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Plumages of northern (*Diomedea sanfordi*) and southern royal (*D. epomophora*) albatrosses observed in Chilean seas in September 2004

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Abstract The 2 species of royal albatrosses, the southern (*Diomedea epomophora*) and northern (*D. sanfordi*), breed only in New Zealand, but adults and juveniles are common off the western coast of South America. They can be separated on their plumage at sea. This paper examines the variation in plumages of the royal albatrosses seen in southern Chilean shelf waters at 46°30′S, based on a series of photographs taken in Sep 2004. *D. sanfordi* were identified by the uniformly black dorsal surface to their wings, and by the absence of a white leading edge to the wing in flight. In contrast, most individuals of *D. epomophora* had a white leading edge to the humeral and radial section of the wing and generally white flecking on the upper surface of the wing. However, some individuals identified as *D. epomophora* had no white on the leading edge nor any white on the dorsal surface of the wing. The black carpal patch near the leading edge of the ventral wing surface was variable in occurrence and was not considered diagnostic. *D. epomophora* out-numbered *D. sanfordi* by *c.*9 to 1 in southern Chilean coastal seas in Sep 2004. Most *D. sanfordi* may have left the area by Sep, moving either to the Patagonian shelf, or to Australasian seas.

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INTRODUCTION

The 2 species of royal albatrosses, southern (*Diomedea epomophora*) and northern royal albatrosses (*D. sanfordi*) (Robertson & Nunn 1998) breed only in New Zealand, but they are well known in South American seas (Murphy 1936; Marchant & Higgins, 1990). Robertson & Kinsky (1972) correctly predicted that the species had a circumpolar distribution outside the breeding season, but it has only been with the advent of satellite telemetry that the nature of these circumpolar movements could be clarified for adult (*D. sanfordi*) (Robertson & Nicholls 2000; Robertson & Nicholls 2004; Nicholls et al. 2005). In their sabbatical year, there were flights direct to South America, when most birds remained on the Patagonian Shelf off Argentina (but one in five birds, over wintered on the Chilean continental shelf). The flights continued eastward, round-the-world, to bring the birds into New Zealand seas late in the same year.

Young birds of the year leave the breeding colony in the southern spring; the mean fledging date for *D. sanfordi* is 22 Sep, and 28 Oct for *D. epomophora* (Marchant & Higgins1990). Analysis of banding recoveries shows that immediately after fledging, juvenile *D. epomophora* disperse to New Zealand waters initially, then move east to Chile in Dec-Apr (Robertson & Kinsky 1972; Moore & Bettany 2005). Immature (20 months - 5 years) and adult birds (≥6 years) are observed occasionally in Chilean waters, but most band recoveries have been from Argentina and the Patagonian Shelf from Dec to Oct (Robertson & Kinsky 1972; Moore & Bettany 2005). Movements of immature *D. sanfordi* are less well known.

The great albatrosses (the various wandering albatrosses and the 2 royal albatrosses) were poorly distinguished at sea until relatively recently. However, with the advent of field identification guides (e.g., Harrison 1985), and the refinement of characters considered useful for field identification (e.g., Marchant & Higgins 1990), these species are regularly distinguished by observers. Both royal albatrosses are very large seabirds with a white head, neck, body (except the back in 1st year birds), and tail (in all but the youngest). *D. epomophora* has a black upper wing that becomes progressively whiter with age. Unlike in the wandering albatrosses, the white plumage in the upper wing develops 1st at

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the leading edge and progresses backwards across the wing towards the trailing edge. Harrison (1979) devised a series (1-5) of stages to classify the development of the white in the upper wing of *D. epomophora*: this is dealt with *in extenso* in Marchant & Higgins (1990). *D. sanfordi* has an entirely black upper wing, and there is no visible white leading edge in flight. However, Marchant & Higgins (1990) describe a white line extending along the front of the wing in *D. sanfordi* and suggest that birds sitting (on land or on the sea) may show a narrow white margin extending from the body to the elbow along the leading edge of the folded wing.

Similar plumage stages have been described for wandering albatrosses. These have been summarised as Gibson Scores (Gibson 1967; Tickell 2000), which have been related to age in some taxa of wandering albatrosses, but not for royal albatrosses (Tickell 2000). It has been presumed that the plumage whitens with age in *D. epomophora* as it does in the various wandering albatrosses. *D. sanfordi* develops an all-white back after 1st displaying broad brown-black vermiculations to the white feathers of the lower back when juvenile (Marchant & Higgins 1990).

In this paper, I describe and illustrate the plumages of royal albatrosses visiting Chilean waters during Sep 2004, and discuss aspects of the features distinguishing the 2 species. The observed plumages allow an assessment of the proportions of the 2 species and the ages of birds of both species present off the Chilean coast in the southern Spring.

METHODS

Opportunities for observing birds at sea off Chile are limited, but these observations were made during a 3-week trip on a Chilean 17 m fishing vessel sailing from Quellón, Chileo, Chile, which was catching golden ling (congul: *Genypterus* spp.). The vessel was engaged in fishing off Tiatoa Peninsula (46°30′S), and remained on station until the hold was full. Fishing proceeded whenever the weather and seas were suitable, but the frequent rough seas meant that the vessel sheltered in an inlet of the peninsula for days at a time. The demersal long lines were set in water depths of 250-500 m, which were usually reached 1 h out of the inlet, at *c.*46°30′S. As the lines were set, the number of royal albatrosses around the ship increased; when the lines were raised, the number of birds increased further, to a maximum of 16. The offal was discarded as the vessel moved either to a new line set or haul site, or returned to shelter in the inlet. Although other artisan vessels were fishing in the area, they were seen only during travel to the fishing grounds. There were factory vessels fishing in the area also, but these operated further out to sea or were steaming when encountered.

Observations on the number of birds sighted were made following protocols used by the Australian Antarctic Division (Woehler 1997). *D. sanfordi* and *D. epomophora* were counted separately, although counts earlier in the voyage were less accurate because my ability to distinguish the species improved during the trip. These counts will be reported elsewhere.

Digital photographs (Canon® EOS 300D camera; Canon® 100-300 mm f5.6 L series lens) were taken during the 50 min alternating with the 10-min hourly count period. Two Compact Flash (CF) cards totalling 1.5 Gb were available for digital data storage. At the beginning of the cruise, photographs were stored as 1Mb jpg files but when the trip was prolonged, the photographs were reduced in quality to 0.5 Mb jpg files. The photographs were imported into Macintosh OS i-Photo® software: some were enlarged and cropped and the brightness or contrast adjusted to clarify underwing or back plumage patterns. After scoring, problematic instances were examined further on screen at a higher resolution.

Most photographs were single images of a single bird, but infrequently, 2-3 photographs taken manually in quick succession of a bird as it flew past or circled the ship, sometimes with photographs of other individuals in the sequence. The photographs could not, therefore, be allocated definitively to specific individuals so the proportions of plumages given here are from counts of photographs. A few individuals will have been scored more than once.

As noted above, up to 16 birds were in sight from the vessel at once. The impression at the time, supported by inspection of the photographs, was that different individuals were seen during separate fishing hauls each day, and certainly on different fishing days, which were often several days apart. Individuals that were conspicuous because of distinct plumage, injury, or a band were seen only on single days, confirming a high turnover of birds. This observation regime differed from that used on continuous at-sea operations of factory vessels and during 1-day "pelagic" observation cruises, during which prolonged observations are made of a few individuals on multiple passes.

Dark-winged (*D. sanfordi*) albatrosses were the initial focus of the study, but it was soon apparent that many immature *D. epomophora* were present, so I then aimed to get a representative sample of all plumage types. There were instances of 2 birds in a photograph (both being scored), but the total number of individual birds assessed was likely to be only less than, or similar to, the number of photographs. Inspection of the photographs showed that most were of different individuals. I believe that very few birds are scored more than once so that the proportions of the plumage scores reported here reflect those of the birds present in the area.

Plumages were assessed for 3 body positions of birds in the photographs: birds flying, with upper

Table 1 Contingency analysis (Count (%)) of leading edge index (see text) of northern (*Diomedea sanfordi*) and southern (*D. epomophora*) royal albatrosses by plumage stage (Harrison 1985) of the rest of the wing. Percentages are proportion of total sample (n = 64). nr, not recorded.

	Leading Edge Index score					
Wing stage	0	1	2	3	4	Totals
0	6 (9.4)	1 (1.6)	1 (1.6)	6 (9.4)	nr	14 (21.9)
0.5	6 (9.4)	2 (3.1)	7 (10.9)	10 (15.6)	nr	25 (39.1)
1	1 (1.6)	1 (1.6)	5 (7.8)	4 (6.2)	1 (1.6)	12 (18.7)
2	1 (1.6)	nr	5 (7.8)	5 (7.8)	nr	11 (17.2)
2.5	nr	nr	nr	nr	2 (3.1)	2 (3.1)
Totals	14 (21.9)	4 (6.2)	18 (28.1)	25 (39.1)	3 (4.7)	64

wing(s) visible; underwing tip visible; and birds at rest on the sea.

Upper-wing patterns were scored using a refinement of the stages described in Marchant & Higgins (1990) as based on Harrison (1979, 1985). The main surface of the upper wing, *excluding* the leading edge was scored as stages 1-5. The presence or absence of a white "roundel" on the upper secondary coverts near the elbow was scored as absent (0), small (0.5), or present (1), or area not visible (-). The leading edge was scored for 2 linear sections (humeral edge — body to mid-point of inner wing; and radial — mid-point of inner wing to carpal) as having a "wide" or "narrow" white leading edge or having no visible white. The extent of the black leading edge of the underwing (from near carpal joint to black primaries) and the size of the carpal patch were noted. The extent of black feathering on the upper sides of the body, the mid- back between the wings, and on the rump was scored. The extent of the black "pincer" feathers at the base of the wing was noted. The presence of black in the tail was noted: no black (0); trace or black in few feathers (1).

Where whole-number scores were too coarse for the grades of variation apparent in the photographs, an estimate in tenths was made, but rounded integer scores are given here, except for main wing scores (0.5 intervals). An index of the leading edge score was calculated as the sum of the score for the 2 sections.

RESULTS

The data presented here are based on 91 images of the upper wing, 61 of the underwing, and 50 images of birds on the sea. The 91 images represented between 16 (maximum simultaneous count) and 74 individuals. Satellite tracking of individuals has shown that sabbatical royal albatrosses forage over areas >10 000 km^2 over 10-day periods (Nicholls *et al*. 2005; author's unpub. data), so it is likely that the number of different individuals scored was at the high end of the range and that even more individuals were sighted during the 3-week study period.

The 91 upper wing images included 17 duplicates (or triplicates), where the photographs of the same individual were taken within a few min. Birds at sea and in the images were examined for bands, injuries, moult, and plumage characteristics that might identify individuals. The underwing images were of birds that had been assessed for other features and there were several instances of birds that were imaged in the air and landing and resting on the sea, and vice versa.

Upper wing

Not all features were visible for each individual of the 91 birds scored. Both the upper wing stage and an index of the leading edge could be determined for 64 birds (Table 1). Birds with upper wing plumages of stages 1-2.5 were observed, but none of stages 3-5, which are usually considered to represent older adults. A representative selection of these plumages is shown in Fig. 1 (A-L).

The extent of white on the upper wing and the presence of the white leading edge of the upper wing are important field characteristics separating *D. epomophora* and *D. sanfordi* (Harrison 1985; Marchant & Higgins 1990). Where the white line on the leading edge was visible in the images of the upper wing, it was seen as a narrow or wide line on the radial and humeral sections of the wing, with the line on the radial section being twice the width of that on the humeral section. In the birds scored with wing stages ≥2, the distinct white leading edge merged with the white on the upper wing, mostly along the anterior part, with the lesser secondary coverts being white or edged with white. Some birds had a black leading edge and a few had the narrowest of white lines along the leading edge of an otherwise all black upper wing: this was visible in the field only from some angles, and usually was not visible in photographs. It was visible in some "black-winged" birds sitting on the water.

These black-winged forms were identified as *D. sanfordi*. Occasionally, single feathers of the underwing or the leading edge or both were ruffled, allowing a temporary, glimpsed, flash of white on

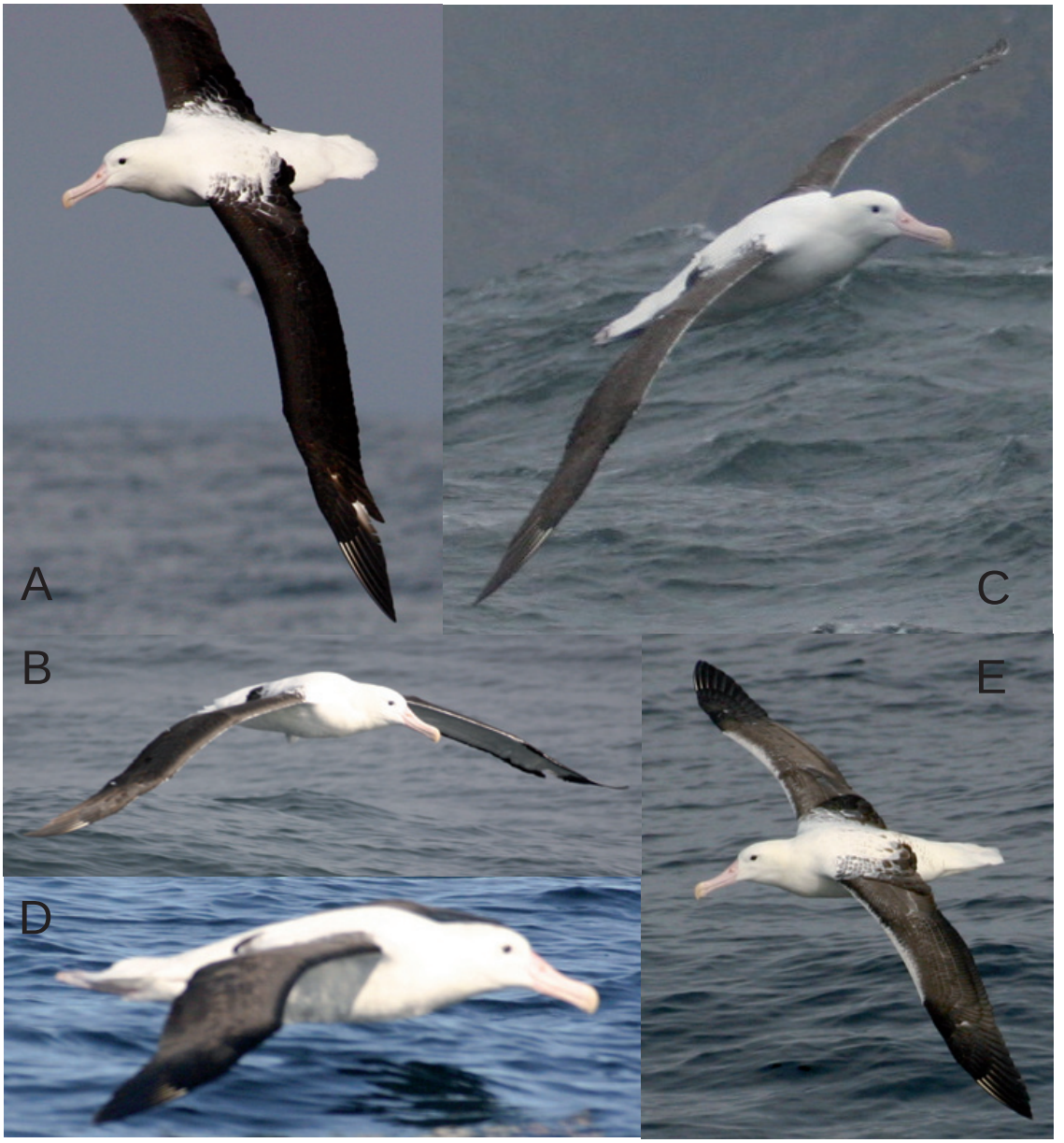

Fig. 1 (A-D) Digital images of 2 taxa of royal albatross observed off Taitoa Peninsula, southern Chile, at 46°30′S, Sep 2004, showing the plumage pattern of the upper wing. **(A-D)** northern royal albatross (*Diomedea sanfordi*) showing the all black upper wing, sunlit black leading edge, and narrow white leading edge (which depending on the angle differs in apparent development).

the leading edge but this effect was ignored in the analysis (see Fig. 1 A-L).

Of the 91 of birds in flight that included the upper surface, 14 had an all black upper wing and 6 (6.6% of total) of these did not have a prominent white leading edge visible in flight. A further 8 (12.5% of total) exhibited a prominent white leading edge for the radial section of the wing, or for both the humeral and radial sections.

Six of 91 birds in flight images had an all-black upper wing, with no visible white leading edge. It is believed that this white edge is not usually seen nor photographed in the upper wing of birds in flight. An exception is bird illustrated in Fig. 1B; a *D. sanfordi* (uniform black upper wing) in which strong sunlight is reflecting off a black leading edge with the narrowest white margin on 1 wing and a slightly more ventral view of the other which has

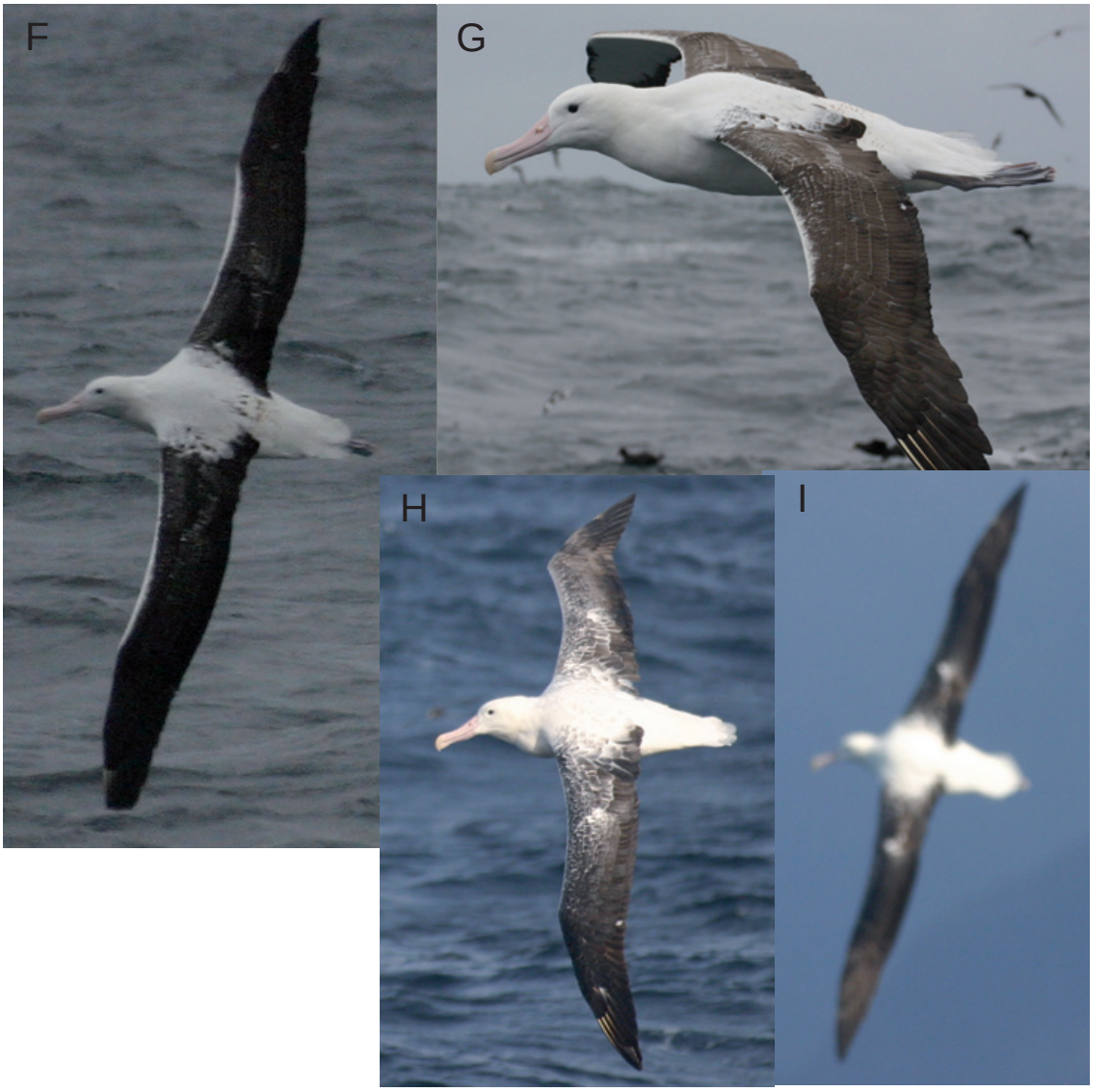

Fig. 1 continued (E-L) Digital images of 2 taxa of *Diomedea epomophora* observed off Taitoa Peninsula, southern Chile, at 46°30′S, Sep 2004, showing the plumage pattern of the upper wing. **(E-I)** Birds with very narrow but distinct white leading edges, clearly showing the different widths of the leading edges on the different sections of the wing; 2 of these birds have very little white on the upper wing; although there are white edges to many of the coverts, over all, the wing is distinctly different from that of the all black *D. sanfordi* (E & G cf. A). **(J-L) (opposite)** Birds in plumage stages 1-2 more typical of older ("young adult") birds.

a broader white line on the leading edge. A similar bird is illustrated in Fig. 1C. Impressions of body shape and neck length are too variable in foraging flight (as around fishing vessels) for these criteria to be useful in distinguishing between species in this set of single images of (mostly) individuals. The birds in Fig. 1 A-D were identified as *D. sanfordi*.

Images of birds on land (author's unpubl. data) do show that the junction of the black upper wing and white underwing is along the base of the leading edge from the bird's back as far out as the carpal joint. Marchant & Higgins (1990) described a thin white line along the leading edge in their subspecies *D. e. sanfordi*. *D. sanfordi* therefore apparently does have the narrowest, uniform white edge along the mostly black leading edge of the wing, but the white is not normally visible in flight. This is therefore significantly different from the prominent white

leading edge and white along the anterior margin of the upper surface of the wing for *D. epomophora* that is so conspicuous in flight.

The birds with all black upper wings and a prominent white leading edge in 8 images were considered to be *D. epomophora*. They may have fledged from the colony 10 months (perhaps 22 months) earlier; or it is likely that only 1 sex was present. Birds with no visible white leading edge, but a variable amount of white on the upper surface of the wing (from white edging to black feathers to all-white coverts) in 8 images were, from the presence of white on the upper wing, presumed to be *D. epomophora* of the other sex. The birds with the least amount of white on the wing may be the youngest, i.e. those that had left the colony 10 months earlier. The remaining birds had some white in the upper wing, a white "roundel", and all had a distinct white leading edge and these were identified as *D. epomophora* at least 22 months post-fledgling.

If these identifications are accepted, there were 6 (6.6%) *D. sanfordi* in the sample of 91 images, and the remainder were *D. epomophora*.

Upper back, head and neck

None of the birds seen off Chile in Sep 2004 was seen to have brown nor black vermiculated feathers on the head or neck, although a few such feathers were present on the upper back of a few individuals (Fig. 1 E,F). This pattern would be more typical of birds that had left the colony at least 12 months before, rather than of individuals that fledge in the same year (i.e. <1 month post-fledging).

In all instances, the dark trailing edge of the wing extended prominently across part of the lower back, forming a black "pincer" on either side of the back in both taxa. There was some variation in the additional amount of black flecking and barring on the sides of the back above the wings, in the central back, and on the back caudal to the trailing edge of the wing (the rump). The maximum observed extent of this black barring and edging was considerably less than (<50%) that illustrated in Marchant & Higgins (1990: Plate 15, facing p. 280). Strong sunlight on the bird's back often meant that the black was washed out in some images: neither angle of view nor digital manipulation of contrast and brightness allowed certain determination of

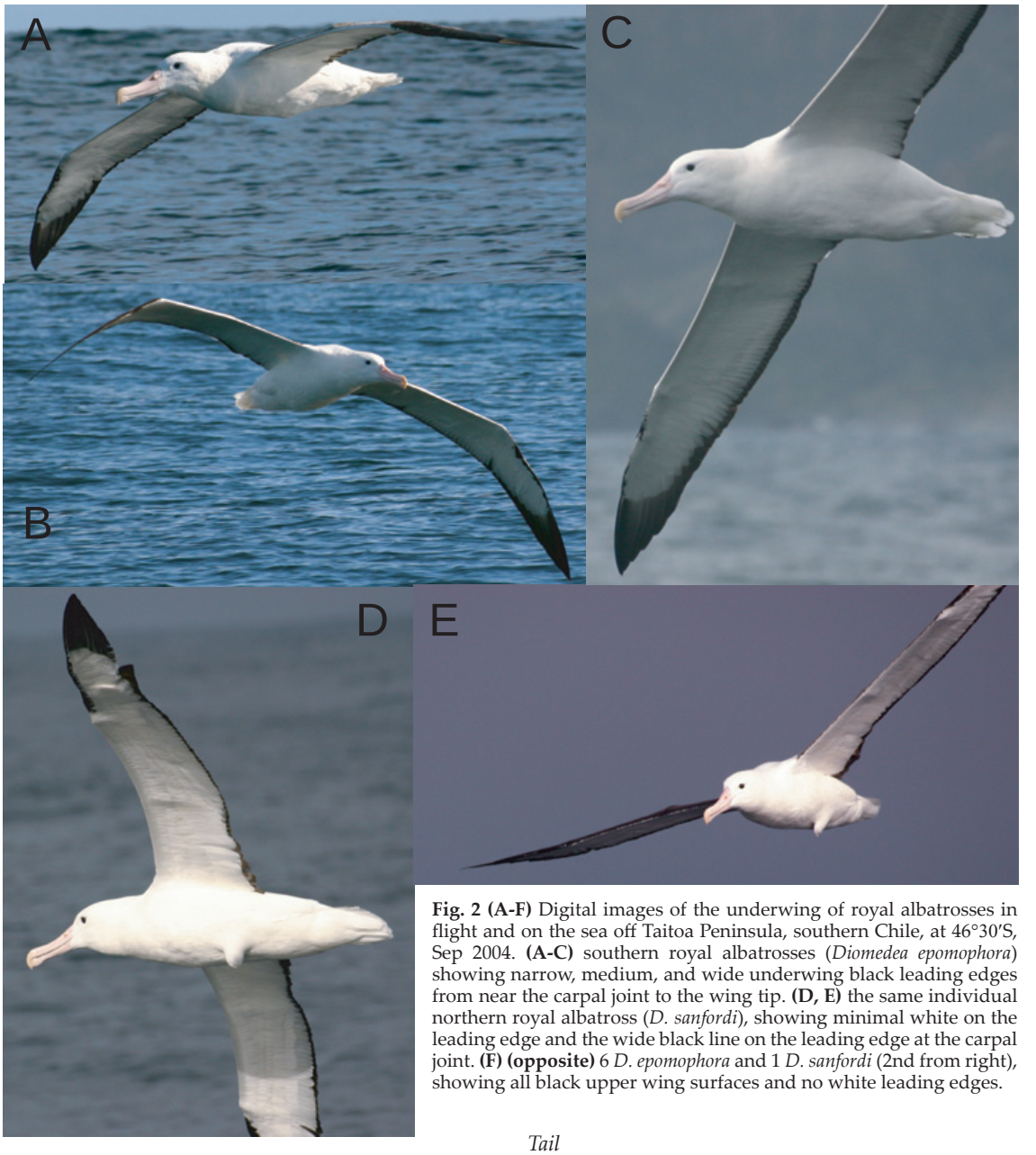

Fig. 2 (A-F) Digital images of the underwing of royal albatrosses in flight and on the sea off Taitoa Peninsula, southern Chile, at 46°30′S, Sep 2004. **(A-C)** southern royal albatrosses (*Diomedea epomophora*) showing narrow, medium, and wide underwing black leading edges from near the carpal joint to the wing tip. **(D, E)** the same individual northern royal albatross (*D. sanfordi*), showing minimal white on the leading edge and the wide black line on the leading edge at the carpal joint. **(F) (opposite)** 6 *D. epomophora* and 1 *D. sanfordi* (2nd from right), showing all black upper wing surfaces and no white leading edges.

the presence or absence of barring on the back. Regardless, it was never extensive in this sample.

Juvenile birds, presumably soon after leaving the colony, are in stage 1 plumage (Marchant & Higgins 1990). The black-brown edging on the back feathers is lost, presumably in the 1st months at sea, because this juvenile feature was not observed on birds seen off Chile in Sep 2004, even though banding results suggest that such birds occur off Chile at that time (Moore & Bettany 2005).

Tail

The tail feathers were white except for individuals in 4 images, which had a small terminal patch of black on 1-3 tail feathers.

Underwing

The underwing of both taxa is white, except for a narrow black trailing edge along the entire length of the wing and a narrow black edge along the leading under surface of the wing for a short length of the wing from the carpal joint to the primaries (Marchant & Higgins 1990). The black leading edge

of the underwing is wider and is expanded into a patch at the carpal region in the *D. sanfordi* (Shirihai 2002; Couve & Vidal 2003).

A representative selection of the 61 images, in which the underwing including the tip and carpal areas is visible, is given in Fig. 2. In 17 of the 61 images it was possible to determine the taxon using the leading edge and or upper wing criteria. Of the 4 images of birds attributed to *D. sanfordi*, 1 had the widest band of black on the underwing; the other 3 had a narrow or very narrow black edge. The proportion of birds assessed to be *D. sanfordi* was higher than observed in the other samples, but if the leading edge criterion does not hold, then some of the 3 could conceivably be *D. epomophora* and not *D. sanfordi*. Among the 13 images of *D. epomophora*, all had a narrow or very narrow black edge that was discontinuous, or continuous from the black primaries. The taxon in the remaining 44 images could not be determined. The black area on the leading edge of the underwing varied in width, between birds, and it was discontinuous in some. In some individuals, the black area was expanded and formed a patch near, but distal to, the carpal joint.

The widest of these black areas was slightly narrower, but the localised widening at the carpal joint thickening was more marked, than that visible in the illustration of a *D. sanfordi* in Couve & Vidal (2003; image 1069, p. 335).

In this small sample from Chilean waters, *D. sanfordi* were infrequent (23%, 4 of 17, *D. sanfordi*), but this was a higher ratio than that determined from the other identification criteria. The plumage stages observed were 1-2.5, there apparently being no mature adults in the sample. If the identifications of the birds in the 4 images of *D. sanfordi* are accepted (without a clear view of the entire upper wing there must be some doubt), the width of the underwing black edge and the presence of a carpal patch were neither distinctive nor consistent between the 2 taxa. Certainly, the underwings of the *D. epomophora* varied significantly between individuals, and there was apparently a low proportion of *D. sanfordi* in the area at that time.

Birds sitting on the water

Thirty-seven (92.5%) of 40 birds sitting on the water all had some white edging in the surface of the upper wing and a prominent white leading edge, or both (Fig 2 A-F). Of the other 3 birds imaged, 1 had entirely black upper wings, and another was not assigned to a taxon because no white was visible in the wing, but light was reflecting off the leading edge which appears black); so 3 (7.5%; or 4, 10%) of the birds were identified as *D. sanfordi*.

Most of the birds on the water were judged to be in plumages stage 1 or 2; a single individual was near stage 3. The *D. sanfordi* had a black upper wing surface, appearing as a uniform dark brownish-black, and there was the narrowest white edge to the lower margin of the leading edge. The very narrow white edge was obviously different from the prominent (although sometimes narrow) white leading edge characteristic of *D. epomophora*. Several birds had only the narrowest white edges of the coverts or the "roundel" had white flecks. These birds were considered to be *D. epomophora*.

DISCUSSION

On the basis of the images examined and reported

here and with the descriptions in Marchant & Higgins (1990), *D. sanfordi* can be separated from *D. epomophora*. Young plumage stages of the *D. epomophora* can also be identified.

D. sanfordi has an upper wing surface that appears as a uniform very dark brown or black. There is a narrow white line along the lower margin of the otherwise black leading edge, but this line is not prominent in flight. It is visible when the bird is sitting on the water, ashore (or being held) when the wing is folded and the underside of the leading edge is slightly lifted and exposed. The underwing carpal patch was not adequately documented in the few *D. sanfordi* observed, but it appears to be more variable and less reliable as an identification feature than is reported to be diagnostic for *D. sanfordi* (Shirihai 2002; Couve & Vidal 2003; C.J.R. Robertson, *pers. comm*.).

In contrast, the *D. epomophora* have a prominent white leading edge that is clearly visible even in the youngest birds, i.e. those that have almost no white in the upper wing surface. There were (young) birds with white on the upper wing, but the leading edge lacked the distinctive white edge. The white leading edge may be a uniform width from the shoulder to near the carpal joint in some individuals (presumably young birds in their 1st year away from the nest) but for most of the young stages (<2), the outer radial portion of the wing is twice the width of that on the humeral portion of the wing. In stage 2, the white-flecked upper surface of the wing extends from the leading edge to the centre of the wing chord over the secondary and tertiary coverts. The distribution of white feathers on the wing has been likened to the pattern expected for a bird that had flown through a cloud of flour (C.J.R. Robertson, *pers. comm*.).

D. epomophora was observed much more commonly than *D. sanfordi* in this southern Chilean sample in Sep 2004. From the images, the proportion of *D. sanfordi* to *D. epomophora* was a maximum of 9% for birds identified from upper wings of birds in flight and 7.5-10% for birds identified on the water. Both ratios differ markedly from the equal numbers that might be expected from the similar numbers — 7715 and 7560 breeding pairs (Marchant & Higgins, 1990); and 6500-7000 and 8000-9000 (Robertson *et al.* 2003) — of breeding pairs of *D. sanfordi* and *D. epomophora*, respectively. Banding results (Robertson & Kinsky 1972) indicate that young (0-1 years) royal albatrosses are common at 30-40°S in summer. There were few recoveries of any royal albatrosses at 45-50°S, a region where there is little human settlement and only sporadic fisheries. They reported just 1 recovery in Sep, an adult *D. epomophora*. Moore & Bettany (2005) reported (based on a larger number of band returns) that 57.6% of the youngest (1-2 years) *D. epomophora* were off South America; in the older age groups, the proportion fell to 40% or less. The rest of the population (42.4%, 60%, respectively) were elsewhere.

Satellite-tracking results showed that adult *D. sanfordi* flew directly to Chile soon after a failed breeding attempt. They remained over the continental shelf of Chile or Argentina until they left South America in Aug and Sep (Nicholls *et al*. 2005), returning to their breeding colony. A single satellite-tracked adult off Chile remained between 40° and 47°S until it began an eastward migration to its breeding colony. Of the other satellite-tracked birds, there were 5 individuals that flew to South America, of which 2 were tracked in successive years. All the satellite-tracked flights continued eastwards, but Robertson (Birdlife International 2004) reported that some birds tracked using geo-location archival tags returned westwards from Chile (Robertson & Nicholls 2004; Nicholls *et al*. 2005).

Regardless of the route taken, *D. sanfordi* return to their breeding colonies earlier than *D. epomophora*, in which peak egg-laying is later by 3 weeks. It is possible, indeed probable, that the *D. sanfordi*, were leaving or had left Chilean waters at the time of the observations reported here, leaving a majority of *D. epomophora*. Alternatively, it is possible that most *D. sanfordi* feed over the Patagonian Shelf and not the Chilean Shelf; of 8 visits by 5 adults (no immature birds were tracked), all but 1 remained on the Patagonian Shelf. However, this proportion reflects the relative areas of the continental shelves. Moore & Bettany (2005) interpret banding data for *D. epomophora* as indicating that younger birds remain on the Chilean Shelf and move to the Patagonian shelf in later years.

All *D. epomophora* observed off Chile had low plumage scores and were presumed to be young birds. Excluding the 6 birds identified as *D. sanfordi*, only 2 birds of 58 were in a plumage stage >2. It is not known if these relatively young birds remained off South American seas or whether they returned occasionally or annually to New Zealand seas before returning to the breeding colony. The latter seems less likely because birds exhibiting these plumage stages are seen infrequently in New Zealand seas (C.J.R. Robertson, *pers. comm*.).

The presence of *D. epomophora* seen during 3 weeks in Sep 2004 over the continental shelf near Taitoa Peninsula, Chile, matches the pattern revealed by satellite tracking of *D. sanfordi*. The fishing vessel from which these observations were made operated in waters 200-500 m deep, and there were no observations further offshore. Satellite tracking showed that the birds concentrated over similar depths and within 1 km of the peninsula, exactly as was observed at sea for the few *D. sanfordi*, albeit 7 years later.

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