeding area has been visited regularly, in the daytime, every Sunday. Additional afternoon and evening visits have also been commenced. These are being made daily whenever possible.

B. Bruni Island: Neck and Cape Queen Elizabeth.

Irrespective of the weather and with only one exception (September 19th), regular daytime trips have been made to the "Neck" rookery on Bruni Island every Saturday since September 12th. The Cape rookery has also been visited at approximately fortnightly intervals since September 15th. These visits will be continued for the remainder of the season and a stay overnight will be included whenever practicable. In addition several days have been spent camping on the "Neck" rookery in November (16th-21st) whilst a similar trip is planned for December.

2. Collection of Data

Most of the data collected so far, in the three study areas, have been obtained by the regular observation of burrows or nesting holes which exhibit some signs of occupation by penguins.

A. Methods used in Identification of Burrows.

In the Boronia area a few notes have been proved sufficient to fix the position of the nesting holes. On the Bruni Island rookeries wooden stakes, painted white and bearing serial numbers, have been used to mark the burrows. Labelling has been confined to nests within a small but representative area on each rookery, which, at the time of their discovery, were actually inhabited by penguins. In both cases the total number of marked nests has been increased gradually as more birds have taken possession of empty burrows. Up to date 88 nests have been pegged in the two areas.

B. Methods used for Banding Adult and Fledgling Penguins.

1. *Temporary aluminium bands.*

A simple hand-made aluminium flipper band was designed for use as a temporary measure to provide a quick means of marking any birds found in the Boronia study area during the last stages of the 1958-59 breeding season. A strip of 20-guage metal 65 mm. long by 10 mm. wide, bearing a serial number together with the legend:

"WRITE UNIVERSITY
HOBART TASMANIA"

was bent into an overlapping shape and applied, fairly loosely, to the left flipper at the shoulder joint. The overlap was placed dorsally and faced caudally.

Altogether, between February and April, 1959, using these temporary bands a total of 30 adult and eight fledglings was ringed in or near the Boronia area.

These bands proved unsatisfactory for general use for the following reasons:

(*a*) The metal both corroded and abraded so that within six months the numbers were often indistinct and the inscription was usually illegible.

(*b*) The overlapping portion tended to cause serious abrasion of the feathers in the armpit—in most cases actually shearing them off at the base.

(*c*) The anterior and posterior edges tended to cause damage to the flipper itself, particularly at the anterior lower border. Here the excessive width of the band was probably partly to blame.

(*d*) The overlapping shape made it difficult to allow sufficient room for expansion without increasing the bulk enormously. Hence, with the storage of fat at the shoulder joint immediately prior to the moult, the affected flipper tended to become severely swollen.

2. *Permanent Stainless Steel Bands.*

F. C. Kinsky of the Dominion Museum, New Zealand, has designed a more satisfactory type of band, which he has used with considerable success on the Northern Blue Penguin in Wellington Harbour (Kinsky 1959, pp. 12-13). This band consists of a narrow metal strip, two inches long by one-quarter inch wide, and is bent to form a butt ended ring. Initially, Kinsky used the metal duralumin for his bands, but he too encountered the same problem of corrosion. In a personal communication he states that he is now testing out the efficiency of a 20-guage stainless steel. The use of this less pliable material has necessitated an alteration in the design of the ring, in that the lower anterior border now has to be rolled outwards and upwards to form a definite flange to allow for movement of the flipper. A sample band of this new type has been copied for use as a permanent right flipper ring in each of the three study areas. The metal used is a 22-gauge stainless steel, otherwise the specifications are as indicated above. The same inscription is being used as before, together with a serial number prefixed by the letter N ("Neck"), E (Cape Queen Elizabeth) or K (Boronia, Kingston). The latter series is being used to replace the temporary bands of any penguins previously marked in the Kingston area, as well as to ring any new birds encountered there.

C. Methods used for Marking Eggs and Chicks

Eggs are numbered at each end to denote the order of laying and a leather punch is used to mark the web of the foot of the first hatched chicks.

D. Data Collected from Burrows

Since the middle of August, on every visit to each of the three study areas, a survey has been made of the burrows previously marked together with those newly labelled. The following information has been collected:—

1. The number of adult birds present and from these:
   - (*a*) The serial number of the flipper band already worn or now applied,
   - (*b*) The condition of the band—especially of the inscription,
   - (*c*) The nature and amount of abrasion caused by the band,
   - (*d*) The weight of each bird,
   - (*e*) The length of its flipper, toe and bill, together with the depth of the latter.
   - (*f*) The general appearance of the bill,
   - (*g*) The condition of the cloaca,
   - (*h*) The state of the plumage and the condition of the feet, &c.,
   - (*i*) The general nature, positon, and relative number of ectoparasites—specimens being collected for identification.
2. The number of eggs present and:
   - (*a*) The appearance of each—their general shape and the amount and nature of soiling, &c.,
   - (*b*) The weight of each,
   - (*c*) The maximum length and breadth of each.
3. The number of chicks present and from these:
   - (*a*) The method previously used or now applied to mark them and its relative efficiency,
   - (*b*) The stage of development of the chick—If in primary down, whether its eyes are open and whether it is yet able to support its own head; if in secondary down, whether any bare patches occur around the eyes, or whether any blue feathers yet appear, and to what extent, &c.,
   - (*c*) The weight of each chick,
   - (*d*) The measurements of its flipper, toe and bill,
   - (*e*) The nature, position and relative number of ectoparasites.
4. The condition of the nest:
   - (*a*) The amount and position of excreta outside and inside,
   - (*b*) The condition of the 'tunnel" and of the nesting chamber itself—whether damp or dry, &c.,
   - (*c*) The nature and amount of nest material present.

E. Equipment

Owing to the length of many of the sand-dug burrows and to the inaccessibility of most of the nesting holes among boulders, some device for extracting the birds was found essential. Two different tools have been designed for this purpose. One of these consists of a 4-ft. length of hollow flexible tubing through the centre of which a double strand of brown plastic-covered wire is threaded so that it leaves an adjustable loop at one end. This can then be slipped over the head of any penguin facing the entrance of the nest. The second tool consists simply of a 4-ft. metal rod provided with a handle at one end and a hook at the other, which can be looped round the leg of any bird facing sideways or presenting its tail to the viewer.

For making the measurements listed above, a pair of 150 mm. calipers, provided with a vernier scale measuring to 0·1 mm. and a set of balance-type scales weighing up to 10 lbs in $\frac{1}{4}$ ozs. are used. Adults and older chicks must be wrapped up in a cloth bag before placing on the pan.

DISCUSSION

Observations have not yet extended over a sufficient period for any definite conclusions to be drawn, but some evidence is available to indicate a possible method of sexing adult birds which are not breeding.

1. Previous Work on Sexing

L. E. Richdale, who, in New Zealand, has carried out over eighteen years of research work on the allied genus *Megadyptes antipodes* (Hombron and Jacquinot) writes (1951, p. 107): "The only certain way of sexing the Yellow-Eyed Penguin other than by dissection, is to examine the vent of both birds of a mated pair in the span of egg deposition*.

* This is also the method adopted by Serventy (1956, p. 213) for sexing mutton birds in the field.

Both in this (op. cit. p. 109) and in his later work (1957, pp. 2-3) he claims that, by this means and with the aid of eleven further points which he uses as tentative guides, he has been able accurately to sex every yellow-eyed penguin living in his study area. In his earlier paper on the genus *Eudyptula*, Richdale (1940, pp. 180-217) does not specifically mention the problem of sexing although he refers to several of his banded birds as males or females.

P. J. O'Brien (1940, pp. 311-312) claims to be able to distinguish the sexes in the white flippered penguin *Eudyptula albosignata* Finsch chiefly by comparing the shape of the bills and the size of the white patch at the base of the tails in the adult birds. He states that in the male the beak tends to be heavier and more square at the tip, while in the female it is " usually more slender and is never as hooked as in the male ". He gives no measurements, but includes an illustration of the two forms.

F. M. Littler (1910, p. 210) likewise claims to be able to separate the sexes in *Eudyptula minor* by comparing the appearance and behaviour of the adult birds, but he gives little definite supporting evidence.

E. B. Nicholls (1918, p. 127), in his discussion of the same sub-species at Phillip Island, Victoria, also mentions a superficial difference between the sexes. He includes a table showing the culmen measurements of seven male and nine female skin specimens. In this, the bill depth measurement is certainly consistently larger in the males, but his evidence seems inadequate to justify any definite assumptions.

In a later paper, W. B. Alexander, in conjunction with Nicholls (Alexander and Nicholls 1918, pp. 54-55) tabulates, together with the above data, the culmen measurements of a further 17 skin specimens, including 12 from Victoria, 2 from New South Wales, 2 from Western Australia and 1 from South Australia. Here a considerable overlap is apparent between the sexes, but the same criticism still applies, especially as Tasmanian forms are unrepresented.

2. Results Obtained in the Present Study

Observations made on the appearance and behaviour of three juvenile penguins reared in captivity, of which two subsequently died and on dissection proved to be males, have to some extent confirmed the claims made by Littler and Nicholls. The bills of these two birds were definitely stouter and more powerful, while their heads were both larger and more square in outline than that of the sole survivor. The latter is assumed to be a female, partly because of the interest it showed in the displays* made by these two males, and partly because of its actual response to similar displays made by another older partner subsequently obtained for it. From the time of their capture as three to four-week-old chicks, the two males tended to be more aggressive than the assumed female and even after several months of constant handling were often quite vicious in their behaviour.

Since dissection is out of the question in an extended ecological study, an attempt is being made to determine the sex of as many penguins as possible, especially of mated pairs, using the method of cloacal examination. Forty-one out of the 153 adult birds, banded in the three study areas between September 12th and November 30th have been positively identified as females. In each case the cloaca has been greatly distended and inflamed during the week or so before and after egg-laying. No comparable changes have been observed in the vents of the partners of these birds. That these partners are mated pairs, has been deduced from, in 22 instances, the observation of the same two birds taking regular turns brooding the same eggs or chicks. In a further 15 cases the relationship between the pairs is more uncertain since they have only been observed keeping company. Twelve individuals have changed partners, one of them twice and in five of the nests involved in these exchanges, clutches of eggs have subsequently appeared.

In an attempt to find a method of differentiating the sexes during the remaining stages of the annual cycle, a correlation has been sought between the sex of each bird and its measurements. For this purpose three tables have been compiled (see appendix). Tables 2 and 3 give the flipper, toe and bill (length and depth) measurements of the series of 15 couples keeping company and of the 22 mated pairs incubating eggs and guarding chicks which have been sexed as indicated above. Table 1 lists the same data for the collection of 20 adult penguins, which were dissected in the course of an osteological study. In this case a number of additional measurements, namely the total, tail and tarsal lengths, together with the bill widths, are also included. These can only satisfactorily be obtained from dead specimens. In the estimation of the flipper, toe and bill length measurements, the procedure outlined by Richdale (1940, p. 200) has been followed throughout, while in the compiling of the additional data for Table 1, the standardized methods listed by Gurr (1947, pp. 59-60) have been used. Gurr's method of estimating the depth of the bill at its base was, however, found difficult to apply later out in the field. Hence the procedure outlined by Nicholls (1918, p. 119) for measuring the bill depth at the gonys, has been adopted for use on live penguins. This means that with regard to this particular measurement, the figures contained in Table 1 cannot strictly be compared with those of Tables 2 and 3. Furthermore, since the measurements for Table 1 were made using a ruler, the figures here have been corrected to the nearest whole number. On the other hand, all subsequent measurements have been made with the aid of a vernier scale, hence a greater degree of accuracy has been attained. In the case of the bill length and depth measurements listed in Table 3, estimations have been made for each bird on at least two and usually on three or four separate occasions. The figures included under the appropriate columns in this Table

* These took the form of the half and full trumpet displays described and figured for this sub-species by Warham (1958, pp. 611-612).

therefore represent the mean of two or more different readings. This also applies to several of the bill measurements listed in Table 2. The toe and flipper measurements of live birds have each been estimated only once and have been corrected to the nearest 0·5 mm.

Although the data contained in the above tables are insufficient for any definite conclusions to be reached, the following points may be noted:—

(*a*) In each table the bill depth measurements show a smaller degree of overlap between the two sexes than any of the other measurements.

(*b*) With only one exception, where a 0·1 mm. overlap occurs, in each of the pairs of birds included in Tables 2 and 3, the bill depth measurement of the female is less than that of the male. This cannot be stated of any of the other data.

(*c*) If changes of partners are as common, in the pre-egg period, as Table 2 appears to indicate, then the problem of sexing will clearly be simplified.

(*d*) A study of the bills of the 20 specimens included in Table 1 and of the 153 specimens examined in the field has not revealed any clear-cut sex difference with regard to the degree of curvature of the upper mandible, comparable with that described by O'Brien.

3. Future Work.

The collecting and assessing of data along the lines outlined above will be continued for the remainder of the present egg-laying season. When mated pairs or single birds are encountered subsequently, so that sex determination by the cloacal method is impossible, a provisional attempt at sexing will be made, to await confirmation at a later date. In the case of mated pairs, this will be based on a comparison of their bill depth measurements, in the case of single birds, the absolute bill depth measurement will be used as a guide, on the assumption that this lies within the range 11·4-13·2 mm. in females and within the range 13·0-15·6 mm. in males. In both instances the general appearance and behaviour of the birds concerned will be noted and recorded.

The extent to which the bill may continue to grow in adult penguins also requires investigation.

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REFERENCES.

ALEXANDER, W. B. AND NICHOLLS, E. B., 1918.—A Study of Australian Specimens of the Little Penguin (*Eudyptula minor*, Forster), *Emu*, 18 (1) pp. 50-57.

BLACK, J. M., 1929.—*Flora of South Australia*, Adelaide, Govt. Printer, 1st ed. (4) p. 612.

————, 1943-1948.—*Flora of South Australia*, Adelaide, Govt. Printer, 2nd ed. (1-2) pp. 36, 115, 161, 187, 287, 340.

CURTIS, W. M., 1956.—*The Students Flora of Tasmania*, Hobart, Govt. Printer, (1) p. 172.

————, Unpublished manuscript.

FORSTER, J. R., 1781.—Historia Aptenodytae. *Comm. Soc. Reg. Sci. Gött.*, 3, p. 147.

GURR, L., 1947.—Measurements of Birds. *N.Z. Bird Notes*, 2 (4) pp. 57-60.

KINSKY, F. C., 1959.—The Northern Blue Penguin (*Eudyptula minor Novaehollandiae*) in Wellington Harbour. *Proc. N.Z. Ecol. Soc.*, 6, pp. 12-15.

LITTLER, F. M., 1910.—*A Handbook of the Birds of Tasmania*, Launceston, pp. 209-212.

NICHOLLS, E. B., 1918.—An Introduction to the Study of the Penguins on the Nobbies, Phillip Island, Western Port, Victoria. *Emu*, 17 (3), pp. 118-144.

O'BRIEN, P. J., 1940.—Some Observations on the Breeding Habits and General Characteristics of the White Flippered Penguin (*Eudyptula albosignata* Finsch), *Rec. Canterbury (N.Z.) Mus.*, 4 (6) pp. 311-324.

RICHDALE, L. E., 1940.—Random Notes on the Genus *Eudyptula* on the Otago Peninsula, New Zealand. *Emu*, 40 (3), pp. 180-217.

————,1951.—*Sexual Behaviour in Penguins*, Lawrence, Univ. of Kansas Press, pp. 1-301.

————, 1958.—*A Population Study of Penguins*, Oxford, Clarendon Press, pp. 1-185.

SERVENTY, D. L., 1956.—A Method of Sexing Petrels in Field Observations. *Emu*, 56 (3), pp. 213-214.

WARHAM, J., 1958.—The Nesting of the Little Penguin, *Eudyptula minor*. *Ibis*, 100, pp. 605-616.

TABLE 1.

Table of measurements of a series of 20 adult specimens of *Eudyptula Minor Novaehollandiae,* dissected in the course of an Osteological Study.

MALES

Locality of Collection	Date of Collection	Specimen No.	Bill Length in mm.	Bill Depth in mm.	Bill Width in mm.	Middle Toe and Claw in mm.	Middle Claw in mm.	Flipper Length in mm.	Total Legnth in mm.	Tail in mm.	Tarsus Front in mm.	Tarsus Diagonal in mm.
Marion Bay	11.1.59	2	38	15	12	49	16	117	385	27	29	35
Bruni Island "Neck" ..	15.1.59	5	41	16	13	52	16	122	402	29	30	35
,, ,,	,,	7	40	16	14	50	15	122	391	30	29	35
,, ,,	,,	8	42	17	15	54	17	122	394	32	29	35
,, ,,	21.1.59	10	40	17	14	52	18	121	408	28	30	36
,, ,,	,,	12	38	15	11	50	15	120	408	29	29	35
,, ,,	,,	17	38	15	12	52	16	117	389	30	30	38
,, ,,	,,	18	40	16	14	54	18	121	390	..	..	..
Seven Mile Beach	17.3.59	19	38	15	13	50	15	119	..	..	28	34
Fulham Island	26.3.59	21	41	15	13	49	13	121	392	..	28	34
,, ,,	,,	22	40	15	14	49	15	125	408	..	28	33
,, ,,	,,	23	37	15	13	48	13	118	418	..	27	33
Maximum			42	17	15	54	18	125	418	30	30	38
Minimum			37	15	11	48	13	117	385	27	27	33
Average			39	16	13	51	16	120	399	29	29	35

TABLE 1.

Table of measurements of a series of 20 adult specimens of *Eudyptula Minor Novaehollandiae,* dissected in the course of an Osteological Study.

FEMALES

Locality of Collection	Date of Collection	Specimen No.	Bill Length in mm.	Bill Depth in mm.	Bill Width in mm.	Middle Toe and Claw in mm.	Middle Claw in mm.	Flipper Length in mm.	Total Length in mm.	Tail in mm.	Tarsus Front in mm.	Tarsus Diagonal in mm.
Bruni Island "Neck" ..	15.1.59	6	38	14	13	50	13	120	380	..	28	33
,, ,,	,,	9	38	13	13	47	14	115	375	..	27	34
,, ,,	21.1.59	11	40	14	12	47	14	112	406	30	28	33
,, ,,	,,	13	37	15	14	48	15	117	399	29	32	36
,, ,,	,,	14	35	..	11	50	15	120	385	30	30	35
,, ,,	,,	15	39	13	12	50	15	119	379	26	30	37
,, ,,	,,	16	40	14	12	48	14	118	376	28	29	32
Fulham Island	26.3.59	20	35	13	11	45	14	118	387	..	29	34
Maximum			40	15	14	50	15	120	406	30	32	37
Minimum			35	13	11	45	13	112	375	26	27	32
Average			38	14	12	48	14	117	386	29	29	34

TABLE 2.

Table of measurements of 15 pairs of *Eudyptula minor novaehollandiae* observed at least once "keeping company" and sexed by the method of cloacal examination during the 1959 egg-laying and incubation season.

MALES								FEMALES							
Locality	Dates when observed	Burrow No.	Specimen No.	Bill Length in mm.	Bill Depth (at gonys) in mm.	Middle Toe and Claw in mm.	Flipper in mm.	Locality	Dates when observed	Burrow No.	Specimen No.	Bill Length in mm.	Bill Depth (at gonys) in mm.	Middle Toe and Claw in mm.	Flipper in mm.
Bruni Is.: "Neck"	Oct. 3	1	N7	38.5	14.5	48.0	119.5	Bruni Is.: "Neck"	Oct. 3	1	*N6	41.0	13.0	47.0	120.0
,,	Sept. 12:26 ..	1	*N1	37.9	15.4	52.0	124.0	,,	Sept. 12 ..	1	N6				
	Oct. 17:24 ..	1						,,	Nov. 14:16 ..	1					
	Nov. 7:14:16:20: 21 ..	1	N1								*N59	37.3	12.6	47.0	115.5
	Nov. 28 ..	41	N102	38.2	15.0	49.0	119.5	,,	Nov. 28 ..	41	N59				
,,	Oct. 10 ..	3	N21	37.5	13.0	49.5	119.0	,,	Oct. 10 ..	3	N22	38.0	11.5	44.0	114.5
,,	Oct. 3	12	*N11	36.5	14.5	48.5	119.0	,,	Oct. 3	12	*N10	34.5	11.6	44.0	115.5
	Nov. 14:16:17:28	29							Nov. 7:16:17:21	30					
								,,	Sept. 26 ..	5					
,,	Oct. 17 ..	18	*N32	36.9	13.9	46.0	118.5		Oct. 17 ..	18	*N2	36.6	12.0	46.0	117.0
	Nov. 7:28 ..	18							Nov. 7:14:21 ..	21					
								,,	Nov. 7 ..	23					
,,	Nov. 17 ..	19	N64	36.7	13.0	48.5	113.5		Nov. 17 ..	19	N48	38.3	13.1	48.0	118.5
,,	Oct. 31 ..	20													
	Nov. 14:16:17:20	20	*N47	38.6	13.8	50.0	123.0	,,	Nov. 14 ..	20	N60	34.0	12.6	..	..
,,	Nov. 7:16:17:20	25	*N50	37.1	13.3	48.0	116.5	,,	Nov. 7:14:20 ..	26	*N51	35.1	11.6	49.0	114.0
	Nov. 28 ..	26							Nov. 28 ..	26					
,,	Nov. 19:28 ..	46	N80	40.8	13.9	47.5	116.0	,,	Nov. 19:28 ..	46	N87	37.0	13.1	49.0	120.5
Bruni Is.: Cape Queen Elizabeth	Oct. 22 ..	Q5	E16	37.9	14.1	48.0	123.5	Bruni Is.: Cape Queen Elizabeth	Oct. 22 ..	Q5	E15	36.2	12.8	46.5	118.0
									Sept. 15 ..	Q4					
	Oct. 22 ..	Q34	E14	39.6	14.0	50.5	125.0		Oct. 22 ..	Q34	E13	38.3	12.3	46.0	117.0
Kingston: Boronia	Oct. 10 ..	B1						Kingston: Boronia							
	Nov. 11 ..	B5	K7	39.3	13.6	45.5	120.5		Nov. 11:13 ..	B5					
	Nov. 26:29 ..	B6													
,,	Nov. 1:6:8 ..	B6	*K2	39.3	14.1	49.0	119.0				*K6	35.8	11.5	48.0	118.0
	Nov. 22:23 ..	B6						,,	Nov. 22 ..	B6					
	Nov. 24:26:27:30	B3							Nov. 24:26:30 .	B3					
	Maximum ..	..		40.8	15.4	52.0	125.0		Maximum ..	..		41.0	13.1	49.0	120.5
	Minimum ..	..		36.5	13.0	45.5	113.5		Minimum ..	..		34.0	11.5	44.0	114.0
	Average ..	..		38.3	14.0	48.5	120.0		Average ..	..		36.8	12.3	47.0	117.0

* In these cases changes of partners have occurred. See also Table 3.

TABLE 3.

Table of measurements of 22 mated pairs of *Eudyptula minor novaehollandiae* sexed by the method of cloacal examination during the 1959 egg-laying and incubation season.

MALES								FEMALES							
Locality	Dates when observed	Burrow No.	Specimen No.	Bill Length in mm.	Bill Depth (at gonys) in mm.	Middle Toe and Claw in mm.	Flipper in mm.	Locality	Dates when observed	Burrow No.	Specimen No.	Bill Length in mm.	Bill Depth (at gonys) in mm.	Middle Toe and Claw in mm.	Flipper in mm.
Bruni Is.: "Neck"	Sept. 12:26 ..	1						Bruni Is.: "Neck"							
	Oct. 17:24 ..	1	N1	37.9	15.4	52.0	124.0		Oct. 24:31 ..	1	N34	39.6	12.7	49.0	119.5
	Nov. 7:14:16:20	1							Nov. 7:16:17:20	1					
	21 ..	1							21:29 ..	1					
,,	Sept. 12 ..	2						,,	Sept. 12 ..	2					
	Oct. 3:17:24:31	11	N8	38.8	14.6	46.0	120.0		Oct. 3:24 ..	11	N9	36.3	12.0	48.0	118.0
	Nov. 7:16:17:20:	11							Nov. 14:16:17 .	11					
	21:28 ..	11													
,,	Sept. 12:29 ..	4						,,							
	Oct. 10:17:31 ..	4	N5	37.9	14.8	49.0	124.0		Oct. 3:24 ..	4	N17	36.5	11.7	49.0	124.0
	Nov. 7:16:17:20	4							Nov. 16:17:20 .	4					
,,	Oct. 3:17:31 ..	9						,,	Oct. 3:10:24 ..	9					
	Nov. 16:17:20:21	9	N18	39.8	14.6	50.0	124.0		Nov. 7:14:16:17:	9	N19	36.9	12.1	46.5	118.0
									20:28 ..	9					
,,	Oct. 10:31 ..	10						,,	Oct. 3:17 ..	10					
	Nov. 7:16:17:21:	10	N24	36.8	14.2	48.5	118.5		Nov. 14:16:17 .	10	N20	36.8	12.4	45.0	121.0
	28 ..	10													
,,	Oct. 3	12						,,							
	Nov. 14:16:17:28	29	N11	36.5	14.5	48.5	119.0		Nov. 7:16:17:20:	29	N53	36.9	13.1	46.5	118.5
									21 ..	29					
,,	Oct. 3:24 ..	13							Oct. 3:17:24:31	13					
	Nov. 7:16:17:21:	13	N13	38.9	13.3	49.5	122.0		Nov. 14:16 ..	13	N12	38.0	12.0	46.0	118.5
	28 ..	13						,,	Oct. 10 ..	14					
,,	Oct. 10 ..	14							Nov. 7:16:17:19:	24	N25	37.8	12.6	46.0	113.0
	Nov. 7:14:16:19:	24	N26	36.3	14.1	50.0	119.5		20:21 ..	24					
	28 ..	24						,,	Sept. 26 ..	5					
,,									Oct. 17 ..	18					
	Oct. 17 ..	14							Oct. 24 ..	18	N2	36.6	12.0	46.0	117.0
	Oct. 24 ..	21	N30	39.2	15.1	50.5	124.0		Nov. 7:14:21 ..	21					
	Nov. 7:16:17:28	21						,,	Oct. 10:24:31 ..	14	N27	35.4	12.9	49.0	123.0
,,	Oct. 17 ..	18	N32	36.9	13.9	46.0	118.5		Nov. 21:28 ..	18					
	Nov. 7:28 ..	18						,,	Oct. 24 ..	20					
,,	Oct.24 ..	20							Nov. 17 ..	33	N36	36.1	11.9	49.5	116.0
	Nov. 16:17:19:	33	N35	40.8	14.1	49.5	123.5		Nov. 19 ..	39					
	20:21:28 .	33													
,,	Oct. 31 ..	20						,,	Oct.31 ..	20					
	Nov. 14:16:17:	20	N47	38.6	13.8	50.0	123.0		Nov. 16:17:20:	20	N46	36.7	12.7	43.0	114.5
	20 ..	20							21:28 ..	20					
,,	Nov. 7:16:17:20	25						,,	Nov. 7:14:16:17:	25					
			N50	37.1	13.3	48.0	116.5		20 ..	25	N49	37.0	12.5	48.0	112.0
	Nov. 28 ..	26													
,,	Nov. 17:28 ..	26	N63	40.7	14.6	47.0	118.0	,,	Nov. 7:14:20:28	26	N51	35.1	11.6	49.0	114.0
								,,	Oct. 3	12					
,,	Nov. 16:17:20:28	30	N61	39.9	15.1	50.0	119.5		Nov. 7:16:17:21	30	N10	34.5	11.6	44.0	115.5
,,	Nov. 16:17:20:	34													
	21:28 ..	34	N62	40.8	14.8	49.0	124.0	,,	Nov. 19:20:21 .	34	N72	37.0	12.5	49.0	124.0
,,	Nov. 17:20:28 .	36	N67	37.7	13.1	49.5	118.5	,,	Nov. 19:21 ..	36	N84	37.6	12.7	45.5	117.0
,,	Nov. 17:19:20:	38													
	21:28 ..	38	N71	38.6	13.5	48.6	119.5	,,	Nov. 17:28 ..	38	N70	36.5	12.6	50.0	114.5
,,	Nov. 19.20:28 .	39	N74	42.5	15.2	50.0	118.5	,,	Nov. 19.21 ..	39	N73	35.8	11.4	49.0	117.5
,,	Nov. 19:28 ..	45	N79	39.7	13.8	50.0	117.5	,,	Nov. 20:21 ..	45	N92	35.9	11.7	47.0	112.0
Kingston: Boronia	Oct. 18 ..	B3						Kingston: Boronia	Oct. 18:25 ..	B3					
	Nov. 1:6:8:24:	B3													
	26:27:30 .	B3	K2	39.3	14.1	49.0	119.0		Nov. 6	B3	K1	35.9	12.9	47.5	120.0
	Nov. 22:23 ..	B6													
,,	Nov. 6:11:18:23:	B4						,,	Nov. 6:8:12:13:						
	25:27:30 .	B4	K5	40.7	15.4	48.5	122.5		15:22:24:26:29	B4	K4	35.8	11.8	48.0	121.5
	Maximum			42.5	15.4	52.0	124.0		Maximum			39.6	13.1	50.0	124.0
	Minimum			36.3	13.1	46.0	116.5		Minimum			34.5	11.4	43.0	112.0
	Average			38.9	14.3	49.0	120.5		Average			36.6	12.2	47.0	118.0

TABLE 4.

Additional Data Obtained from Six Late Laying Pairs of *Eudyptula minor novaehollandiae*, sexed by the method of cloacal examination during the month of December.

MALES								FEMALES							
Locality	Dates when observed	Burrow No.	Specimen No.	Bill Length in mm.	Bill Depth (at gonys) in mm.	Middle Toe and Claw in mm.	Flipper in mm.	Locality	Dates when observed	Burrow No.	Specimen No.	Bill Length in mm.	Bill Depth (at gonys) in mm.	Middle Toe and Claw in mm.	Flipper in mm.
Bruni Is.: "Neck"	Oct. 10:24 ..	8	*					Bruni Is.: "Neck"	Oct. 3:17:31 ..	8	*				
"	Nov. 7:14 ..	28	N23	43.2	15.6	54.0	124.0	"	Nov. 7 ..	28	N16	34.4	12.1	..	118.0
								"	Dec. 5 ..	28					
"	Oct. 17:24 ..	17						"	Oct. 31 ..	17					
	Nov. 7:16:17 ..	17	N31	37.7	14.7	51.0	118.0		Nov. 14:16:17	17	N45	35.9	13.2	47.0	121.5
	Nov. 21:28 ..	17													
	Dec. 19:25 ..	17							Dec. 5:25:28:29	17					
"	Oct, 17:24 ..	19	*					"	Oct. 24 ..	19					
	Nov. 14:16:17:20	32	N33	37.8	13.3	49.0	121.5		Nov. 14:16:20	32	N40	36.8	12.8	47.5	112.0
									Dec. 5:28 ..	32					
"	Nov. 19:21 ..	41	N75	36.0	13.2	47.5	118.5	"	Nov. 20 ..	41	N93	38.8	12.6	46.5	116.0
	Dec. 5:28:29	41							Dec. 5:12:19:25	41					
"	Dec. 5 ..	53	*N113	37.8	14.6	..	..	"	Dec. 5:12 ..	53	*N111	37.1	12.9	..	..
								"	Oct. 18:25 ..	B3					
									Nov. 6 ..	B3					
"	Dec. 4:6:11 ..	L1	K14	38.9	13.8	44.0	117.5		Dec. 4:8 ..	L1	*K1	35.9	12.9	47.5	120.0
	Dec. 13-18:31 ..	L1													
	Maximum			43.2	15.6	54.0	124.0		Maximum			38.8	13.2	47.5	121.5
	Minimum			36.0	13.2	44.0	117.5		Minimum			34.4	12.6	46.5	112.0
	Average			38.6	14.2	49.0	120.0		Average			36.5	12.7	47.0	117.5

*These birds subsequently disappeared or deserted their nests.

ADDITIONAL DATA.

Further data obtained between December 5th and March 5th has confirmed the relationship between 15 of the 22 pairs assumed to be mated and listed in Table 3. Three of the remaining seven pairs (N1 and N34, N49 and N50, K1 and K2) deserted their eggs in November and subsequently changed partners, while four apparently lost their mates. N36 was found dead(and her sex was confirmed by dissection) on November 19th. Several bands, including that of N18, were found opened and discarded early in December. N17, N67and N84 disappeared at the same time. During the following weeks further desertions and disappearances occurred in one particular section of the Neck study area. Burrows 18, 20, 21, 24, 38, 39 and 45 were among the nests involved.

An additional six pairs of birds were sexed in December, in four cases (N16 and N23, N45 and N31, N93 and N75, K1 and K14) upon the laying of a second clutch of eggs. The data obtained from these late layers is tabulated below (see Table 4). The bill depth measurement of each of the six females is again considerably less than that of her partner.