THE DISTRIBUTION OF BREEDING RED-BILLED GULL COLONIES IN NEW ZEALAND IN RELATION TO AREAS OF PLANKTON ENRICHMENT

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INTRODUCTION

In New Zealand the Red-billed Gull *(Larus novaehollandiae scopulinus)* is predominantly a coastal breeding species; 82 colonies are known to occur on the coastline or offshore islands and only two inland (Fig. 1). The latter are at Lake Rotorua (Gurr and Kinsky, 1965) and at Kohukohu (Cowan 1967).

Records suggest that crustacea are the main food of the coastal colonies during the breeding season and that the euphausiid *Nyctiphanes australis* is especially important. Turbott and Bull (1954) found chicks regurgitated *N. australis* at the Three Kings Islands colonies; Buddle (quoted by Wheeler and Watson 1963) noted they were fed " shrimp " at Mokohinau Island; Gurr and Kinsky noted chicks were fed extensively on small crustacea at the Lake Grassmere and Kapiti Island colonies but small fish in the Nelson colonies. The adults and chicks in the large Kaikoura colonies feed almost exclusively on *N. australis* (Mills 1967).

According to Sheard (1953) euphausiids usually live in the water layers near the bottom of the shelf; feeding on copepod faecal pellets and diatoms. At Kaikoura Grieve (1966) found the maximum concentrations of all euphausiid stages were between 100 and 22 metres below the surface. However, both these authors note that *N. australis* swarms at the surface during breeding.

At Kaikoura these swarms are usually attended by sprats *(Maugeclupea antipodum)* kawahai *(Arripis trutta)* and Red-billed Gulls. Stonehouse (1965) recorded flocks of 2,000 gulls associated with such swarms; smaller flocks totalling several thousand birds occurred simultaneously along many miles of coast. Turbott and Bull observed similar feeding flocks at varying distances offshore near Three Kings Islands.

The Red-billed Gull colonies in New Zealand are situated predominantly on the east coast (Fig. 1). Gurr and Kinsky have suggested that there are few colonies on the west coast because the gulls require relatively calm conditions for feeding at sea and thus feeding is restricted to lee shores. They further considered that except for local areas of sheltered water about New Plymouth, Kapiti Island, Mana Island, Fiordland, and opposite Muriwai and Okarito, the open and exposed western coastlines are unsuitable for foraging.

If sheltered water is the sole factor determining the location of colonies it is difficult to see how colonies flourish at Three Kings Islands. These colonies are in an exposed situation 35 miles to the north of the mainland of New Zealand, yet are among the

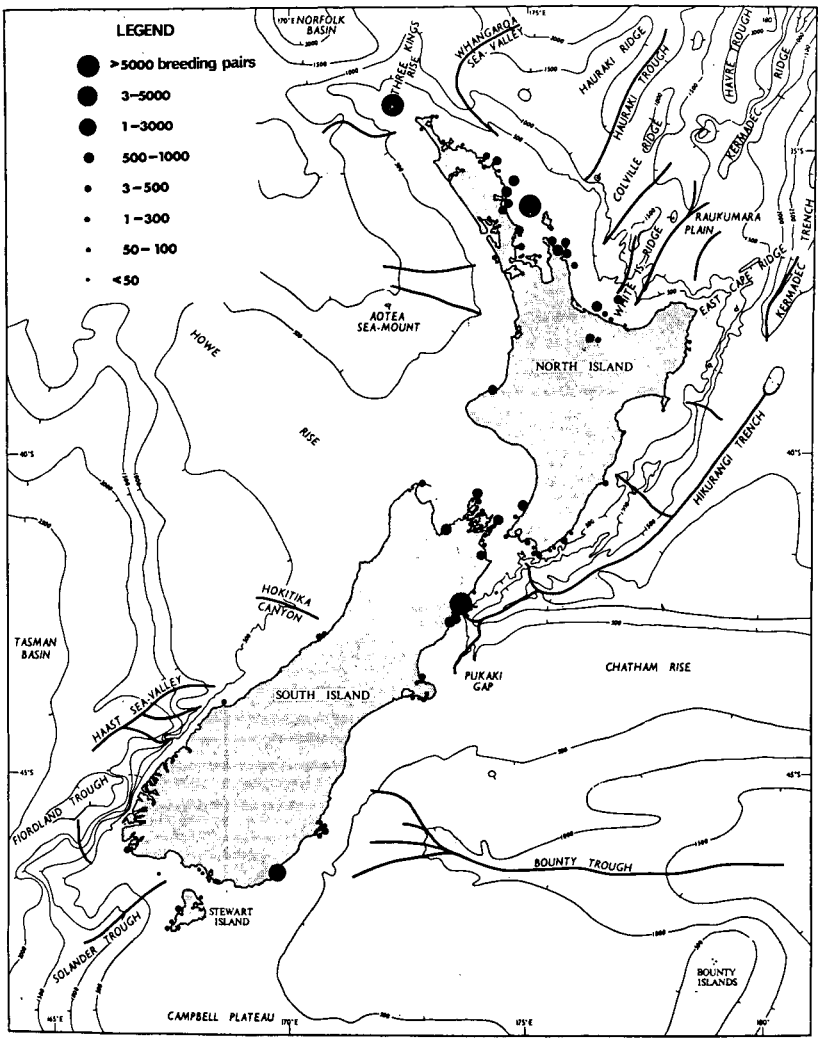

FIGURE 1 — Distribution of Red-billed Gull *(Larus novaehollandiae scopulinus)* Breeding Colonies and the Major Canyon Connections Between the New Zealand Shelf and Abyssal Areas. (After Brodie, 1964; Gurr and Kinsky, 1965)

largest in New Zealand. The distribution of colonies on the east coast is very irregular and perhaps factors other than, or additional to, that of sheltered water, determine the distribution of gull colonies in New Zealand.

To support large numbers of breeding birds an abundant and continuous food supply in close proximity to the colony is essential. As noted earlier, planktonic crustacea, especially euphausiids, are utilised by breeding Red-billed Gulls. The amount of plankton in the surface layers of the ocean depends to a large extent on the availability of nutrient salts and sunlight. Nutrient salts are most abundant in areas where there is extensive, free, vertical circulation of water from the lower levels to the euphotic zone. Bourne (1963) lists the following phenomena which promote mixing between the surface and deeper layers of the ocean: turbulence in ocean currents along irregular coastlines and around islands, wind movement of surface water away from a coast and diverging currents which cause upwelling at sea.

Murphy and Shomura (unpublished manuscript) quoted by Ashmole and Ashmole (1967) emphasise the importance of " fronts " in concentrating plankton into small areas. According to Voorhis and Hersey (1964) a front is detected by abrupt changes in the surface temperature. Many of the fronts which develop are associated with convergence and sinking (Uda 1938, Cromwell and Reid 1956, Knauss 1957). Ashmole and Ashmole pointed out that the biological significance of such fronts is that: " they tend to concentrate plankton species which are capable of resisting the downward currents." King and Demond (1953) emphasise that where a strong convergence develops for a sufficient length of time, an area of high plankton abundance should result. Murphy and Shomura quoted by Ashmole and Ashmole pointed out that " front like " circulation cells and eddies also develop near islands especially on the leeward sides. Ashmole and Ashmole explain that whereas upwelling and vertical mixing of nutrient rich water produces a broad zone of enrichment tens or hundreds of miles wide, the concentration of organisms at a convergent front may be only a few yards wide.

In the following section the distribution of Red-billed Gull breeding colonies is considered in relation to hydrological features which could promote plankton enrichment near the colonies.

DISTRIBUTION OF GULL COLONIES IN RELATION TO PLANKTONIC ENRICHMENT

Upwelling of subsurface water close to New Zealand has so far been detected at Cape Reinga, East Cape, Cape Farewell, Kaikoura and in Cook Strait (Table 1). With the exception of East Cape, these are comparatively large gull colonies with a long history of occupancy.

The East Cape upwelling is apparently variable as Garner (1961 p. 21) found no sign of it in 1953. This variability may account for the absence of breeding colonies in the vicinity. As the upwellings at Kaikoura, Cape Reinga and Cook Strait occur near the head of submarine canyon systems, the distribution of colonies shown by Gurr and Kinsky has been superimposed upon the bathymetric chart of the New Zealand Shelf (Brodie 1964) Fig. 1.

TABLE 1 — Red-billed Gull *(Larus novaehollandiae scopulinus)* Colonies in Vicinity of Known Areas of Upwelling of Subsurface Water

Areas of Upwelling	*Colony*	*Size (Pairs)*	*Authority of Upwelling*
Cape Reinga	Three Kings Islands	6000	Garner 1954 pp 295 & 299 1959 p 326 1961 p 17
East Cape	–	–	Garner 1959 p 334
Cape Farewell	Farewell Spit	c175	Garner 1954 pp 297 & 299
Cook Strait	Large No. in Vicinity	c6000	Garner 1961 pp 15, 51 & 52
Kaikoura	Kaikoura Peninsula	6000	Garner 1961 pp 15, 51 & 52

Colonies Associated with Submarine Canyons

The hydrological phenomena off the Kaikoura coast are complex (Grieve 1966). Periodic upwelling of subtropical water throughout the year has been detected by Garner (1961), Houtman (1965) and Grieve (loc. cit.). Grieve considers that the bottom configuration in conjunction with the current and wind systems off the east coast produce the upwelling phenomena. Stonehouse (1965) has shown that the enrichment from the Kaikoura Canyon is carried northward by the Canterbury Current (Fig. 2) and possibly southward by northerly and northwesterly winds.

In addition to those noted earlier (Kaikoura, Cook Strait and Cape Reinga), Fig. 1 shows that many of the troughs coming close to the shoreline have gull colonies near them or at least within the flying range of 30-40 miles. (Stonehouse (loc. cit.) has shown that the feeding range of the Red-billed Gull at Kaikoura extends 50 - 60 miles north and south of the colonies.)

Although Mokohinau Island is approximately 60 miles from the head of the Hauraki Trough, enrichment could be carried closer to it by the South Auckland Current (Fig. 2) and southeasterly and easterly winds. In the Hauraki Gulf, seasonal intrusions of oceanic water and plankton occur nearly every summer (Dr. J. B. Jillet, pers. comm.). The plankton brought in is frequently characterised by swarms of salps, doliolids, and large numbers of euphausiids and chaetognaths. Cassie (1960) also gives a general account of such intrusions.

Colonies Associated with Turbulent Water

Tidal currents about Cook Strait produce turbulent and rapid fluctuations in speed and direction of the water at and below the surface (Gilmore 1960). This movement could promote the production of " fronts " and could also provide renewal of nutrients to the surface layers for the 13 colonies in this region.

Similarly the large number of small colonies on islands in the Hauraki and Bay of Plenty areas may depend on feeding areas

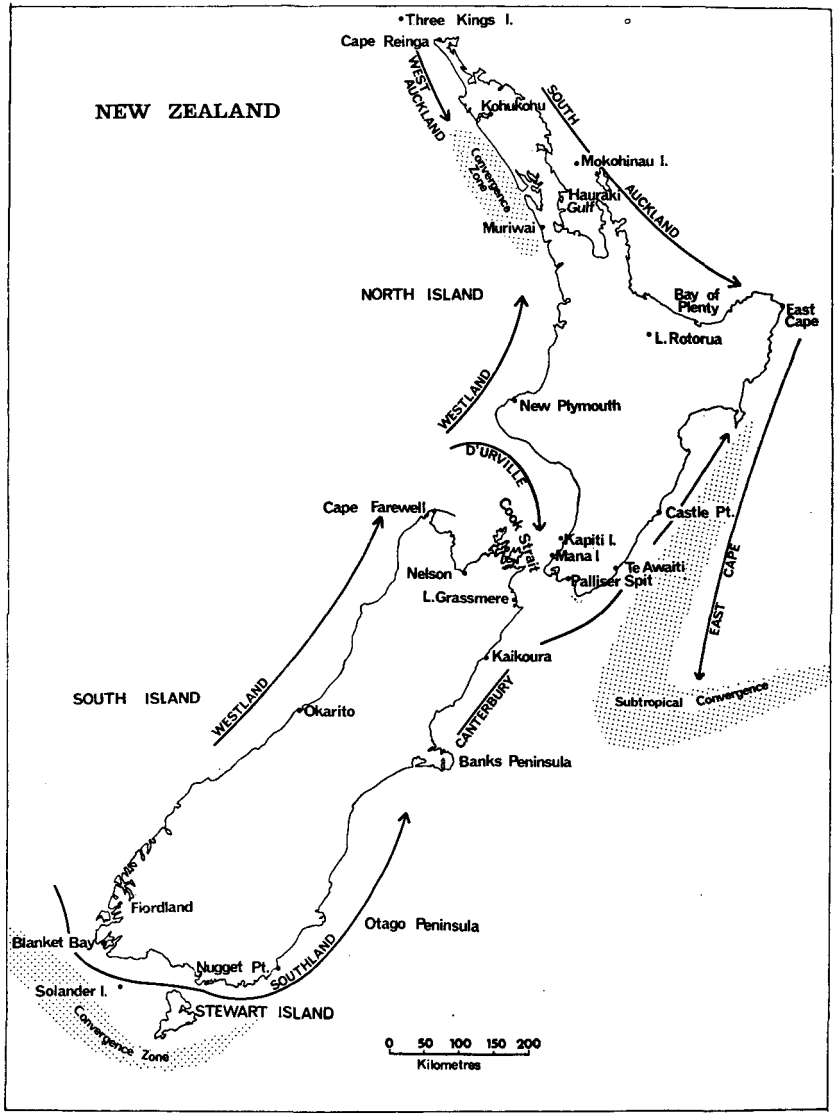

FIGURE 2 — New Zealand Coastal Currents. (After Knox, 1963)

supported by turbulence developing " front like " circulation cells and eddies around the islands, and those on Banks Peninsula and the Otago Peninsula on the turbulence developing along the irregular coastline.

Colonies Associated with the Wind Drift Upwelling

The colonies at Muriwai, New Plymouth, Kapiti Island and Mana Island (along the west coast of the North Island) lie in the same zone as the beds of the toheroa *(Amphidesma ventricosum)* (Cassie 1955). As these species utilise zooplankton and phytoplankton respectively, Cassie's account of factors affecting toheroa distribution is relevant. He suggests that an upwelling of deeper water off the west coast of the North Island may be induced by prevailing winds which tend to move surface water away from the coast. During the summer and autumn (December to May) the North Island lies within the influence of the subtropical anticyclone and any easterly to southeasterly winds experienced during this period would tend to induce upwellings of colder water near to the coast (Garner 1954).

Colonies Associated with "Fronts"

The Sub-Tropical Convergence could produce conditions favourable for the increased production of plankton at Te Awaiti, Castlepoint and Palliser Spit. Similarly localised plankton enrichment could be produced at Muriwai at the convergence zone of the West Auckland Current and the Westland Current.

DISCUSSION

Other things, such as nesting area and distance from the feeding area being equal, the size of the breeding colonies is probably indicative of the availability of plankton, especially *N. australis,* which in itself depends on the extent of the water enrichment.

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SUMMARY

The main food of breeding Red-billed Gulls *Larus novaehollandiae scopulinus* in New Zealand appears to be the planktonic euphausiid *Nyctiphanes australis.* The distribution of the breeding colonies is discussed in relation to offshore hydrological features which could result in plankton enrichment near the colonies.

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SHORT NOTE

OYSTERCATCHERS AND BANDED DOTTERELS NESTING HIGH IN CENTRAL OTAGO

SOUTH ISLAND PIED OYSTERCATCHER *(Haematopus ostralegus finschi)*

Pairs assemble below the retreating snows (about 4000ft.) during November on the unforested inland ranges where suitable swampy meltwater basins, cirques and subalpine tarns and swamps occur e.g. Old Man, Dunstan, Pisa, Carrick Ranges. (It is interesting to note that in the ranges further to the north and northeast of the area, where the Otago green schists grade into less metamorphosed 'greywackes,' the summit slopes are steeper and suitable habitat of the type mentioned above is lacking, e.g. Kakanuis, Hawkduns and St. Bathan's Ranges.)

Nest-sites range from ca. 4000ft. to 6000ft. close to the wet habitats mentioned, the nests themselves being invariably situated on top of a dry, well-drained frost hummock in the subalpine tundra zone, which usually is a *Dracophyllum muscoides - Raoulia hectori* community.

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BANDED DOTTEREL *(Charadrius bicinctus)*

Preferring the drier type of habitat, with short vegetation, these dotterels are to be found both on the subalpine tundra zone as above, and on suitable neighbouring zones both below and above that altitude, e.g. among Blue Tussock *(Poa colensoi)*, among the mixed subalpine herbfield, and at the top of the ranges on the fellfield. Altitudinal distribution is thus about 4500ft. to 6200ft., varying somewhat on each range.

An unusual extension of their normal lowland distribution occurs on the semi-arid northern slopes of the Old Man Range towards the Fraser Dam, where they are to be found in small numbers on the short turf-scabweed areas up to ca. 3000ft.

— PETER CHILD