

## ACKNOWLEDGEMENTS

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## MARINE BIRDS AND MAMMALS AT KAIKOURA

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## INTRODUCTION

The Kaikoura peninsula ( $42^{\circ}25'$  S.  $173^{\circ}42'$  E.) and neighbouring coastline are a centre of attraction for marine birds and mammals on the north-east coast of New Zealand's South Island. The area is noted for its resident sea birds, including flocks of 6000-8000 red-billed gulls\* and almost as many white-fronted terns. Large flocks of spotted shags, fluttering shearwaters and other non-breeding species appear

regularly off-shore. There is a rapidly growing population of New Zealand fur seals (*Arctocephalus forsteri*), and schools of dolphins are frequently visible within one or two miles of the shore. No other area within fifty miles of the peninsula, on either side, so consistently attracts large concentrations of marine birds and mammals.

\* Specific names of birds appear in the species list.

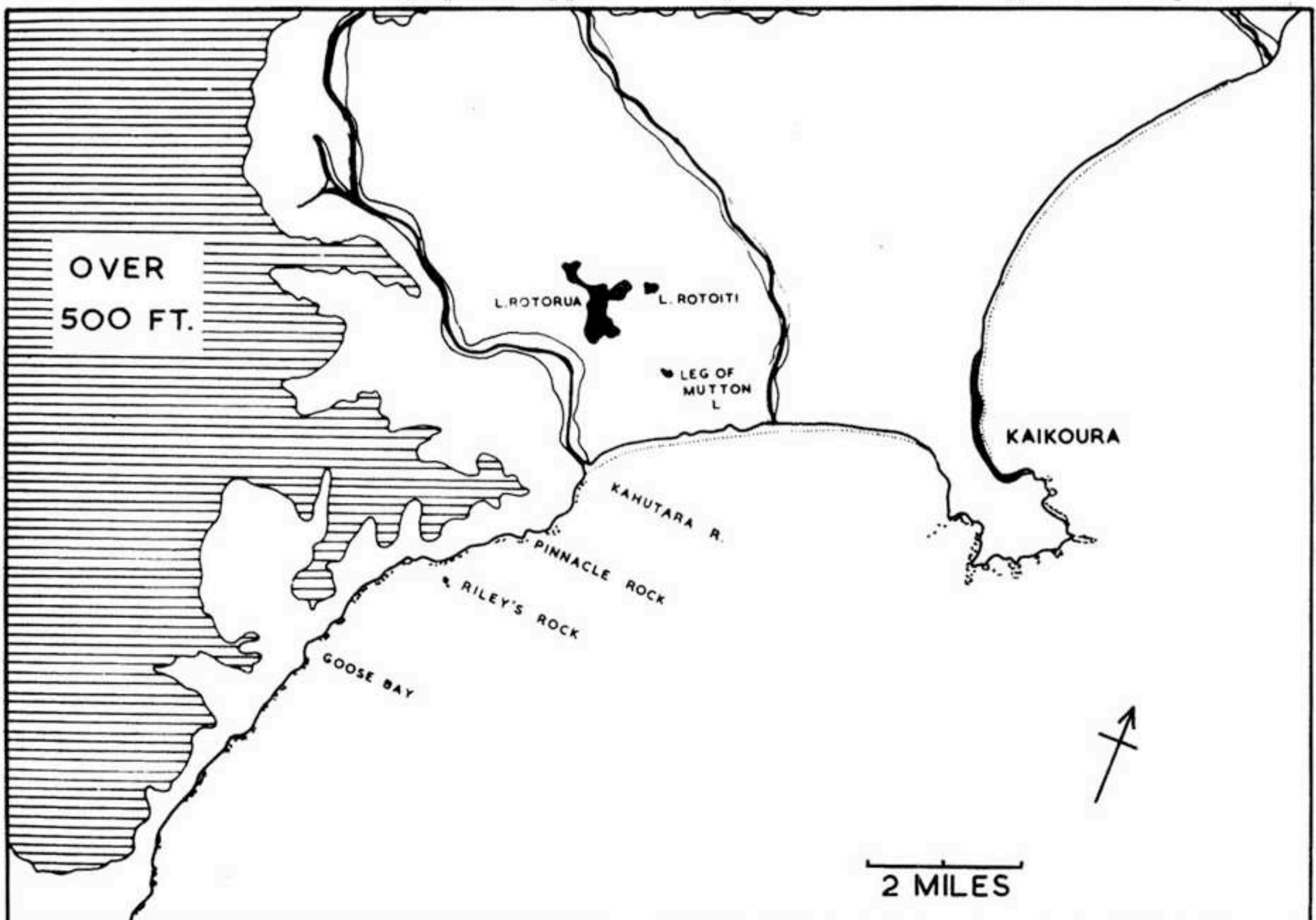


FIGURE 1. *The Kaikoura coast.*

This paper describes the area as a habitat for marine birds and mammals, and lists species recorded between 1952 and 1964. My own observations and those of senior students of the University of Canterbury since 1960, systematic aerial observations by commercial pilots in 1963-64, and field notes from 1953 by Mr. Brian Bell (Wildlife Division, Department of Internal Affairs) are incorporated.

#### THE KAIKOURA COAST

The peninsula (Fig. 1) is an eroded and faulted limestone block one to two miles wide, jutting some  $2\frac{1}{2}$ -3 miles out to sea at a right angle to the north-east south-west trend of the North Canterbury and Marlborough coasts. The peninsula is deeply indented by erosion on its two southern faces, and bounded by reefs on all three seaward sides. Geologically recent changes of sea level have provided extensive intertidal platforms and raised beaches below the steep limestone cliffs. Kaikoura town lies at the base of the peninsula on the north side. Bare rolling pasture covers most of the block. The cliffs have fallen in many places, and the grass-covered slopes are easily climbed.

On either side of the peninsula lie curving bays of shingle and sand, backed by dunes and an old cliff escarpment. Beyond the long beaches, narrow stretches of sand and cobbles alternate with reefs; the coast is mainly rocky and backed by steep cliffs and mountains. Immediately behind Kaikoura lies a narrow triangular plain, bounded to the north by the steep Seaward Kaikoura Range with peaks of 5000-8000ft., and to the south by lower hills forming impressive coastal scenery.

The low rocky headlands of the peninsula provide nesting grounds for between 2500 and 3000 pairs of red-billed gulls, and slightly fewer white-fronted terns. A small brackish lagoon on the north-western corner of the peninsula provides food and nest sites for seven to ten pairs of pied stilts. Small numbers of black-backed gulls, banded dotterel and mallard also nest along the shore. Subsidiary breeding grounds of red-billed gulls and white-fronted terns are at Pinnacle Rock, Otamatau, and Riley's Rock, on the coast south of Kaikoura. Riley's Rock also houses a single pair of reef herons and about a hundred nests of black-backed gulls.

A system of small lakes in rolling country between Kaikoura and the Kahutara River provides nesting grounds for three species of shags,

which feed daily throughout the year on the peninsula shore and along the coast south of Kaikoura. White-faced herons, now increasingly common in the intertidal zone of the peninsula, are believed to breed near the lakes.

#### THE SEA

Shallow bays to north and south of the peninsula fall away rapidly into deep water two or three miles from the coast. The 50 metre submarine contour passes within half a mile of the end of the peninsula, swinging eastward and southward to lie only 200-300 yards off-shore at Goose Bay. An extensive steep-sided submarine canyon lies five miles south of the peninsula, where depths of over 1000 metres are found within four miles of the shore (Fig. 2).

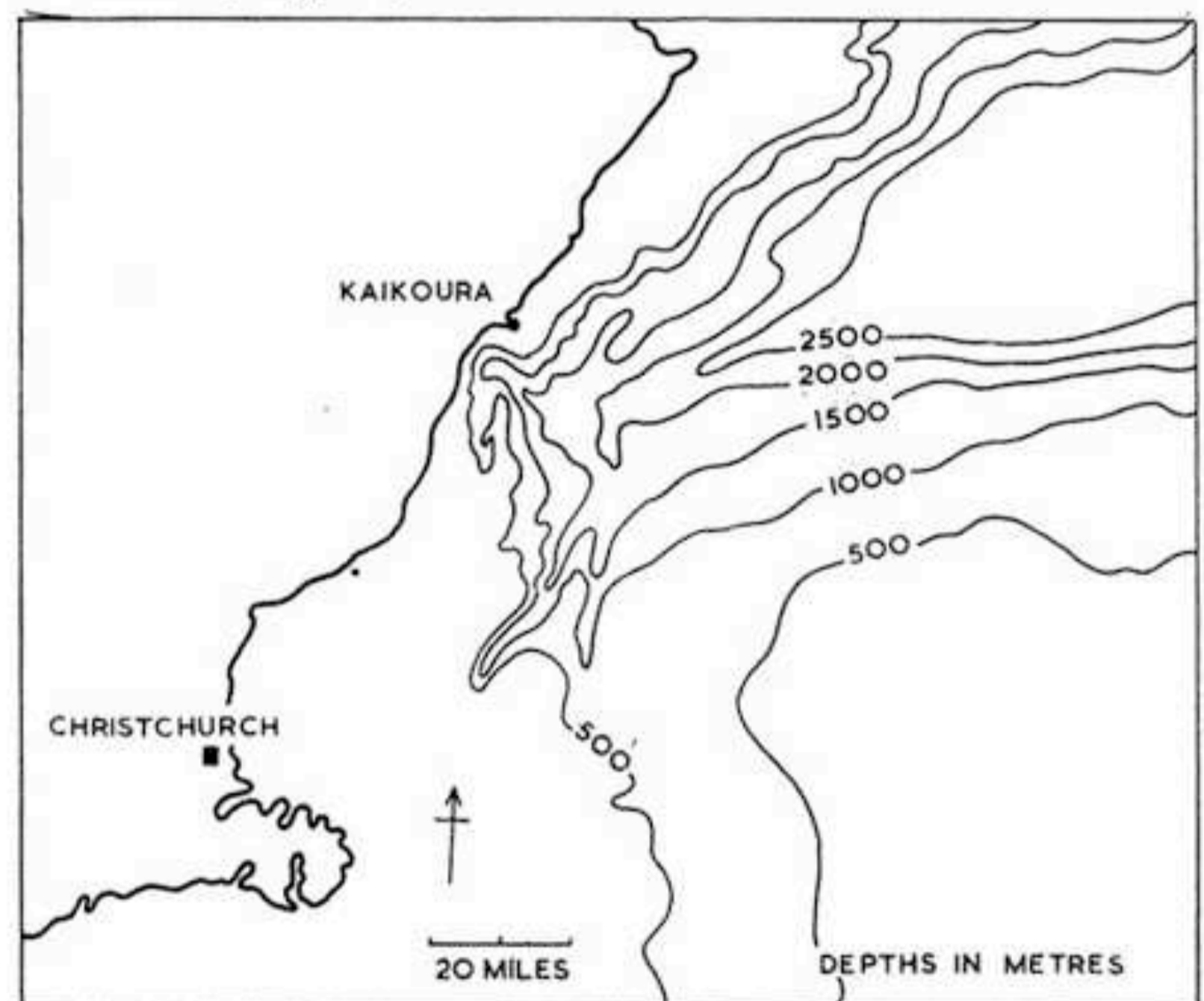


FIGURE 2. *Submarine contours off Kaikoura.*

Brodie (1960) and Garner (1953, 1959, 1961) have described sea water movements and temperatures off the Kaikoura coast. The north-flowing Canterbury Current runs close inshore, bringing a mean annual temperature of  $12^{\circ}\text{C}$ . (range  $3.9^{\circ}\text{C}$ .) to Kaikoura. Further out, the sub-tropical East Cape Current brings warmer water to within a few miles of Kaikoura in summer. Garner (1961: 51-52) reported periodic influxes of cold subantarctic water in the 1955 summer, detectable to the north but not to the south of the peninsula and probably ascribable to upwelling in the canyon region. Thus cold water originating from depths off Goose Bay is apparently carried northward by the inshore Canterbury Current. Aerial observations of fish shoals (see below) support this

suggestion: throughout the summer of 1963-64 extensive shoals of fish and plankton occurred north of Kaikoura, but only occasionally off points south of Goose Bay.

Enrichment may occasionally be carried southward. Working with drift cards, Brodie (1960) detected no southern movement of in-shore waters, in spite of frequent local north-easterly winds which might, from time to time, be expected to stem or reverse the Canterbury Current. Occasional reversal of flow with little apparent relation to local winds has since been detected by Grieve (pers. comm.) and aerial observations suggest that at least the superficial water layers occasionally flow southward under the action of persistent northerly winds.

Some local enrichment is also apparent near Conway Bank (or Bushett Shoal), a prominent kelp bed on the continental shelf 25 miles south of Kaikoura. Fish, bird and mammal concentrations rarely appear south of this region.

Water movements and chemistry off Kaikoura are now being studied at the Edward Percival Marine Laboratory (Professor G. A. Knox), and research on fish shoals, gulls and marine mammals is planned.

#### AERIAL REPORTS OF ANIMAL CONCENTRATIONS

Between April 1963 and early June 1964, air-line pilots of New Zealand National Airways Corporation co-operated with this department in a scheme for reporting concentrations of fish, sea birds and dolphins along the coast between Pegasus Bay and Cape Campbell (Figure 3). In Douglas Dakota freighter aircraft, at heights of 500-2000 ft. and speeds of 100-120 knots, the pilots normally flew over the sea within two or three miles of the shore, recording their observations on outline maps with superimposed 10-mile grid; between three and sixteen maps were returned monthly during the observation period. Personal observation and contact with interested pilots allowed me to amplify and to assess the limitations of the information.

Observations were usually restricted to clear, fairly calm days with limited high cloud, and marred by rough water toward the north end of the coast. Consequently, more maps were completed in summer than in winter, and comparisons of data from different areas along the coast can be made only with caution. Animal concentrations, marked on the maps by crosses or circles, were located with a probable accuracy of two or three miles; for analysis the coastal waters are divided into a

strip of ten-mile square sectors, to which the reported concentrations are referred. Animals were generally not identified to species, although small sea birds (gulls and terns) were separated from larger mollymawks and albatrosses, and dolphins and porpoises together from larger whales. Many fish shoals clearly included fish of two size ranges (see below), and single large fish (probably sharks) were distinguished from whales by shape and movement. Numbers of shoals or flocks, and of individual animals, may not be very accurate, although some pilots took trouble to check their estimates with photographs and to count systematically.

Nearly all observations were recorded within the ten-mile coastal strip, and observers agreed that very few dolphins, gulls or fish shoals were seen in deeper water. Excursions by special request yielded little additional information, although large whales (see below), albatrosses, mollymawks and giant petrels were most frequently reported well out to sea. Few pilots flew more than 25 miles from the coast. Only two groups of fish shoals were reported beyond the limit: both lay in fairly shallow water off the northern end of Pegasus Bay, 20-25 miles from the coast, late in April 1964. No gulls or other birds accompanied them, and other shoals may have been missed in this area. All gull and dolphin concentrations were recorded within 12 miles of the coast, except for a single anomalous record of a dolphin concentration covering some ten acres 30 miles east of Kaikoura in late May 1964. I thank Dr. R. A. Falla for the suggestion that this may have been a group of erect crested penguins on annual migration from the Bounty Islands.

Figure 3 tabulates the distribution of gull flocks, fish shoals and dolphin schools throughout the observation period. The coastal silhouette shows features named in the text, and the limits of the ten-mile sectors appear alongside. The body of the figure shows, month by month, coastal sectors in which bird, fish or dolphin concentrations were recorded at least once. The monthly total of such records, together with the number of report sheets returned, appear at the bottom of each monthly column. In the table on the right, the total number of records (N) for each of the three animal categories appears at the bottom, and the tabulated figures are percentages of N recorded in each of the fourteen coastal sectors.

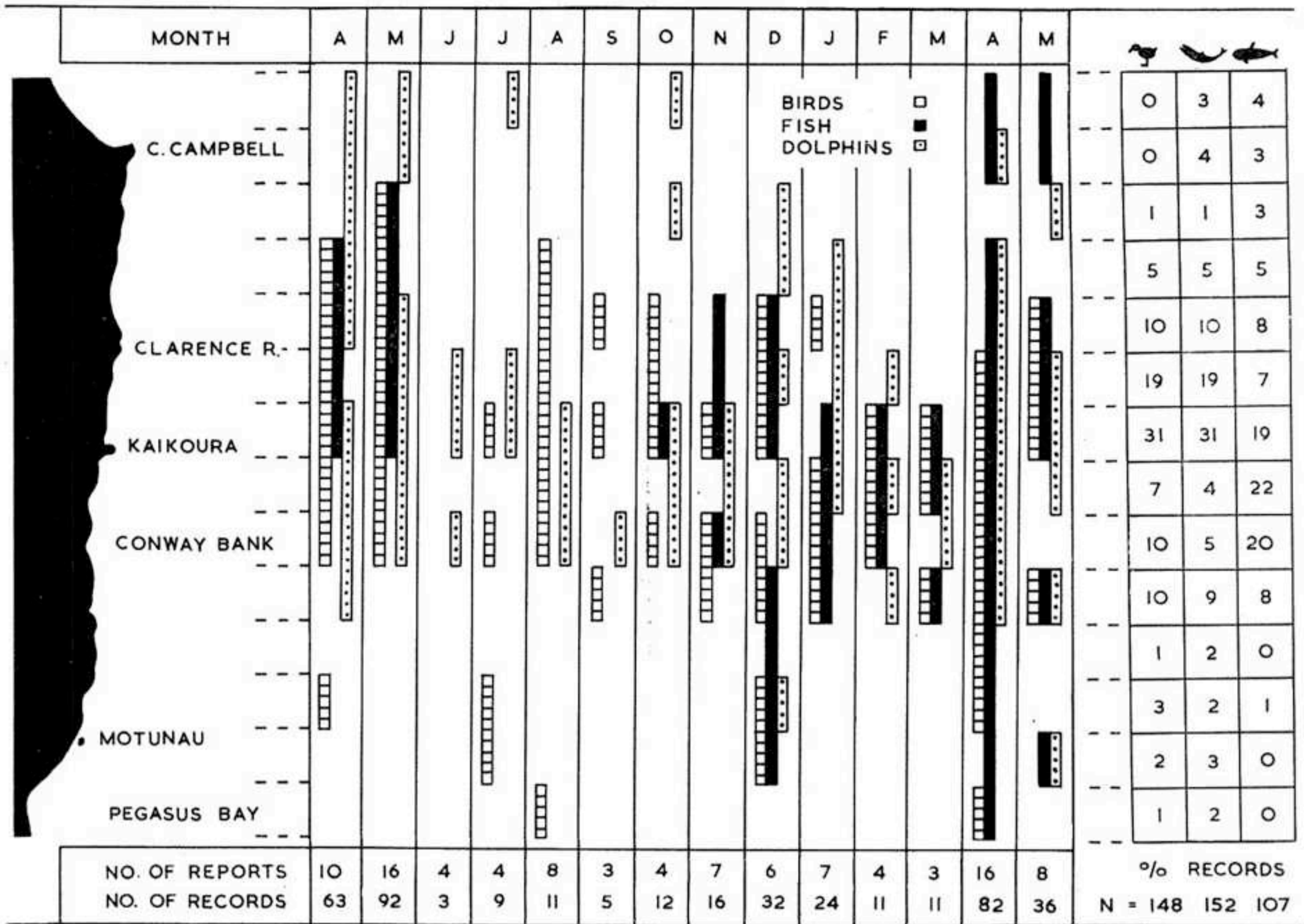


FIGURE 3. The distribution of bird flocks, fish shoals and dolphin schools off Kaikoura, April 1963-May 1964. (For explanation see text.)

Fish shoals generally appeared as patches of disturbed water with birds in attendance. Most were from 3-20 metres, some up to 100 metres, across. Myriads of small fish, roughly 10-20 cm. long, were sometimes distinguishable as a shimmering mass. Hundreds of closely-aligned large fish, 60-100 cm. long and more, possibly kahawai (*Arripis trutta*) or barracuta (*Leionura atun*), were often in attendance. The shoals usually appeared in groups of 5-50 within an area of five to ten square miles. On 11 April 1963, 124 such shoals were counted in a broad band between Kaikoura and the Clarence River, 22 miles to the north, and nine days later over 200 shoals appeared in the same area. Nothing is known of the movements, diurnal rhythms or activities of individual shoals, but the masses of fish appeared to split, merge, and change shape rapidly when observed from a circling aircraft.

A shoal washed or driven ashore near Goose Bay in May 1962 consisted of sprats (*Mauge-clupea antipodum*) and kawahai. Similar concentrations of these species were reported by Graham (1956: 103) off Otago, and may be plentiful at particular localities elsewhere about the New Zealand coast. Pilchards (*Sardinops neopilchardus*) are known to form similar shoals, with larger fish and birds commonly in attendance.

The shoals were markedly seasonal. They were abundant off Kaikoura between January and March 1963 (Stocker, pers. comm.), and to the north of Kaikoura in April and May. None appeared anywhere along the coast between June and September 1963 (Fig. 3), and only a single small group of shoals was recorded in October, north of the peninsula. Thereafter the shoals were plentiful through-

out summer, mostly to the north of Kaikoura but occasionally also off Goose Bay and more southerly points. They were particularly widespread during December 1963 and April 1964, extending from north of the Clarence River to south of Conway Bank. In May 1964 they became sporadic, and none was reported after the beginning June. In June and July, off Otago, Graham (1956: 103) found sprats in the stomachs of larger fish caught at depths of 120 fathoms. Little else appears to be known of their biology.

*Flocks of red-billed gulls* were usually closely associated with fish shoals, although some were reported in winter when fish shoals were absent, and flocks were occasionally seen in summer over patches of sea where no fish were visible. Pink droppings in summer and winter suggested that plankton formed at least part of their diet throughout the year. Single flocks of up to 2000 gulls were reported occasionally, and smaller flocks totalling several thousand birds were at times reported simultaneously along many miles of coast. Possibly excepting small groups of birds from Motunau I. (where a few pairs bred in 1963) and Grassmere (west of Cape Campbell, where a small breeding colony has developed in the last decade), all the flocks are probably based on the Kaikoura peninsula and neighbouring coast. Their morning departure for the feeding grounds, and evening return to roost on the reefs and breeding areas, are spectacular features of the winter scene at Kaikoura.

Red-billed gulls predominate in the flocks feeding at sea, with white-fronted terns and a few mollymawks also present. In addition, pilots occasionally reported smaller groups of other species feeding close inshore between Motunau I. and Goose Bay; spotted shags and sooty shearwaters may be identified from their descriptions, the latter species appearing particularly in April and May during their northward migration. Although fluttering shearwaters frequently feed close inshore at Kaikoura and Goose Bay, and many fairy prions and white-faced storm petrels breed at Motunau I., no concentrations of smaller petrels were recorded by pilots.

*Dolphin schools* are often visible from the coast road south of Kaikoura, and the common dolphin (*Delphinus delphis*), dusky dolphin (*Lagenorhynchus obscurus*) and common porpoise (*Cephalorhynchus hectori*) have all been

washed up in the area. Aerial observations suggest the existence of several schools of 50-200 animals, which amalgamate in autumn to form groups of well over 1000. In April 1963 schools of 200-500 were noted, and throughout May they were especially plentiful, although dispersed in large groups up and down the coast. On 31 May over 1000 were amassed off Conway Bank, apparently heading eastward out to sea. Smaller schools appeared in June, and between July and November schools were scattered and seldom included more than 100 dolphins. The size of the schools increased from December onward, and in April and May 1964 concentrations of up to 1200 were again reported, mostly to the south of Kaikoura.

Dolphins were recorded more frequently south than north of Kaikoura (Fig. 3, extreme right); their main centre lay between Conway Bank and Kaikoura throughout the year, and they seldom appeared south of Conway Bank in the Motunau or Pegasus Bay areas. While the distribution of fish shoals and bird flocks is very closely correlated, there are no records of fish shoals being attacked or even accompanied by dolphin schools.

*Plankton shoals* were not recorded as such by the pilots, but their presence is inferred from birds feeding on the water where no fish shoals could be seen. They may also form the nuclei around which many of the fish shoals are assembled. Large patches of reddish-brown water occasionally reported close inshore at Pegasus Bay in July and August, with only a few attendant sea birds, suggest shoals of *Munida* larvae (Knox, pers. comm.).

*Whales* were recorded singly and in small groups: most were described as large, and were probably humpbacked (*Megaptera nodosa*) or sperm (*Physeter catodon*) on migration. Of 30 records, all but four were between April and July; there were 16 records in April and May 1963, but only two in the same months of 1964. All whales were sighted in fairly deep water, close inshore by Kaikoura or well out to sea (Fig. 4). Whaling stations were formerly established on the peninsula and on the coast to the north and south.

*Discoloured water* was frequently reported by the pilots. Muddy water from the rivers was usually distinguishable as a series of fans, tending to merge and spread northward with green water from the Canterbury Current.

Two reports, dated 26 October and 14 November 1963, showed the fans spreading southward before strong northerly or north-westerly winds. On 26 October the effect was marked at the mouths of each of the three rivers (Conway, Waiau and Hurunui) entering the sea between Kaikoura and Motunau I., but on 14 November only the Hurunui outwash was markedly deflected southward.

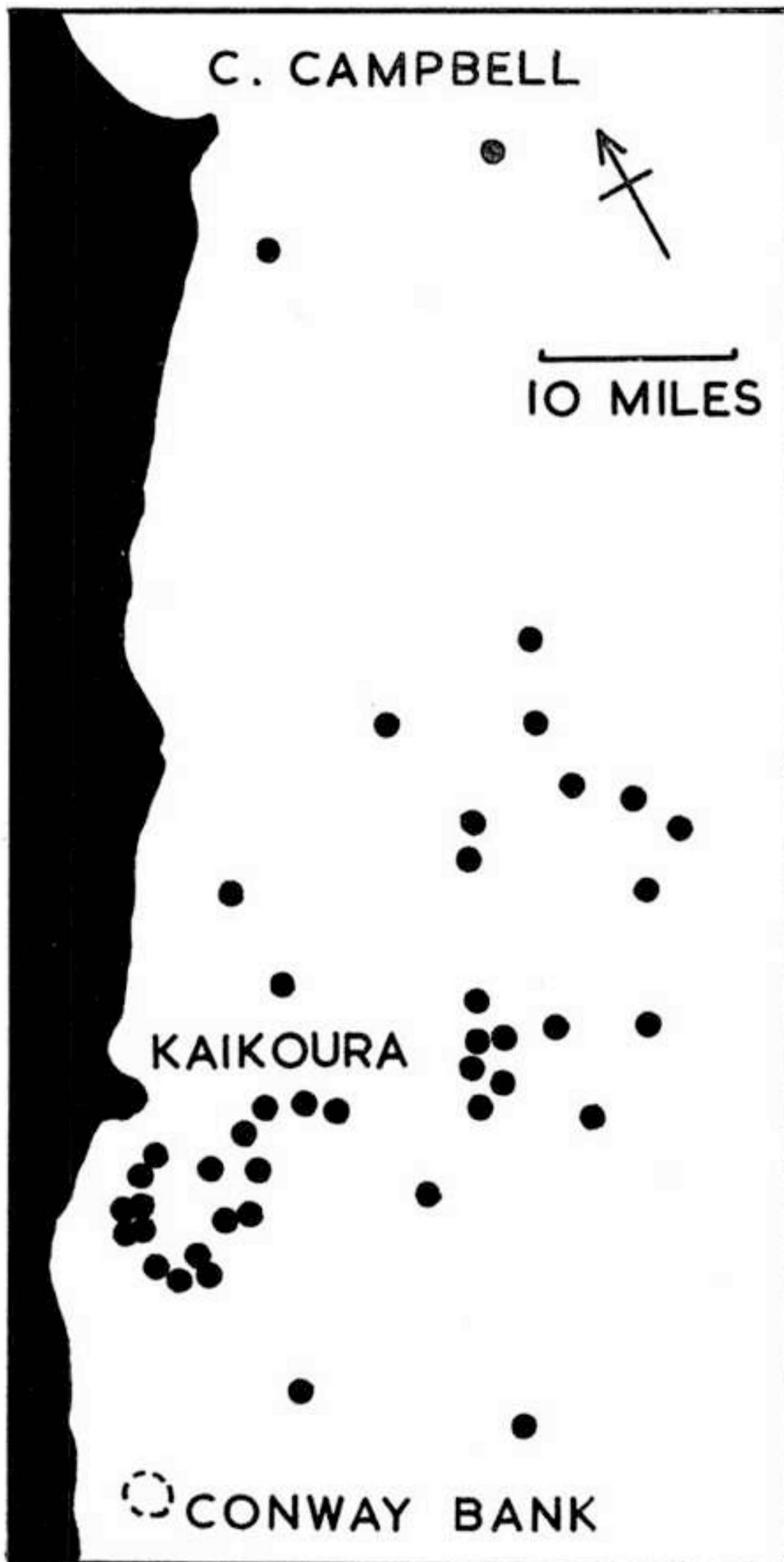


FIGURE 4. Whale sightings off Kaikoura, April 1963-May 1964. Each dot represents a single whale or group of whales.

Many reports commented on green water inshore and to the south of Kaikoura, and clear deep blue water offshore and to the north, the two separated by a fairly distinct boundary. More critical observations might help to determine movements of the sub-tropical convergence and other marine discontinuities.

The aerial survey has suggested a number of research problems of ecological and economic significance. Local enrichment, the presence of plankton, fish and large flocks of dependent sea birds, and the proximity of a marine biological station and a fishing community, provide opportunities unique in New Zealand for studies of marine food chains and predator-prey relationships. The recent growth of the gull population (see below) and its relation to the available food, suggest long-term problems of unusual bionomic interest to accompany fisheries investigations in the Kaikoura area.

#### FUR SEALS

Non-breeding groups of New Zealand fur seals (*Arctocephalus forsteri*) have been reported for many years on the Kaikoura reefs. Their numbers have increased markedly during the past decade, especially since 1958. Bell (pers. comm.) reported totals of 46 and 50 in May and June 1956, and 30 in August 1957. By contrast 427 were present on 11 May 1964 (pers. obs.), rising to over 550 in mid-August (Rasmussen, pers. comm.). Numbers are lowest at Kaikoura between November and January, possibly due to the attraction of breeding areas off southern New Zealand and the subantarctic islands. In December 1957 Bell recorded only seven seals, and 12 one year later. In November and December since 1960, I have recorded totals between 60 and 150, although interference from visitors at this season makes accurate counting difficult. Thus populations at present fluctuate annually between 60 and over 550. Immature and mature males predominate. From March onward small animals, possibly pups of the year, appear among the older males. Carcasses and skeletons of several males collected during the past four years are deposited in the University of Canterbury Zoological Museum. Large females have occasionally been reported on the reefs, but none has so far been found dead. No breeding activities have been recorded, although Rasmussen (*in litt.*) saw aggressive behaviour among bulls in May 1964, and a female with a pup of the year was seen in May 1963.

Street (1964: 9) records the stomach contents of nine fur seals shot at Kaikoura as squid 19.2%, barracouta 41.5%, and miscellaneous fish (including whiptail *Macruronus novaezealandiae*) 39.3% by weight. His findings from this and other New Zealand areas do not support the contention of local fishermen that the recent increase of fur seals has reduced the numbers of crayfish and penguins at Kaikoura.

### SEA BIRDS

About 40 species of seabirds nest at, or regularly visit, the Kaikoura area. Numerically there is a marked preponderance of birds which feed at sea. Red-billed gulls and white-fronted terns are present in thousands, and hundreds of spotted shags and small petrels (which feed offshore) have been recorded in successive winters; birds which feed along the shore are present in much smaller numbers. The following list includes records by Bell from 1952 onward, but is probably not exhaustive.

*Penguins.* None are known to breed in the area. Yellow-eyed penguins (*Megadyptes antipodes*), New Zealand crested penguins (*Eudyptes p. pachyrhynchus*), white-flippered penguins (*Eudyptula albosignata*), and both the southern and northern forms of blue penguin (*Eudyptula m. minor*) have been recorded alive on the beaches or washed up dead. Local reports suggest that blue penguins were once more plentiful along the coast and may have bred, but there are few likely breeding sites on the peninsula and a coastal road and railway may have made the neighbouring shores unfavourable.

*Petrels.* Wandering and royal albatrosses (*Diomedea exulans* and *D. epomophora*), New Zealand black-browed mollymawks and Buller's mollymawks (*D. melanophris* and *D. bulleri*), and giant petrels (*Macronectes giganteus*) have been recorded dead on the beaches, and are frequently seen at sea. Fluttering shearwaters (*Puffinus g. gavia*) and small blue petrels, probably fairy prions (*Pachyptila turtur*), often feed within sight of the shore in large, wheeling flocks; occasionally hundreds of fluttering shearwaters feed among kelp two or three yards off shore. Broad-billed prions (*Pachyptila v. vittata*), white-faced storm petrels (*Pelagodroma marina maoriana*) and Buller's, Hutton's and sooty shearwaters (*Puffinus bulleri*, *P. gavia huttoni* and *P. griseus*) have been recorded dead.

*Gannets and shags.* The Australian gannet (*Sula bassana serrator*) is a frequent visitor; adults and juveniles appear singly or in twos and threes in any month. They feed in deep water just beyond the reefs. Between 20 and 30 pairs each of pied shags and white-throated shags (*Phalacrocorax v. varius* and *P. melanoleucos brevirostris*) nest in trees bordering Lake Rotorua (Figure 1) in company with fewer black shags (*P. carbo novaezealandiae*). Black shags feed only occasionally along the shore, but 25-35 each of pied and white-

throated shags feed about the peninsula and neighbouring rocky coasts throughout the year. Pied shags usually feed just beyond the rocks and toward the middle of the bays on either side of the peninsula. White-throated shags fish close inshore, over the intertidal zone at high tide and in shallow water and rock pools among the reefs. Spotted shags (*P. punctatus punctatus*) are not known to breed along the Kaikoura coast, but flocks of young birds and adults in non-breeding plumage are prominent in winter. About 500 birds roost on Riley's Rock, and smaller groups often rest on rocks near the Kaikoura fish quay. By day spotted shags feed over deep water 3-4 miles off shore, returning at intervals to rest on the fish quay rocks. A marked movement takes them back to Riley's Rock before sunset.

*Hérons.* Bell (pers. comm.) reports that a single pair of blue reef herons (*Egretta s. sacra*) breeds annually on Riley's Rock. Up to about six usually feed in the intertidal zone about the peninsula in winter. White-faced herons (*Notophayx novaehollandiae*) may be increasing; up to a dozen were counted in May 1961, but 26-30 in May 1964. They feed in rock pools and among algae at low tide, roosting high on the south-eastern cliffs at night. They may breed in high trees on a saddle between Lakes Rotorua and Rotoiti (Bell, pers. comm.).

*Ducks and waders.* A single pair of mallard/grey duck hybrids (*Anas platyrhynchos/superciliosa*) nests annually in the brackish lagoon at the western tip of the peninsula. Winter flocks of up to 20 feed intertidally, especially during the shooting season when lakes are disturbed. South Island pied oystercatchers (*Haematopus ostralegus finschi*) in winter flocks of 50-60 feed on extensive sand flats and rocks at low tide; polychaet setae are prominent in their droppings. The flocks often include two or three northern and black oystercatchers (*H. unicolor reischeki* and *H. u. unicolor*). Six to eight pairs of pied stilts (*Himantopus h. leucocephalus*) breed each year on the edges of the lagoon, feeding there and on nearby tidal flats. One or two pairs of banded dotterel (*Charadrius bicinctus*) breed at the northern end of the lagoon. Turnstones (*Arenaria i. interpres*), Knot (*Calidris canutus rogersi*), Pacific golden plovers (*Charadrius dominicus fulvus*) and bar-tailed godwits (*Limosa lapponica baueri*) have been recorded as transient visitors.

*Gulls, terns and skuas.* Red-billed gulls (*Larus novaehollandiae scopulinus*) are the most prominent birds at Kaikoura, breeding in large groups on three rocky headlands along the south-eastern face of the peninsula. Smaller groups nest at Otamatou Rock, Pinnacle Rock and Riley's Rock (Figure 1). They have increased markedly during the past few years, from about 1000 nests in 1957 to 1500-1600 in 1958 and 1959, and about 2500 in 1962 and 1963 on the peninsula alone, with a further 400-500 in the smaller isolated groups (Bell, pers. comm.). The birds feed mostly over the fish shoals in summer, possibly travelling up to 50-60 miles north or south of their base each day in search of food. There is usually a spectacular dispersal from the peninsula roosts on winter mornings and a homeward flight at night; occasionally temporary roosts are formed on isolated rocks along the shore north and south of the peninsula. Red-billed gulls sometimes feed singly or in small groups among the coastal rocks, or dabble in shallow water just beyond the reefs. White-fronted terns (*Sterna striata*), although almost as numerous,

are less prominent at Kaikoura. They usually breed close to the gulls on patches of gravel and sand where their nests are hard to find and almost impossible to count. Bell (pers. comm.) estimated 2000-2500 nests in 1957 and 1958; I estimate that not more than 1500 pairs nested in 1962 and 1963. White-fronted terns often feed close inshore in small flocks, but larger flocks fly out to sea in the mornings and return at sundown. They probably feed among the gull flocks. Courting birds sometimes carry silver fish 5-7 cm. long in their beaks; food species have not been identified. Black-backed gulls (*Larus dominicanus*) roost on the reefs in winter, usually in small flocks totalling 100-150 birds. They feed intertidally and scavenge about the fish quays. In summer this species becomes less prominent; only two or three pairs are believed to breed on the peninsula, but Riley's Rock supports about 100 nests (Bell, pers. comm.). Caspian terns (*Hydroprogne caspia*), black-billed gulls (*Larus bulleri*), Arctic skuas (*Stercorarius parasiticus*), and southern skuas (*Catharacta skua lonnbergi*) are occasional visitors. About 20 pairs of black-billed gulls nested among red-billed gulls on the peninsula in 1964. None of their chicks survived.

#### SUMMARY

This paper describes the Kaikoura peninsula and neighbouring coastline and draws attention to the rich fauna of sea birds, seals and dolphins centred in the area. Local water movements are summarised, and information given of persistent fish shoals, large dolphin schools, inshore whale movements, and the extensive feeding range of Kaikoura's red-billed gulls, from reports contributed by commercial pilots. An annotated list of sea birds is presented.

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## NOTES ON THE 1964 ERUPTION AND THE VEGETATION OF RAOUL ISLAND

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The sudden eruption of the Raoul Island volcano on 21 November 1964 abruptly terminated the Ornithological Society of New Zealand's\* Expedition to the Kermadecs which had arrived only two days previously. The following observations are mostly little more than general impressions gained by the writer who was the botanist to the Expedition. The parts of the island visited were the north and east sides and the central crater area.

Raoul Island is the largest of the Kermadec group and lies just south of latitude 20° 15' S. and east of longitude 178°W. Thus it is on the fringe of the subtropical region and has a mean annual temperature which averages 19.0°C. Rainfall averages 59 inches per annum and is fairly well distributed. The total area is 7260 acres, of which nearly half is occupied

by the large central caldera, in the bottom of which are three lakes. The whole island is of volcanic origin, and the andesitic rock, often overlaid with pumice, has generally resulted in a very rugged surface. The highest point, Moumoukai peak, is just under 1700 feet, and forms part of the mostly steep-sided rim of the caldera.

Raoul does not seem ever to have had a permanent Polynesian settlement. After serving as a rendezvous for whalers in the early 19th century, a number of attempts at settlement were made by Europeans during the

\* I acknowledge with gratitude the opportunity to visit Raoul Island given me by the Council of the New Zealand Ornithological Society, and the assistance from members of the Kermadec Expedition.