OBSERVATIONS ON DIVING OF THE AUSTRALASIAN GANNET (Sula bassana serrator Gray).*

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INTRODUCTION.

In our work on the behaviour of the Australasian gannet, forty-three kinds of behaviour patterns have been found (Robertson and Wodzicki, unpublished data). Thirty-seven occur while the birds remain on land and six at sea. Of the latter, diving is the most spectacular and important, as gannets appear to feed solely by the well-known bomber-like dive.

The pattern of diving of the Australasian gannet appears to be similar to that of the North Atlantic gannet (**Sula bassana**) as described by Tucker (Witherby et al 1952) and by Gurney (1913) and Bent (1922).

According to Oliver (1930), the Australasian gannet has the same two kinds of dive—a vertical dive into deep water and a short oblique dive into shallow water near the shore. Oliver says gannets normally dive vertically in New Zealand waters from a height of 20 to 30 feet, while English observers state that North Atlantic gannets dive from usually 50 to 80 or 100 ft., and some may dive from as high as 140 ft. Except for Oliver's general statement there is no published record of any checked observation of diving height in New Zealand. Phillips (1947) gave an account of winter diving habits of gannets in Wellington Harbour.

The shallow diving of Australasian gannets was first described by Wilkinson (1927) who stated "if the sea is rough they will drop down to about 8 feet or less." Also he stated, "I have occasionally seen it dive in from about 3 feet at an angle of about 25 degrees and skip along the surface in and out like a flat stone thrown on the water."

FIELD OBSERVATIONS.

It is rather surprising that during our nine years' study of the Hawke's Bay gannetries, when over 60 visits were paid, on only three occasions were gannets observed fishing off the six miles of beach between the gannetries and Clifton (Wodzicki and McMeekan 1947, p. 231, see map), though this part of Hawke's Bay is reputed to abound in fish. On each of these three occasions the display was spectacular and lasted long enough to allow detailed observations to be made on this behaviour pattern of the gannet in New Zealand waters.

On 30th November 1953, at about 10.00 hours, a single gannet was observed fishing at a short distance from the shore in one of the bays between Black Reef and Clifton. The bird remained in sight for about a quarter of an hour, and there were 2–3 dives a minute from an altitude estimated at 15–20 feet. Despite this low altitude the bird managed to fold its wings and to assume the projectile-like position described by Bent (1922). However, when at times the bird found itself close to the shore in water probably not more than 6 to 8 ft. deep, it resorted to oblique dives as described by Wilkinson (1927). In both kinds of dives the bird disappeared and remained under the water for at least a couple of seconds.

On 4th and 22nd January 1954, one of us (K.W.) witnessed the remarkable spectacle of several hundred gannets fishing for two or three hours in the bay between Kidnappers and Black Reef. On both occasions the observer arrived when most of the birds were already congregated and fishing was in full progress. The following is an account based on field notes:

On 4th January at 17.00 a large formation of at least 500 gannets was fishing in the middle of the bay. There was intensive activity over a comparatively large area with several gannets diving like projectiles at the same time. Some black-backed gulls (**Larus dominicanus**) and perhaps

* Contributed from the Animal Ecology Section, Department of Scientific and Industrial Research.

a dozen white-fronted terns (**Sterna striata**) were also fishing with the gannets in the same area. The centre of most concentrated diving activities gradually shifted and the altered position suggested that the shoal of fish was moving. It was first located close to the Cape, then gradually shifted towards the Black Reef and eventually towards the centre of the bay. At this stage a few "flotillas"* were formed, the members of which seemed to remain inactive for quite a time.

The centre of the main fishing area comprised perhaps 25 to 30 square chains and presented a picture of an almost frenzied, though apparently organised activity. (Fig. 1.) A regular succession of activities involving several phases could be recognised in the behaviour of the fishing flock. A number of birds flew in an irregular row. A dozen or more in the front were in various phases of diving, some just turning downwards and others with wings already folded beginning their dive. All these activities happened in quick succession and about half a dozen plunges took place and the same number of splashes two to three feet high were constantly rising from the calm surface of the bay. Immediately behind the diving birds others were emerging from their dive. Behind this irregular row, several birds deep, was a large group of gannets swimming, at the rear of which about a score of birds was rising and joining the group in the air for their next dive.. The majority of the swimming and rising birds were facing into the prevailing south-easterly breeze. Most of the birds were diving from an altitude estimated at 30 to 50 ft., but some, particularly when the fishing area moved towards the shore, changed to short, oblique dives.

The fishing activity remained at much the same intensity until 19.00 when the number of gannets engaged in feeding began to dwindle, and more and more birds were seen flying towards the gannetries. At that time there were about 300 birds still fishing and a similar number of birds resting on the water in a few large "flotillas." By 19.30 about 40 gannets were still fishing, though they were hard to see in the fading light. About 200 birds remained in "flotilla" formations which increased in size by additions from the fishing flock. At 19.45 in rapidly-fading light, there were still several gannets fishing. Fifteen minutes later when the birds could no longer be seen, the splashes of single gannets diving could still be heard.

On 22nd January at 08.45 another large formation of gannets was observed about three-quarters of a mile from the shore in Kidnappers Bay. The diving pattern, the arrangement of the flock, and the number of gannets present, were very similar to those observed on 4th January. There was, however, greater variation in the location of the fishing gannets, probably due to movements of the shoals of fish in the bay.

By 09.00 a flock of about 200 gannets was fishing in the vicinity of the eastern end of the Black Reef and another small group was operating further south. By 09.20 the school of fish had apparently moved towards the shore and the flock was diving south-east of rock No. 6 of the Black Reef (Wodzicki and McMeekan, 1947). At the same time, scattered gannets began to dive all over the bay while another large flock of at least 500 birds had been formed and had commenced fishing about ten chains north of the main gannetry. There was intense activity and ten or more gannets were diving simultaneously from an altitude estimated at 25 to 30 ft.; a number of other birds were making short, oblique dives. No other birds were associated with the gannets at the time.

At 09.30 only a few gannets remained fishing south of rock No. 6 and small scattered groups were diving all over the bay but the main flock was still operating in undiminished numbers north of the Cape. At about 09.40 this flock was reduced to 300-400 birds and single birds were observed

* A "flotilla" is another pattern of behaviour of the gannet while at sea (Robertson and Wodzicki, unpublished data). A varying number of birds ranging from a score to a couple of hundred congregate together at sea, swimming, basking and preening themselves. Flotillas are a common feature of gannet behaviour and can be observed at any time in fine weather during the breeding season, a few hundred yards from the nesting colony. The significance of this behaviour pattern of the gannet is not yet fully understoood though these formations include both non-breeding birds and those "off duty."

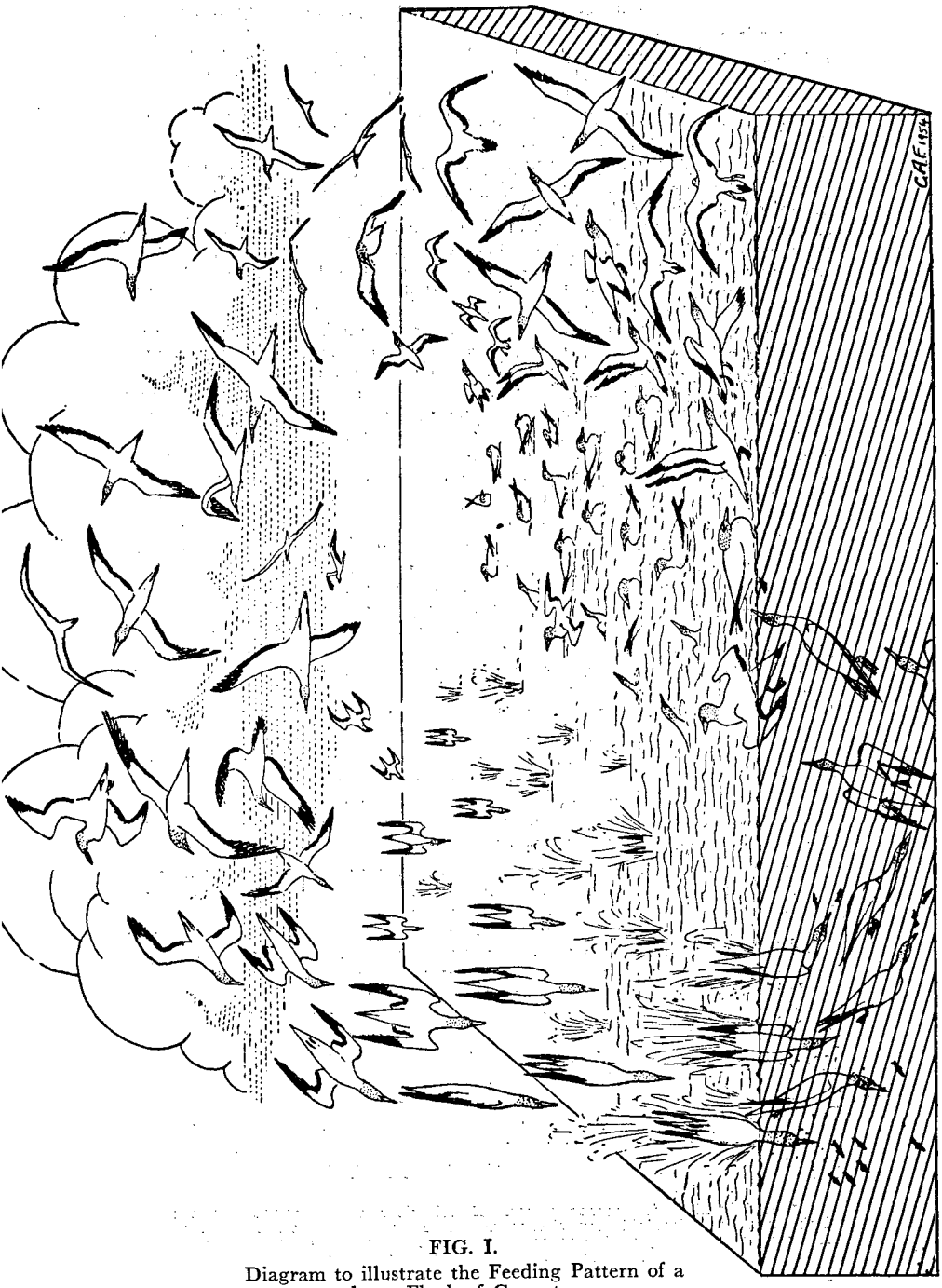

FIG. I.
Diagram to illustrate the Feeding Pattern of a large Flock of Gannets.
The vertical height is not to scale.

to join several "flotillas." While some birds were joining these congregations, others after a period of floating and basking were returning to the main fishing flock. No gannets at that time were to be seen in the middle of the bay, and the main flock fishing on an area of two to three square chains was gradually shifting eastwards toward the lone pinnacle. At 10.00 the large flock near the Cape had split into three concentrations: west and north of the pinnacle and a third one far out to the east. At this time there was still a high degree of fishing activity and about a dozen gannets were participating in each of the several phases of fishing behaviour. A few muttonbirds (**Puffinus** sp.) were feeding on the outer fringe of the gannet flock. By 10.30 the number of gannets fishing had dwindled to about a hundred, with 200-300 other birds congregated in a few "flotillas" nearby. At 10.40 the main centre of fishing involving some 50-100 birds had shifted eastwards, while the "flotillas" remained in similar strength. At 11.15 a new group of gannets associated with a dozen black-backed gulls was fishing in the bay close to the shore. By 11.30 the shoal or shoals of fish must have dispersed as gannets in small, scattered groups were diving over most of Kidnappers Bay and over a wide area beyond Black Reef towards Napier. There were now large numbers of black-backed gulls and close to the shore, some white-fronted terns. Farther at sea, hundreds of muttonbirds, many of them flying eastwards, could be seen.

DISCUSSION.

The congregation of gannets into large flocks for fishing has been known to New Zealand fishermen for a long time. Phillips (1929) reports that "gannet watchers" were stationed on certain high points around Queen Charlotte Sound to signal fishermen operating for "Picton herring" (pilchards) as gannets invariably collected and commenced diving when pilchard shoals became large.

Bartholomew (1942) has described the fishing habits of double-crested cormorants (**Phalacrocorax auritus**) in Californian waters, and concludes that small flocks hunt for individual fish and large ones pursue entire shoals of fish. According to Dice (1952) such a social band constitutes an efficient organization for feeding by the division of a fishing flock into three main components, viz. birds swimming on the surface, swimming beneath the water and flying from the rear to the front of the flock. The flock itself forms a long, narrow line at right angles to the direction of its movement.

The observations described above suggest the existence of similar social bands of gannets when fish appear in schools extending sometimes several square chains. The differences between the movements of a fishing flock of cormorants and those of gannets are mainly due to a different pattern of fishing. Cormorants secure fish by shallow dives of swimming birds, and fish are swallowed at emergence from water. Gannets secure fish usually at a greater depth owing to their perpendicular dive and swallow it under water. Otherwise, the similar three components may be also recognised in a social band of fishing gannets, i.e., birds flying from the rear to the front, diving in the front and emerging and swimming at the rear.

No abrupt stopping of fishing as described for cormorants was observed in gannets at Cape Kidnappers, suggesting that schools of fish at times dwindled but did not disappear altogether. Also the presence of three gannetries occupied by birds with chicks nearby with a population estimated at 2,800 pairs (Fleming and Wodzicki 1952) might have contributed to the extension of time spent on active fishing. Bartholomew's cormorants when replete, repaired to their usual roosts. Gannets in Kidnappers Bay returned to the gannetries or formed "flotillas," the size of which increased gradually.

The pattern of diving appeared to be in general similar to that described by previous authors. However, in comparison to descriptions given by British and American observers, it would appear that the Australasian gannet dives normally from a lesser height. This needs further confirmation as we have found it difficult to estimate accurately the height at which a gannet begins its projectile-like dive. Also, the fact observed on

4th January of gannets still diving at dusk is rather surprising and difficult to explain as it has been assumed that gannets spot their prey from the air. Mr. M. Cassie, Fisheries Laboratory, Marine Department, suggests however, that at dusk on moonless nights the phosphorescence of fish may be sufficient to assist gannets to spot their prey.

Only three species—black-backed gulls, white-fronted terns and mutton birds—seemed to be associated with gannet bands fishing at Cape Kidnappers. Of these, white-fronted terns were fishing close to the shore, and black-backed gulls out in deeper waters. The association of muttonbirds appears to be a very loose one as these birds did not come close to the shore. All these birds seemed to be ignored by the gannets though gulls and terns were at times close to fishing gannets.

ACKNOWLEDGMENTS.

We are grateful to Dr. C. A. Fleming for the preparation of the illustration, and Mr. M. Cassie kindly supplied information on movements of shoals of small fish.

SUMMARY.

Two behaviour patterns of the Australasian gannet at sea-diving and formation of "flotillas" are briefly described. On two occasions, social bands amounting to several hundred gannets were observed and a description of their feeding on large shoals of fish is given.

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LATE SHINING CUCKOO RECORD.—On May 24 and 25 a shining cuckoo was heard singing in our garden at Howick. Also on May 24 a neighbour, Mr. J. Gandy, reported that a plump shining cuckoo came to rest on a window sill of their home for a few minutes. This was probably a young bird which perhaps was not strong enough to make the migration and is wintering in New Zealand. The song consisted of the three long notes only and until the sight report came in it was thought that the notes had come from an imitating blackbird.—Noelle Macdonald, Howick.