

Islands; dominantly subantarctic with small (perhaps relict) subtropical populations.

Fluttering Shearwater: Range N. Auckland to Cook Strait; now classed as member of almost cosmopolitan species group.

Spotted Shag: Range N. Auckland to Otago; subspecies Stewart and Chatham Islands; related species in Chile; thus weakly zonal near subtropical convergence.

Marlborough King Shag: Northernmost race of a subantarctic New Zealand species, in a group which is circumpolar and strongly zonal in subantarctic seas; Cook Strait population probably relict.

Red-billed Gull: Race of wide-ranging African-Australasian species, northern in remote origin, spanning subtropical and subantarctic zones.

Black-backed Gull: Northern in remote origin, now circumpolar and subantarctic, but entering subtropical zone; not typically pelagic in ecology.

White-fronted tern: Endemic to New Zealand (migrating to Australia), ranging from Auckland to Auckland Islands. Affinities and origin not clear.

In summary, of 13 breeding seabirds in Cook Strait, seven (Blue Penguin, Diving Petrel, Black Petrel, Sooty Shearwater, Marlborough Shag and Black-backed Gull) seem clearly derived from subantarctic stock at some time in the past, two (Spotted Shag, Red-billed Gull) are weakly zonal but of uncertain derivation and four (Storm Petrel, Mottled Petrel, Fluttering Shearwater, White-fronted tern) belong to more or less cosmopolitan groups, lacking obvious zonal affiliations. All 13 species range north into

subtropical breeding waters. No Cook Strait species shows strong subtropical affinities, and the aberrant attempt of Fiordland crested Penguins to nest at Palliser Bay underlines the dominance of subantarctic influences.

In an analysis of the bird fauna present in Cook Strait at any one time, the presence of migrants and seasonal wanderers has also some slight significance, e.g., one of the subantarctic penguins, the Erect-crested (*Eudyptes slateri*) with a breeding range south of the convergence, is found in winter frequenting surface water to the south-east of Cook Strait and normally 60-70 miles off shore. However, in some years substantial numbers are reported in western Cook Strait, usually in August. Circumpolar wanderers of such species as the Giant Petrel (*Macronectes*) regularly congregate in the Straits area, although it may be assumed that the length of their stay is determined rather by adventitious food supply at whaling stations, on fishing grounds and in harbours rather than any attraction of free pelagic food supply. Most of the Southern Hemisphere smaller albatrosses or mollymawks have been recorded at one time or another from the Cape Palliser area. Some mention might also be made of the ready availability of food supply in current rips such as occur off Cape Jackson, Cape Terawhiti and elsewhere. Such a concentration of food in disturbed water is an invariable attraction to oceanic birds, resulting in spectacular congregations which undoubtedly draw in nomads and wanderers, and perhaps help to determine a regular pattern of seasonal movement. Birds listed in the above categories are again, in the main, of subantarctic origin.

Discussion

Commenting on the significance of the papers read during the morning PROF. L. R. RICHARDSON said that 15 years ago there was very little information available in regard to Cook Strait of the kind with which the meeting had been presented. It could be seen from the information contained in the papers that knowledge was rapidly advancing, and that the Cook Strait area would

in future become one of the most "researched" in the world. He asked on how many stations the present knowledge of the geology and physical oceanography of the Strait was based.

MR. GARNER said there had been no specific investigation into the physical oceanography of the Strait. It was an area of intermixing of a large number of different

water masses. The number of samples in Cook Strait was estimated at one or two hundred.

MISS L. B. MOORE showed slides of the distribution of species of marine algae, inshore and drift, which had been referred to. The slides had been based on material collected during the last 15 years. She commented that Cook Strait was a good area for ecological research, as in this area is found a large proportion of the total seawater flora of the whole country, containing both northern and southern elements. She made three further points: (a) the tremendous difference in tide time from one side of the Strait to the other, which affected collecting round the harbour or on the open coast; (b) the good contrasts provided by the Strait in the conditions to which inter-tidal plants were exposed; (c) the fact that some large masses of seaweed, e.g., *Macrocystis*, had large air vessels to keep them afloat and carried other things along with them. In West Australia and Tasmania one species which did not grow there (*Durvillea antarctica*) had been found.

R. K. DELL said that 15 years ago there were no complete lists of species occurring in Cook Strait, although there were lists for several other areas, and there was still no complete list of mollusca. The Cook Strait mollusca showed very strong evidence of the mixing of northern and southern elements, either through hybridisation or the presence of clines, producing many intermediate forms. There was a great range of types of habitat, deep-water shelf, littoral, sub-littoral, and pelagic forms. Endemic shallow-water forms show a definite relationship with both north and south.

MR. YALDWYN asked if there was any evidence of tidal upwelling of deep water forms in Cook Strait such as occurred in the Straits of Messina in the Mediterranean where deep water fauna was upwelled and swept through the Strait. MR. GARNER said there was a diffusion of turbulent motion upwards from the bottom, but the usual motion was horizontal rather than upwelling. He knew of no areas of upwelling in Cook Strait, but thought it could take place under certain wind conditions. There are eddies off the major points in the Marlborough Sounds and these may be the cause of small basins off these points.

MR. YALDWYN asked if temperature changes could produce upwelling in Cook Strait. MR. GARNER said that the only major evidence of upwelling was off Cape Farewell where there was often a drop of 5deg. F. and high salinity of water, indicating a deep sub-tropical upwelling. DR. BARY said that one small piece of evidence that upwelling did occur in Cook Strait was that sub-antarctic amphipods sometimes cropped up right inshore, accompanied by slight discoloration.

J. H. SORENSON asked for information about the places in which driftcards were found after a release. MR. GARNER replied that of the cards dropped to the west of the Straits a large percentage came ashore between Pukerua Bay and the Manawatu. Cards dropped in the southern part of Cook Strait and released close to the shore were recovered from the southern coast of the North Island but cards dropped in the centre of the Straits had never been heard of again.

A. C. KABERRY commented that all but two of the major commercial fishes occurred in Cook Strait. Up to 1943 there was good seasonal fishing for hake on the western shore of Palliser Bay but by 1943 it had failed. MR. YALDWYN noted that groper and ling were both good fishermen for shrimps and that much material had been obtained from their stomachs. He asked for information on the areas where these two species were fished. MR. KABERRY answered that ling were fished in the deep 200-fathom channel between the canyon and the basin in Cook Strait and groper in the same general area but on the edges of the banks.

DR. U. V. CASSIE asked for suggestions for a suitable method of marking a mass of seaweed to trace its path. MISS MOORE said scattering driftcards had good results.

MR. KABERRY said he had never seen kelp covered in barnacles when growing, but when drifting it was covered with them.

DR. BARY said that until more information is obtained on deep waters and the effect of topography on northern-moving sub-surface waters, there would be unexplained riddles in Cook Strait, particularly in connection with pelagic and other fauna, e.g., Mr. Yaldwyn's material re decapods in shallow water.

N. G. ROBERTSON mentioned the stomach contents of groper in the past season. He

said the season had been unusual climatically and might affect collections. Sometimes there was a marked predominance of certain weather conditions, and that may influence collections made in a particular season. Last summer there was a lack of southerly winds, and January and April were the warmest for some time. If the distribution of driftcards were affected by surface currents only, Mr. Garner's explanation would fit in with the normal wind pattern for Cook Strait.

DR. BARY mentioned the effect of wind on distribution of organisms between Kapiti and Durville Island, and said that in the course of "Lachlan's" work it had been found that in southerly conditions through the Strait, albatrosses, mollymawks, and occasionally a Royal Albatross would come on the northern side of the Strait, together with a porpoise, but in northerly weather they did not appear.

MR. SORENSON asked why hump-backed whales on their annual migration following up sub-antarctic waters, pass through Cook Strait instead of through Palliser Bay. DR. BARY said that water conditions did not seem to have a great deal to do with migration.

PROF. RICHARDSON said whales follow up from the south, and only a small number out of the total went through Cook Strait. Some of them went in from well out to sea, and those to the north struck the west coast.

MR. KABERRY said that in Foveaux Strait none of the whales went through the Strait either on northerly or southerly migrations.

DR. R. A. FALLA said that the trend was northerly, and the whales touched the Cook Strait channel only accidentally.

DR. CASSIE drew attention to the fact that in all the papers read during the morning, all the references had been to Atlantic groups rather than to Pacific groups. DR. FALLA said the picture might be false because of the size of the Pacific and the fact that much less is known about it than about the Atlantic.

MR. YALDWYN asked if the dove petrels nesting on Brothers Islands were allied to the sub-antarctic race. The Stephens Island birds were more like the sub-tropical race. Where did they feed, and were there one or two forms in Cook Strait? DR. FALLA said that the birds in each breeding colony were distinguishable. Those in colder water have stouter but not necessarily longer bills. Both kinds are found at the Chatham Islands. The birds at Brothers Island have stout bills but at Stephens Island the bills are uniform and slender in comparison. MR. YALDWYN remarked that the difference in the bills could be an adaptation to different faunas.

Y. M. MCCANN spoke of the abnormal climatic conditions of the last few months. He said that during the last three months a logger-head turtle had been caught off Flat Point, and a Sowerby's whale stranded at Whatarangi. Records of the movements of sunfish along the New Zealand coast were all along the eastern side of the country and only a few along the western coast, following the current sweeping round the southern portion of the country and up the eastern coast.

P. C. BULL said more would be learned about the movements of seabirds through the ringing carried out by Mr. Abernethy. Gannets ringed at Cape Kidnappers and Horohoro had been recovered in Cook Strait, and 80-100 had been recovered in Australia, which showed that they did move westwards.

MR. YALDWYN asked what large numbers of fleshy-footed shearwaters were doing in Cook Strait during the breeding season, whether they were coming down on tropical water masses or breeding. DR. FALLA said that still remained to be explained. The breeding grounds were North Auckland and Bay of Plenty. The same applied to the Buller's shearwater, which was probably a northern breeder with a wide feeding range.

MR. KABERRY closed the discussion with the comment that we are obviously fortunate in having Cook Strait with its varied water masses and great depths so close for ecological study.