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SCAVENGING BEHAVIOR OF THE WAVED ALBATROSS IN GALÁPAGOS: A POTENTIAL PROBLEM WITH INCREASING LONGLINING?

By: Godfrey Merlen (reprinted from Pacific Seabirds[1])

In 1994, the population of waved albatross *(Diomedea irrorata)* was estimated at 15,000 breeding pairs (Anderson 1995a). Well over 99% of their breeding activity is confined to Española Island in the Galápagos Archipelago. By attaching satellite transmitters to breeding birds during the incubation period, Anderson (1995b) was able to show that his sample (n=5) foraged over the continental shelf off Peru. However, the present report of a census carried out later in the same year shows that scavenging near the Galápagos Archipelago may also be an important part of waved albatross feeding. The proposed introduction of new fishing techniques (longlining and squid fishing) near the islands could result in a new conservation problem in an already beleaguered archipelago.

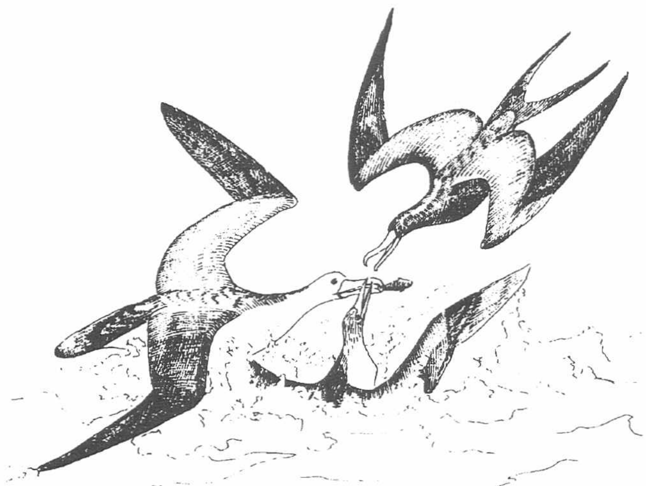
An unpublished report by the author on the occurrence and feeding activities of the waved albatross suggested that the birds are, to a greater or lesser extent, scavengers when in the waters near the archipelago during the breeding season. An excellent opportunity to further these observations on the distribution and scavenging behavior of waved albatross came when the author was asked by David Parer and Elizabeth Parer-Cook, of the Australian Broadcasting Corporation, to accompany them on a reconnaissance trip to the western part of the archipelago, aboard the motor yacht *Samba* between 1 and 14 September 1995. We maintained a dawn-to-dusk survey on nine full days. On the other days, the *Samba* was anchored or made short journeys. Observations were made on these short trips also. The survey was carried out mainly by two observers (G. Merlen and David Day), using 8x binoculars, but additional help was provided by the crew of the *Samba*, Naturalist Guide Mauricio Garcia, and by D. Parer and E. Parer-Cook. There was an excellent observation platform in the form of the flying bridge 3.5 m above sea level.

During the mostly calm weather, the distinctive white heads and necks of the waved albatross facilitated observation on the sea. Higher winds caused the birds to soar above the horizon, which aided the count in more adverse conditions. We avoided counting birds twice by only searching ahead of the boat. Whenever the boat stopped, circled, or made other maneuvers, the census was ended.

Where large concentrations of albatross were encountered, several counts were made by independent observers. After leaving such an area, no counts were made for half an hour. The average speed of travel was 8 knots and all positions were plotted by GPS.

Albatross in flight were usually alone, although a few to many were often in the same area. On the water small groups (1-3) were common.

By far the greatest concentrations were found where blue-footed boobies *(Sula nebouxii)* were or had recently been feeding. On one occasion, 389 albatross were closely associated with several other species in a feeding frenzy. Such activities were frequent offshore in deep water, when magnificent frigatebirds *(Fregata magnificens)*, common dolphins *(Delphinus delphis)*, blue-footed boobies, masked boobies *(Sula dactylatra)*, waved albatross, white-vented storm petrels *(Oceanites gracilis)*, wedge-rumped storm petrels *(Oceanodroma tethys)*, and Galápagos sea lions *(Zalophus californianus)* were present. Inshore (in shallower water or between the central islands) bottle-nose dolphins *(Tursiops truncatus)* may replace common dolphins. Feeding frenzies are associated with concentrations of fish, which include tunas, sardines, jacks and sharks (pers obs.).



The development of a feeding frenzy seemed a fixed pattern. Dolphins found the food and blue-footed boobies followed overhead. Once the food was accessible to the birds, they began to dive on it. Frigatebirds, which had kept up, often at considerable height, then descended to mob the boobies, causing them to disgorge their recently gathered fish; if this occurred, the fish was eaten by the frigatebirds. Albatross, which were present in these associations, also tried to take advantage of the melee by moving in and grabbing at the disgorged food. This was observed on dozens of occasions. We saw up to four albatross around one "downed" booby. Albatross did not seem to mob the boobies initially, but appeared to depend on the aggression and flying ability of the frigatebirds. Storm petrels picked up whatever morsels were left over.

These feeding activities were highly dynamic and moved over the ocean at speeds of up to 3-4 knots. Some lasted for hours, but many broke up after 20 minutes or so. Prediction of such events is extremely difficult, as the productivity of the region is controlled by upwellings and

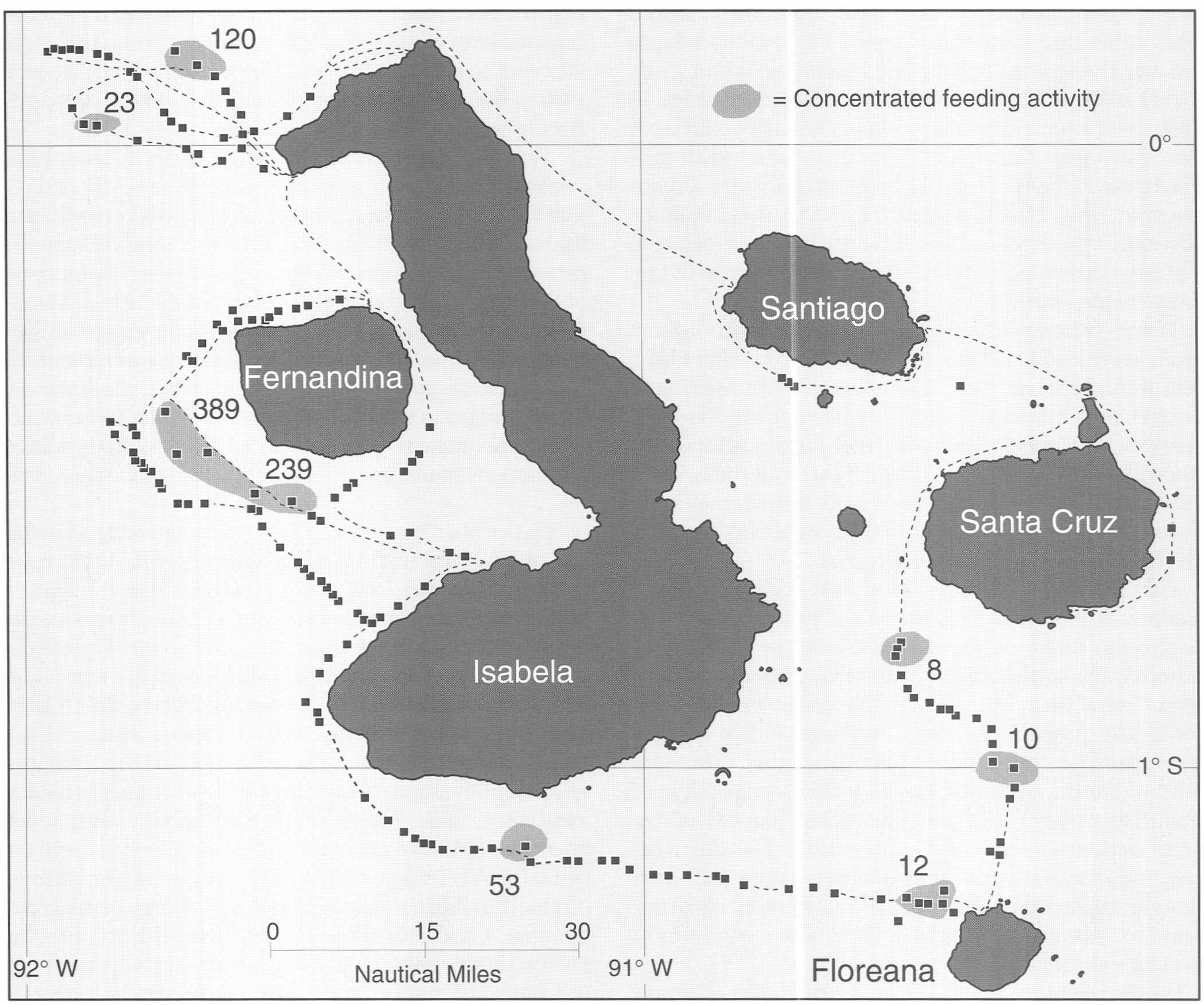


Figure 1. Survey route of the yacht *Samba* in the western part of the Galápagos Archipelago 1-14 September 1995. Locations of observations of waved albatross and of feeding concentrations are shown on survey route track.

fronts between water masses, which are unpredictable and unstable in themselves. On two consecutive days we found boobies and albatross in the same area to the south of Cape Hammond (southwest Fernandina). However, the great concentration along the equator was ephemeral and not repeated over three further days of observation. Perhaps it was due to changes in oceanic conditions or perhaps it was because on the first day (7th September) we witnessed an attack (0°09.4'N 91°44.0'W) by 7 orcas *(Orcinus orca)* on the feeding common dolphins. They killed at least one dolphin, and the small pieces that remained were scavenged by storm petrels, frigatebirds and albatross. Albatross also scavenged a large dead squid (0°19.9'S 91°43.4'W), later identified as *Angistrocheirus lesevri*. Large concentrations of albatross were always associated with feeding frenzies.

During the 24 days of observations (the cumulative time of the two reports), not a single albatross was seen feeding on live prey. Harris (1973) reported that the main food of breeding waved albatross was fish and squid. Since blue-footed boobies do not eat squid, the albatross must gather this themselves or gather it from other birds that frigatebirds attack such as swallow-tailed gulls *(Creagrus furcatus)*. Some of the fish (Clupeids) found in albatross stomach contents in Harris's study could have been scavenged. Harris (1973) observed the interaction of albatross with boobies and felt that this behavior did not contribute greatly to their diet. However, the frequency with which we observed this albatross behavior leads me to believe that at least at times, or at certain stages of life, it may be important.

When concentrated feeding by boobies and dolphins began, it seemed to act as a signal, sucking in other birds, including albatross, from a great distance. The spacing of the birds over the ocean seemed such that the individuals were in sight of their neighbors at any particular moment, although not necessarily in direct sight of all the birds in the area. The movement of those nearer the fray may have caused others, further away and not in sight of the feeding activity, to move in the same direction.

This process sometimes continued until very large numbers of boobies were present (> 1000), although often the process broke up before such large accumulations gathered. Thus, although many solitary boobies and albatross were seen, spaced over a huge area of ocean, it was highly probable that they were capable of quickly joining various concentrated feeding groups. This system could be important, as it would allow a population of boobies to survey the ocean and quickly take advantage of any feeding opportunity that occurred. The albatross, clued in to the reaction of the boobies or using their own eyesight, could take advantage of this system, allowing them to scavenge more efficiently in areas where food was more abundant.

Masked boobies *(Sula dactylatra)*, the other common diving sea bird near the islands, were not a major feature of the feeding activity and they never represented more than 5% of the boobies feeding. The figure was often as low as 2%.

It is not easy to ascertain the exact relationship of the organisms involved in feeding frenzies, because, in the Galápagos, common dolphins are very nervous of the close approach of vessels. This may be due to the presence of purse seine tuna boats, which often set their nets on the dolphins, because tunas associate with them. Or perhaps any strange noise alarms them since their predator, the orca, is present year round.

It seems that the waved albatross is, at least at some times, a scavenger. From the duration of the observations and their limitation to daylight, it is not possible to say how important this method of feeding is, nor is it possible to state the importance of feeding frenzies, even though this feeding technique is extremely common. Should it be important, then the availability of food to scavenge has to be maintained. This, in turn, means that the structure of feeding frenzies and the well being of all their components (fish, dolphins, boobies, frigatebirds) may be of importance to the feeding, and, ultimately, to the breeding success of waved albatross. In this uncertain situation, it is vital to maintain the viability of this pelagic trophic system that is found in the western part of the Galápagos Archipelago.

One of the reasons that the marine environment has remained relatively untouched until the last few years is that the fishing fleet has been slow, local, and primitive in the techniques used. At present (1996), there is enormous pressure to allow local fishermen to increase the tonnage of their fleet. This is in part because of the lure of anticipated riches in the ocean in the form of migratory fish, but also because the conservation of coastal marine resources requires reduced fishing pressure near the shoreline. A large increase in the fleet could have serious and unforeseen consequences for the marine environment, especially if strong measures are not taken to control fishing activities.

One of the "new" techniques to be introduced is the use of longlines to harvest the valuable yellow fin tuna *(Thunnus albacares)* and other pelagic fish in the waters surrounding the Archipelago. As it is, longliners are already arriving from the mainland of Ecuador. The effects of longlining on albatross in other parts of the world has been catastrophic (e.g., de la Mare and Kerry 1994, Gales 1993.). Albatross scavenge from the baited hooks as they enter the water. It is not known whether waved albatross will adopt the same habit once this food source becomes available to them. However, with the knowledge that the birds are not only scavengers, but also feed largely on squid (Harris 1973), which is a popular bait for longlining, it is inadvisable to ignore the effects that may result from opening a fishery without further studies. In order to protect the assemblage of animals that may help to ensure the future of the endemic waved albatross, an overall protection should be given to the waters within the Marine Reserve (15 nautical miles seaward from the perimeter of the Archipelago) by prohibiting potentially dangerous fishing techniques within this area. This is not only for the protection of single species, but for the well being of the ecosystem.

I would like to thank David Parer and Elizabeth Parer-Cook for giving me the opportunity to travel with them. Also to the crew of the *Samba* for the use of their keen eyes and especially to David Day.

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GALÁPAGOS PLUMOLOGY

By: Karen Harpp and Dennis Geist

INTRODUCTION

Although the Galápagos Islands are best known as one of the world's greatest natural laboratories for biological studies, they have also lent considerable insight into the dynamics of the earth's interior. Modern accounts of the geologic origin of the Galápagos Islands, including popular descriptions (e.g., Boyce 1994, Jackson 1990), attribute their formation to a "hotspot" or "mantle plume." The term "hotspot" refers to localities where volcanoes occur in the middle of one of the earth's great tectonic plates; hotspots are unusual, because over 90% of the world's volcanic activity occurs at plate boundaries. It is thought that hotspots result from "mantle plumes," conduits of hot, plastic (but not molten) rocks that ascend from deep within the earth's mantle (Figure 1). As these plumes of hot rock rise to depths of about 100 km from earth's surface, they begin to melt. When the melted fraction of the rock reaches several percent, it segregates from the rock (like water being squeezed from a damp sponge), eventually erupting to form volcanoes. No one knows the depth to the roots of mantle plumes, but most geologists believe they come from a layer in the earth's mantle either at 650 km or from the bottom of the mantle at 2700 km depth. Recent work on Galápagos lavas has identified some problems with the simple mantle-plume theory, but has taught us much about the origin, composition, and behavior of hotspots.

THE GALAPAGOS HOTSPOT

Although the Galápagos were proposed as resulting from a mantle plume early in the development of the theory (Morgan 1972), there are two problems with the simple plume model when it is applied to Galápagos. First, at more conventional hotspots such as Hawaii and Yellowstone, only one to four volcanoes at the young "upstream" (in terms of plate motion) end of the chain are active. In contrast, nearly all of the Galápagos islands have erupted in the recent geologic past, regardless whether they sit at the easternmost, or oldest, end of the chain, or at the westernmost, or youngest, end of the archipelago.

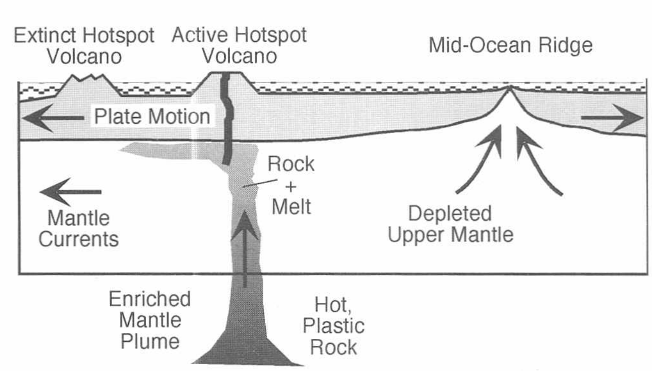

Figure 1. Cartoon of a simple plume rising from the lower mantle. The plume is a plastic solid which begins to melt as it nears the bottom of the overlying plate.