# SEABIRD ABUNDANCE PATTERNS ALONG A SYDNEY-LOS ANGELES TRANSECT

CHRISTOPHER D. MCQUAID

*Department of Zoology and Entomology, Rhodes University, South Africa (c.mcquaid@ru.ac.za)*

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## ABSTRACT

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Our understanding of seabird occurrence patterns is influenced by the fact that some parts of the ocean are less travelled than others, particularly in the centres of oceanic gyres. During the Transglobe Expedition, the M/V *Benjamin Bowring* undertook a 34-day crossing of the Pacific Ocean from Sydney to Los Angeles. During the crossing, three one-hour watches were conducted daily (morning, noon, and evening), during which all birds visible from the ship were counted and identified (when possible). Bird counts were extremely low in the central regions of the South and North Pacific gyres, in stark contrast to the elevated counts—by orders of magnitude—recorded over seven days in the waters of the South Equatorial Current. The sparseness of seabirds in oligotrophic regions of the world ocean is as noteworthy as their abundance in more productive areas.

**Key words:** South Equatorial Current, North Pacific Gyre, South Pacific Gyre, tropical seabirds

## INTRODUCTION

Mott & Clarke (2018) note that large sectors of the ocean, particularly in the Southern Hemisphere, remain poorly investigated with respect to seabird observations (see Figure 1 in Mott & Clarke [2018] for coverage in the Pacific Ocean). Between 01 September 1979 and 01 September 1982, the M/V *Benjamin Bowring* participated in the Transglobe Expedition, completing the first polar circumnavigation by way of a voyage from London to London via both the south and north polar regions. This expedition provided a unique opportunity to observe seabirds in widely separated and often rarely visited parts of the world's oceans, all recorded by the same observers using consistent methods from the same ship. The first report from the Transglobe effort documented seabird observations between Antarctica and Cape Town, South Africa, and between Antarctica and Christchurch, New Zealand (McQuaid & Rickett, 1984). Presented here is a much-belated second installment from the Transglobe Expedition, providing data from a southwest-northeast crossing of the northwestern portion of the South Pacific Ocean to the southeastern portion of the North Pacific Ocean, conducted from April to May 1981. While seabird occurrence patterns are well known in the eastern tropical Pacific (ETP)—that is, the eastern portion of the transect (see, e.g., Ainley & Boekelheide, 1983; Ballance et al., 2006; Pitman, 1986; Ribic et al., 1992, 1997; Ribic & Ainley, 1997)—the western tropical Pacific has received much less attention. Although the observations reported here provide only snapshots, i.e., an index of seabird abundances, some striking patterns were revealed.

## METHODS

Daily counts of seabirds were conducted during a 34-day crossing of the Pacific Ocean aboard M/V *Benjamin Bowring*, from Sydney, Australia, to Long Beach, the port of Los Angeles in California, USA (18 April–20 May 1981; Fig. 1). Observations were made each day during three one-hour watches (morning, afternoon, and evening) from the bridge deck, ~3.5 m above sea level. During each watch, all birds visible within 360° were counted for consecutive 10-min periods and, where possible, were identified to species. Given the ship's small size (61 m in length, 1,200 tons) and slow speed (9–10 knots), it is likely

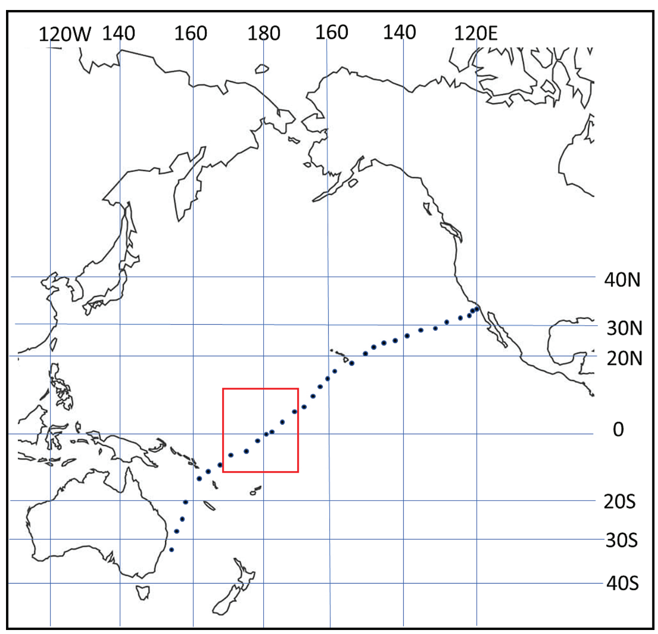


**Fig. 1.** Cruise track between Sydney, Australia, and Los Angeles, USA, 18 April–20 May 1981. Points indicate approximate midday positions. The red box encloses the seven days with high bird counts.

that some birds overtook the ship. However, full visibility along the ship's length allowed observers to identify individuals and minimize the risk of recounting birds that followed or attended the ship. The ship's position at the start and end of each one-hour watch was recorded using the satellite navigation system. Visibility, ship speed, and wind speed and direction (corrected for the ship's speed and course) were also recorded at the start and end of each watch.

Daily totals of bird abundance were summarised and categorised as either coastal (within *c*. 350 km of mainland) or open ocean. These categories were further refined into five groups: coastal Australia, South Pacific Gyre, South Equatorial Current, North Pacific Gyre, and coastal America (Fig. 2). As the number of observation days differed among these groups, abundance data were analysed using one-way ANOVA for an unbalanced design, with an alpha value of 0.05.

## RESULTS AND DISCUSSION

A total of 43 species were positively identified (Appendix 1, available on the website), including coastal species near the Australian and American mainlands. These coastal waters have been extensively surveyed (e.g., Ainley, 1976; Briggs et al., 1987; Daudt et al., 2024) and will not be discussed further in this report. In contrast, offshore waters, excluding the eastern tropical Pacific (ETP; see above), have been less thoroughly surveyed. Bird counts while crossing respective portions of the South and North Pacific gyres were generally extremely low, with no birds observed during many count periods. On many days, totals of just four or fewer individuals were recorded. ANOVA results indicated that counts in the vicinity of the South Equatorial Current (red box in Fig. 2) were significantly higher than in the South Pacific Gyre, North Pacific Gyre, and Australian coastal waters. American coastal waters showed intermediate abundances (Fig. 3). Due to their particularly large standard deviations, however, bird counts from the American coastal waters were not significantly different from those in any other region. This pattern is in accord with observations by Ainley and Boekelheide (1983) along a similar cruise track and represents a key point of interest for seabird researchers. A contemporary focus in seabird research on tracking individual species—rather than conducting broad at-sea surveys—would be unlikely to detect such a pattern (e.g., Shaffer et al., 2006).

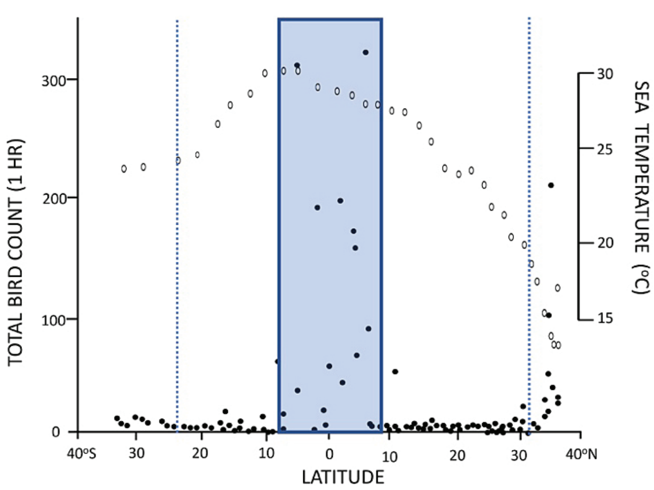


**Fig. 2.** Total number of birds counted during one-hour watches (closed points). The shaded box indicates the approximate historical position of the boundary region between the South Equatorial Current and North Equatorial Countercurrent. Vertical blue lines demarcate the Australian (left hand) and American (right hand) coastal regions. Open points indicate Sea Surface Temperatures derived for the dates of cruise, and the Copernicus Global Ocean OSTIA Sea Surface Temperature and Sea Ice Reprocessed web site (https://data.marine.copernicus.eu/product/SST_GLO_SST_L4_REP_OBSERVATIONS_010_011/description; Copernicus Marine Service, 2025).

In contrast, over a seven-day period between approximately 6°S and 8°N, flocks of 60–200 birds (with a maximum of 331) were regularly encountered, with most birds apparently feeding on shoals of fish driven to the surface by subsea predators (Fig. 2; see, for example, Spear et al., 2007). These flocks were composed primarily of Spectacled Terns *Onychoprion lunatus* and Sooty Terns *O. fuscata*, although Buller's Shearwaters *Ardenna bulleri* were also abundant on occasion. Overall, 67.4% of a total of *c*. 2,500 birds counted were observed during just seven of the 33 survey days.

The records of large numbers of seabirds coincided with the presumptive position of the South Equatorial Current (Johnson et al., 2002), particularly near the Equatorial Front, which is the boundary between the South Equatorial Current and the North Equatorial Counter Current where abundant prey are found (Spear et al., 2001). The shaded area in Fig. 2 indicates the approximate historical average latitude of this front (Lukas, 2001; Weisberg, 2001). Unfortunately, sea surface temperature (SST) was not recorded during the voyage. The SST data shown are from the Copernicus Global Ocean OSTIA Sea Surface Temperature and Sea Ice Reprocessed web site (https://data.marine.copernicus.eu/product/SST_GLO_SST_L4_REP_OBSERVATIONS_010_011/description; Copernicus Marine Service, 2025). This data set begins in October 1981, whereas the voyage took place several months earlier, spanning April and May of that year. Given the high variability in the intensity of Pacific equatorial currents (Wyrtki, 1974), the SST data are plotted for a single day in October and are presented solely for illustrative purposes.

Our understanding of the relationships between seabird assemblages in the Pacific Ocean and their physical environment has evolved significantly, progress that has been possible through the analysis of an extraordinary dataset from multiple cruise tracks in the ETP between approximately 10°N and 10°S, extending westward to the international dateline, during the early 1980s to the early 1990s. Pitman (1986) produced a seabird atlas for this region. Taking a more community ecology approach, Ribic & Ainley (1989), identified consistent species groupings associated with physical characteristics of the water column, particularly SST. They hypothesized that these assemblages would remain largely unchanged despite spatial shifts in oceanographic conditions caused by the El Nino-Southern Oscillation (ENSO). Some changes were detected during the El Niño and La Niña phases, generally involving shifts in diversity due to variations in the abundance or presence of minor species within assemblages (Ribic et al., 1992; Ribic & Ainley, 1997). The concept was further refined by Ribic et al. (1997), who proposed that seabird assemblages were more

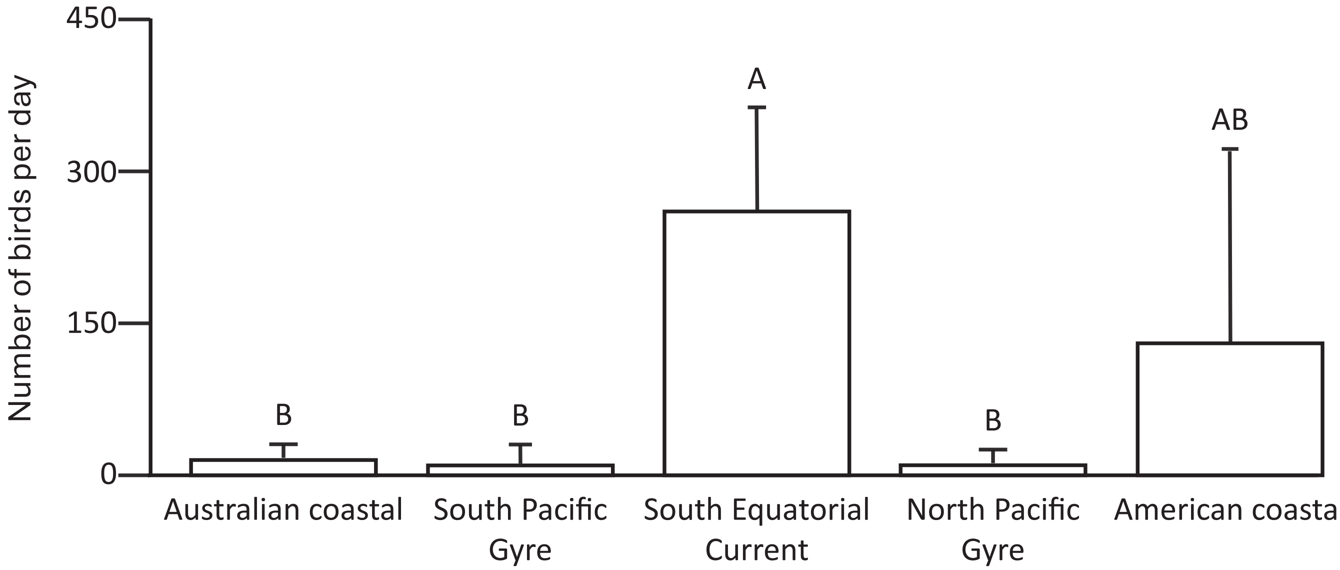


**Fig. 3.** Daily mean (+ standard deviation) for bird counts in the five regions defined in the text. Letters indicate homogenous groups (alpha = 0.05).

closely associated with ocean current systems than with water masses per se, and that changes primarily affected planktivorous rather than piscivorous species (Spear et al., 2001, 2007). Spear et al. (2001) found that high densities of planktivorous birds at the Equatorial Front were linked to the strength of the front, while densities of piscivorous birds were correlated with thermocline depth. They suggested that the latter relationship reflected the spatial concentration of prey when a strong thermocline allowed tuna and cetaceans to drive prey toward the surface (see also Ballance et al., 2006; Ballance & Pitman, 1999). Overall, these findings emphasise the complexity and subtlety of the direct and indirect processes that shape the consistent relationships between seabird density, community composition, and the physical and biological conditions of their at-sea habitat in the tropical Pacific.

An important theme running throughout this body of research is the focus on ocean productivity and seabird foraging behaviour (Ballance et al., 2006; Spear et al., 2007). Serratosa et al. (2020) showed that SST, sea surface salinity, and chlorophyll-*a* concentration were among the most important factors explaining the distribution of seabird assemblages in the South Pacific. Ribic et al. (1997) suggested that the limited impact of ENSO on seabird distributions may reflect the ability of birds to persist in areas of relatively low productivity, facilitated by sub-surface predators (see above). Focusing on feeding ecology and community composition, Spear et al. (2007) found a high degree of prey partitioning, influenced by species, sex, and body size. The ETP is recognised as a region of enhanced biological activity, especially compared to the North and South Pacific gyres, due to the effects of open ocean upwelling (see Ballance et al., 2006; Nelson & Landry, 2010). The contrast with the central gyres was striking, with some days yielding few or no seabird sightings (see also Ainley & Boekelheide, 1983). Understanding such patterns, especially where seabirds are scarce, is as important to interpreting the dynamics of tropical ocean ecosystems as identifying areas of high seabird abundance.

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## AUTHOR CONTRIBUTION

The work was conceived and carried out by the author. Data interpretation, figure preparation, and writing were done by the author.

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