THE WANDERING ALBATROSS (Diomedea exulans): RESULTS OF BANDING AND OBSERVATIONS IN NEW SOUTH WALES COASTAL WATERS AND THE TASMAN SEA

By J. D. GIBSON

Presented at the Eleventh Pacific Science Congress of the Pacific Science Association, held at the University of Tokyo, Japan, August-September, 1966, and organized by the Science Council of Japan

SUMMARY

The albatrosses occurring in Australian seas are briefly enumerated noting the predominance of different species in different regions.

The development of an effective method of catching Wandering Albatrosses at sea is mentioned, by means of which over 1700 have been banded (up to 1966). Data on weights and measurements are given.

Most of the 61 recoveries of *exulans* have come from South Georgia, a distance of over 7000 miles, where British and American biologists have been active for several seasons. Reciprocal recoveries have also been recorded of birds banded at South Georgia. Other returns have proved that individuals from Kerguelen, Marion and Auckland Islands are present off New South Wales in winter.

The high rate of retraps at the place of banding indicates a facility for precise navigation and suggests an ordered migration pattern to remembered feeding areas between breeding seasons.

Tasman transects are examined and related to hydrological factors. A field method for recording plumage patterns is described and the sequence of plumage change, based on individual retraps, is discussed.

INTRODUCTION

Through its magnificent size and absolute mastery of the elements the Wandering Albatross never fails to excite the beholder. Fact and legend have combined to make it the best known seabird although its circumpolar range is restricted to the southern latitudes, generally between 30° and 60°.

They nest on sub-antarctic islands around the world which are mostly remote, inhospitable and suffer little interference from man, so much so that it is only comparatively recently that details of their unusual two-yearly breeding cycle have been properly recorded. The courtship dance of the Wanderer, like that of the other giant albatross (the Royal) is fittingly impressive. The two species resemble each other in appearance and general behaviour but the Royal breeds only in the New Zealand region and apart from the coast of Argentina is rarely found outside the southern Pacific.

With the exception of one or two historical records, it is only in the last few years, through the banding of large numbers, that factual evidence on their global movements has started to accumulate.

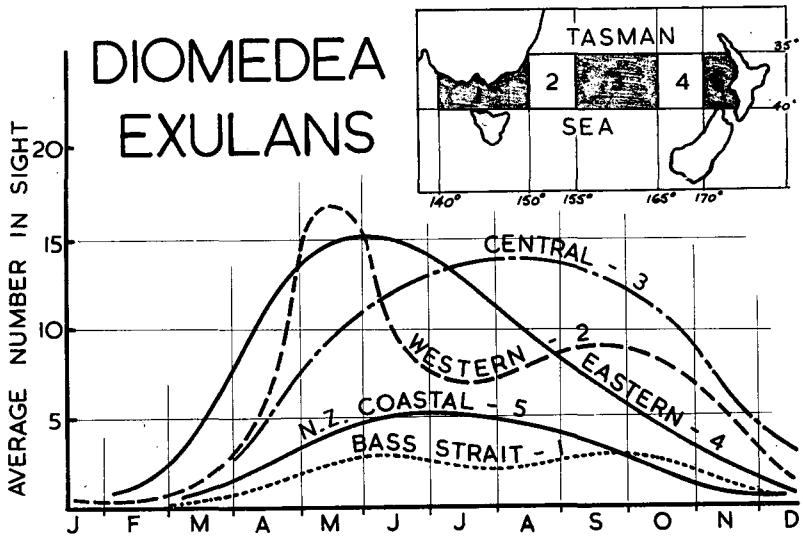


Fig. 1 — Monthly abundance of **D. exulans** in the Tasman Sea.

DISTRIBUTION OF ALBATROSSES AROUND THE AUSTRALIAN COAST

Although only the Shy Albatross (*Diomedea cauta*) breeds in Australian waters, all southern hemisphere representatives of the group have been recorded there. The numbers are low during the southern summer when most have resorted to breeding islands or are ranging in higher latitudes. In the cooler months several species are regularly to be seen in coastal waters showing varying preference for different regions. Some are only casual visitors and none frequents the northern coasts.

Considering the seas surrounding the southern half of Australia and taking the species in probable order of abundance, their winter distribution is as follows:—

Diomedea melanophris. The Black-browed Albatross is probably the most numerous and is present in all areas. It is the species most likely to be seen in the Great Australian Bight and, with *D. exulans,* in the off-shore waters of New South Wales.

Diomedea exulans. The Wandering Albatross is present in all areas but heaviest concentrations occur in the western Tasman, particularly near the coast.

Diomedea chlororhynchus. The Yellow-nosed Albatross is by far the commonest species on the Indian Ocean side but it extends in diminishing numbers to the Tasman Sea and has been taken, rarely, in New Zealand.

Diomedea cauta. The Shy (White-capped) Albatross breeds on islands off Tasmania and hence is the common albatross of Bass Strait and

coastal Victoria. It is sometimes numerous in the eastern part of the Bight and off the southern coast of New South Wales and occurs occasionally off the west coast. Sub-species from the outlying islands of New Zealand, particularly *D. c. salvini,* probably occur sparingly in Australia waters.

Diomedea chrysostoma. The Grey-headed Albatross is seen regularly in the west and south and there are two specimens from N.S.W. beaches.

The two Sooty Albatrosses, *Phoebetria fusca* and *P. palpebrata,* are represented by occasional storm derelicts while the Royal Albatross (*D. epomophora*) and Buller's Albatross (*D. bulleri*), both New Zealand birds, normally disperse into the southern Pacific and have been recorded twice and once respectively.

BANDING OPERATIONS AND TECHNIQUES

The comparatively dense concentrations of *exulans* and *melanophris* which occur off New South Wales, mainly within sight of the coast, seem to be unique for such temperate latitudes. The food attraction for both species is the large cuttlefish *Amplisepia verreauxi* supplemented near Sydney by meat processing wastes etc. from a particular sewage outfall. Schools of dolphins (*Delphinus delphis*) materially assist in making many cuttlefish available to the albatrosses by virtue of their habit of killing more than they require for food.

The physical structure of the great albatrosses is such that it is seldom easy for them to take off from the surface of the water and is often impossible in calm conditions after they have recently fed. This fact, plus its numerical availability from mid June to mid September, determined the Wandering Albatross as the subject for a special banding study and led to the development of a netting technique and the formation of the New South Wales Albatross Study Group which commenced operations in 1956 and has been active every winter since 1958 (Gibson and Sefton 1959, 1960; Gibson 1963).

Throughout the project banding material has been supplied through the Bird-banding Scheme of the C.S.I.R.O. (Commonwealth Scientific and Industrial Research Organization) which records and co-ordinates all such work in Australia. Up to 1963 size 14 butt-end aluminium bands (16 mm. x 19 mm. I.D.) were used but evidence was obtained that some of these were being lost and that the rate of wear was excessive for the useful life required of them, 5% by weight being lost every two years and most of the wording becoming illegible after 10 years. This problem seems to have been overcome by changing to similar bands made from monel metal.

Banding has been done at two centres, Malabar (near Sydney) and Bellambi (35 miles south) where additional data on plumage, measurements and weights have been collected.

Up to 1966 over 1700 Wandering Albatrosses have been banded at these centres plus an incidental number of Giant Petrels (*Macronectes giganteus*), and mollymawks.

[V. Woods

Plate I — Wandering Albatross caught for banding, N.S.W. coast.

RESULTS

Weights and Measurements

Early opportunity was taken to weigh and measure the wingspan and culmen of reasonable samples. The results, of necessity, are unrelated to sex, age or origin.

Weight (108 in sample): maximum 25 lbs. (11.3 kgs.); minimum 13 lbs. (5.9 kgs.); average 18 lbs. (8.3 kgs.). On another occasion a bird known to have come from South Georgia was weighed at 27 lbs. (12.2 kgs.).

Wingspan (119 in sample): maximum 10′ 7¼″ (323 cm.); minimum 8′ 11″ (272 cm.), over 50% falling between 9′ 9″ and 10′ 2″.

Length of exposed cumen (243 in sample): maximum 176 mm.; minimum 138 mm.

Excluded from the above is a single specimen significantly smaller than any measured here or recorded in literature elsewhere (weight 12 lbs. (5.4 kgs.), wingspan 8′ 4¾″ (256 cm.), culmen 131 mm.). This was considered to be freakishly undersized though the possible existence of a smaller undescribed race (Gibson and Sefton, 1960) or even species (Bailey and Sorensen, 1962) has been recognized.

Retraps

An unexpectedly high rate of retraps has been maintained. At one centre (Bellambi) in 1966, 30% of the albatrosses caught had previously been banded in the same small area of ocean while approximately 25% of the birds banded in any one year are retrapped at least once within seven years.

The two N.S.W. banding centres are only 35 miles apart yet analysis of retrap data indicates a definite tendency of particular individuals to patronize one place. The suggestion has been put forward (Tickell and Gibson, awaiting publication) that young birds in their roving years encounter favourable feeding areas which are remembered and become routine stages in later migrations.

Traffic of D. exulans between Australia and South Georgia

The first long distance return of a Wanderer banded in N.S.W. was from South Georgia, probably the largest breeding ground of the species and involving a journey in the albatross latitdues of over 7000 miles. This resulted from a visit to that island by the South Georgia Biological Expedition 1958-59 (Tickell and Cordall, 1960) whose work, which included a study of *exulans,* was continued in a series of expeditions through the U.S.A.R.P.* Bird Banding Program (Tickell 1962, Tickell *et al,* 1965). To 1965, 50 N.S.W. birds have been recorded 90 times at South Georgia and 12 have made the passage both ways. One bird (140-02800) "was first seen off New South Wales in July 1959 and by 1961-62 it was present at Bird Island, South Georgia. The following July it was back in Australia and, although we have no record of it anywhere in 1962-63, it was again in Australia in July 1963 but had returned to South Georgia by the following summer, 1963-64." (Tickell and Gibson). The many returns from South Georgia are the result of intense field work there and are not necessarily indicative of a preference for N.S.W. winter feeding areas by South Georgian birds.

* United States Antarctic Research Program

The South Georgian expeditions have banded over 6000 Wanderers and since 1959 thirteen of these have been caught off New South Wales.

Other Recoveries

Apart from the South Georgia recoveries, six have been reported from the southern coasts of Australia or adjacent seas, one from the southern extremity of New Zealand, five from breeding islands in the Indian Ocean (Kerguelen 2, Crozet 1, Marion 2) and one from the Auckland Islands. These recoveries and the range of dimensions given above are probably sufficiently distributed to show that the winter population of coastal N.S.W. and the western Tasman Sea has representatives from all the nesting islands.

ABUNDANCE OF *D. EXULANS* IN THE TASMAN SEA

Observations on the varying abundance of Wandering Albatrosses in the waters between Australia and New Zealand have been made by J. A. F. Jenkins (unpublished) which indicate a high density during the southern winter and spring. Between 1960 and 1964 Jenkins made 28 Tasman crossings and many coastal voyages off south-eastern Australia and New Zealand on all of which he systematically recorded, at four-hourly intervals, the weather conditions, number of Wanderers in sight and their plumage patterns using a version of the plumage key (Fig. 2) modified for shipboard observations. Crossings were made in all months except January and February and the result is a very useful record of the seasonal relative abundance between 35°S and 40°S latitude (Fig. 1). For analysis this broad transect is arbitrarily divided into five sections — Bass Strait, Western Tasman, Central Tasman, Eastern Tasman and New Zealand Coastal.

From December to March minimal numbers are present in all areas, more inhabiting the Eastern Tasman than elsewhere. The numbers in Bass Strait and Victorian coastal waters remain fairly constant, at a slightly higher level, for the remainder of the year with no evidence of 'funneling' through the Strait at any season.

The distribution of seabird species being generally determined by the availability of their preferred food and this being inevitably linked with hydrological factors, some correlation might be expected between the observed annual distribution pattern and the circulation of surface water masses. Interpreting the distribution graph in the light of such data (Wyrtki 1960, Rochefort 1954, Hamon 1961), movements in this area appear to be as follows:

(1) Northward penetration commences in the Eastern Tasman during March probably directed towards suitable areas west of the North Island of N.Z. Maximum density occurs in May/June coincident in this area with a period of divergent activity in the surface flow of water masses which are of sub-antarctic origin. This divergence probably causes some upwelling.

(2) In the Central Tasman maximum numbers are not present until July-September, at which time the subtropical convergence has moved to its most northern position placing most of the area under sub-antarctic influence. The increasing numbers here coincide with a decline in the Eastern Tasman probably indicating a westward shift of population preceding a general southerly withdrawal.

(3) Furthest northward penetration is achieved by the element entering the Western Tasman whose northern and southern movements probably produce the bimodal curve in Fig. 1. The majority of this group is apparently heading for preferred areas off the N.S.W. coast e.g. the Sydney region where maximum numbers are observed from mid June to mid September. The East Australian Current brings tropical water down the western Tasman but during maximum albatross density its southern extent is weakest and a strong divergent flow pattern develops off N.S.W. This occurs when the current deflects away from the coast and is sometimes accompanied by upwelling. Coastal sea water temperatures at this time vary from 58°F to 62°F (14½°C to 16½°C).

Further northward movement involving progressively smaller numbers presumably occurs, some birds reaching the tropics as indicated by records at Whitsunday Passage (Queensland, 20°S) in September, New Caledonia (22°S) in August and 400 miles south of Fiji (24° 05'S) also in August. In the mid South Pacific it has been observed 300 miles south of Pitcairn Is. (29° 20'S) in October. With few exceptions the northern limit approximates the 70°F (21°C) sea surface isotherm.

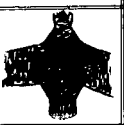
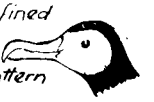
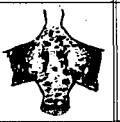
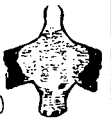
The lower Tasman Sea probably supports a denser Wandering Albatross population than other oceans from which comparable data are available. Whereas Dixon (1933) during twenty-five years of voyaging in southern oceans only saw 10 or more together on 25 occasions, Jenkins' log shows that on Tasman crossings the *average* number in sight exceeds 10 at any time from May to August and up to 50 have been observed together.

PLUMAGE DEVELOPMENT

Method of Recording. The handling of large samples of *exulans* provided the opportunity of collecting data on plumage patterns for which a convenient method of recording was desirable. A system has been adopted which considers four aspects of the dorsal surface in comparison with a standard plumage chart (Fig. 2) each area being given an appropriate number. The areas considered are back, head, inner wing and tail. This reduces the general appearance of the bird to a four figure reference which is easily recorded and comparable with the appearance on subsequent retrappings. Subjective variation in ascribing an observed condition to a particular number has been minimized by one person being responsible for all recording.

Results. More than 600 Wanderers have now been examined with special reference to plumage and over 100 of these have been examined more than once at intervals of up to six years. Something may now be said about the observed changes though it is realised that the limits imposed by working with birds of unknown age, sex or origin randomly taken at sea leave most problems still to be solved by long term studies at breeding grounds, e.g. plumage/age relationships, racial differences, sexual dimorphism, moult, etc. From published data it would appear that some breeding populations do not attain the whiteness of others (notably Campbell Island) but the numbers examined are very small and may represent relatively young birds. It has also been recorded that females do not become

PLUMAGE KEY *Diomedea exulans* D.G. 6/5/60

BACK		HEAD	
1 All brown		1 Sharply defined brown juvenile pattern	
2 Mottled brown & white with some pencilling throughout		2 Juvenile pattern Still easily discernable	
3 Mostly white & pencilled with some dark feathers on lower back.		3 Some dark feathers in crown & nape	
4 Pencilled all over (4H = heavy & distinct pencilling)		4 Separated dark crown	
5 Faint pencilling, or traces thereof.		5 Traces of dark feathers in crown (5P = traces of pencilling)	
6 White		6 Pure white crown	

INNER WING		TAIL	
1 All dark		1 All dark	
2 A few white feathers		2 White & dark	
3 Distinct white patch at elbow		3 Few dark tips	
4 White patch merging with white of back		4 Pure white	
5 Mostly white			

N.B.—Intermediate stages recorded thus: 3, 3+, 34, -4-, 4 4+ 45

Fig. 2 — Key used for recording plumage of **D. exulans** while banding.

as white as males. Males, as a rule, mate with less-white females but the possibility that this could be an inherent pairing preference giving the impression of sexual dimorphism while a similar plumage progression is taking place, should be well considered.

The order of change is shown in Fig. 3, which also indicates typical plumage states and their percentage distribution. Characteristic are the appearance of white mottling first on the back, the development of a distinct white patch at the humeral flexure of the wing which later coalesces with the white back, and the presence of a vermiculate pattern on some dorsal feathers on all except very white (presumably old) birds and dark plumaged immatures. This pattern, particularly on the mantle, sometimes regresses temporarily to an earlier, darker condition but the general development of all areas is towards increasing whiteness. The bracketed references relate to Fig. 2.

Back. The solid dark brown back of the fledgling bird (1) becomes interspersed with some white or barred feathers increasing until, at a distance, the mantle appears more or less uniformly mottled (2). The dark feathers become confined to the lower back and rump (3) and ultimately disappear leaving the whole area heavily vermiculated (4H). This pattern is retained but the barrings become finer and paler (4), subsequent moults however may restore the former pattern (4H). Eventually the barrings become discontinuous and are only seen when closely examined (5) while a few individuals achieve immaculate whiteness (6).

Head. The development of the head and neck pattern, though generally towards whiteness, at times shows a temporary regression to an earlier, darker condition. Typically the solid juvenile pattern (1) becomes mottled and less distinct (2 to 3). In about 30% of birds a conspicuous dark crown develops but in all documented instances this has deteriorated usually to a few barred feathers 5 or 5P) and sometimes entirely disappeared. This is evidently not a permanent characteristic and there is little to suggest that it is exclusively a female one. Individuals with traces only of dark feathers in the crown comprise about 40% of the population at any time while only about 10% are perfectly white when closely examined.

Wing. The appearance of white feathers on the upper wing follows their appearance on the mantle. The beginning of a white patch opposite the humeral flexure soon becomes apparent and enlarges to a distinctive feature (3) exhibited by over 25% of all birds. Further whitening may then occur connecting this patch with the back and increasing until dark areas are confined to the wing tips beyond the carpal flexure and the trailing edge decreasing proximally. Some spotting persists on the outer secondary coverts and on a row of major coverts in the humeral segment. Some birds with maximum white development in the wing have this area, as well as the entire dorsal surface, covered with fine barring.

Tail. The originally dark rectrices are gradually replaced with white or dark-tipped feathers, the latter persisting longest in the outermost positions and ultimately disappearing to give the pure white tail exhibited by 6% of the population examined.

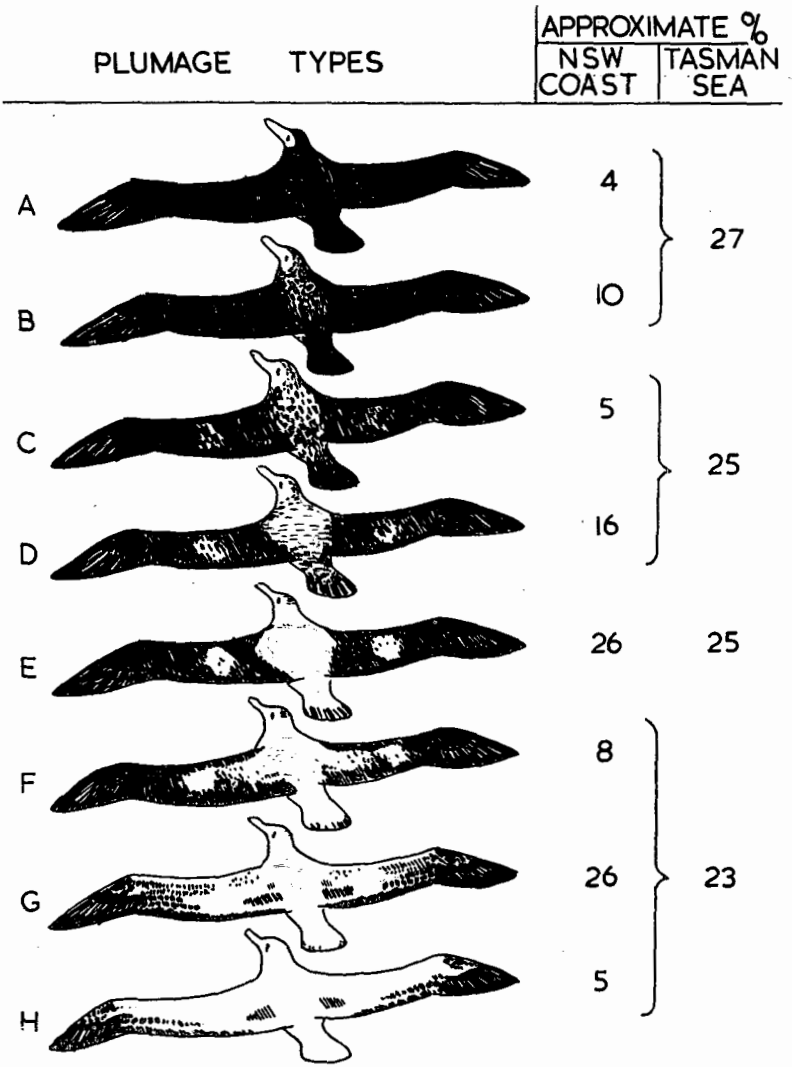


Fig. 3 — Plumage types of **D. exulans** and their relative abundance.

The dusky ventral surface of the body soon turns white on the belly followed by the neck and under tail coverts. The breast plumage, particularly at the sides, is last to change. The underwing remains constant throughout life — white lining with dark tips and narrow trailing edge.

Despite the numerous short term changes it has been possible to record, the overall problem of plumage development is still a perplexing one. Figure 3 is a complete picture derived from the collected data which indicate broadly that one state progresses to the next. Some, however, have shown little or no change over five years, suggesting that further development is sometimes temporarily or permanently arrested.

Age Groups. There is an interesting comparison to be made between the plumage patterns of birds encountered in the Tasman proper and those at coastal feeding stations off New South Wales. In the open sea there are approximately twice as many predominantly dark ("young") birds and approximately half as many very white ("aged") birds as occur on the coast. This situation appears to reinforce the theory, mentioned earlier, of birds accumulating experience of good feeding grounds during random wanderings in early life to be later consolidated into routine migratory behaviour.

Almost the first question asked and the last that can be answered is "how long do Wandering Albatrosses live?" The rate of plumage development is extremely slow, making it quite conceivable that breeding could take place in the darker phases. About 5% achieve the extreme whiteness indicated by plumage H in Fig. 3. Is this the ultimate state reached by all individuals if they survive long enough? In any case it should not be surprising if they approached the longevity of man.

Mystery remains in this, as in many other aspects of the life of this fabled bird. Some secrets have been revealed but many more remain to intrigue and challenge our curiosity.

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