BIRDS, LARGE AND SMALL

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Four examples will illustrate the special problems and experiments that relate to the telemetry of birds large and small. They have been thought about and discussed a good deal. Some are at present unsolved, others only partially solved. My chief aim in this paper is to urge the need for closer affiliation between the physicists and the biologists; to base experiments on sound knowledge of the birds; and to stress that many telemetry experiments can be done inexpensively.

The Emperor Penguin's, Aptenodytes forsteri, adaptation to the harsh Antarctic climate needs investigation because these birds are unique in the animal kingdom. They incubate their eggs in mid-winter in total darkness at temperatures reaching minus 70 degrees. The male has the longest fasting period (3 months) of any bird. The single egg is laid on winter sea ice and then incubated on the dorsum of the foot without any form of nest. Groups huddle together, without aggression, in winds of hurricane force. A number of biologists have had ambitious ideas for studying the physiological adaptation of Emperor Penguins, particularly during the winter, but as yet the challenges imposed by the birds' peculiar habits and the rigors of the environment and habitat have limited them. Carl Eklund diverted from Emperors to the Adelie Penguin, Pygoscelis adeliae, to become the first to use biotelemetry on free-living animals[1] Prevost[2] studied confined Emperors during winter by probes and thermometers. Our Johns Hopkins studies[3] [4] concerned Emperor chicks or adults in enclosures and not freely moving around in the rookery.

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[1] Eklund, C. R. and Carlton, F. E. 1959. Measuring the temperatures of incubating penguin eggs. Amer. Sci. 47:80-86.

[2] Prevost, J. 1961. Ecologie du Manchot empereur Aptenodytes forsteri (Gray). Expeditions Polaires Francaises, No. 222, 204 pp.

[3] Goldsmith, R. and Sladen, W. J. L. 1961. Temperature regulation of some Antarctic penguins. J. Physiol., London, 157: 251-262

[4] Boyd, J. C. and Sladen, W. J. L. 1971. Telemetry studies of the internal body temperatures of Adelie and Emperor Penguins at Cape Crozier, Ross Island, Antarctica. Auk, 88: 366-380.

The earlier study was with thermistor probes the later one with these as well as implanted transmitters designed by Howard Baldwin of Sensory Systems Laboratory, Tuscon. Both monitored body temperature on a continuous basis without-repeated disturbance for catching. But the original objectives, the monitoring of free-living, undisturbed Emperors from a distance, have yet to be achieved. The technical problems so far have been too great. For example transmitters and antennae had to be implanted inside the abdominal cavity as the bird's structure, and the aquatic and ice environment made harnesses impractical for anything but short-term studies. This cut the range to a few meters. Further cuts in range come from the habit of huddling with large numbers of other penguins, during blizzards. The dangers of the sea ice breaking up during an experiment were very real, as the rookery was as much as 3 Km from secure land. Thus, a technique needs be found for boosting the implant transmitter to a range of 4-6 Km. It is an ideal challenge for the technical experts. One approach would be to give the Emperor an artificial egg containing a booster transmitter. The penguin would carry this around on its feet as though incubating a real egg. It would be kept warm and always in close proximity to the implanted transmitter in the bird's abdominal cavity. The experiment would, of course, abruptly terminate if the dummy egg was passed to another penguin, but since the Emperor male incubates its egg continuously for two months, some extremely valuable data could be collected on body temperature under many differing conditions during the south-polar winter.

Some of the most spectacular radio-telemetry work has been done by William Cochran[5] and his colleagues of the Illinois Natural History Survey on North American thrushes. The Emperor Penguin weighs up to 32 Kgm, the thrushes about 32 gms; birds very large and quite small. Cochran designed a transmitter averaging 2.5 gm which increased the weight of the bird by 8%. These minute radios with a trailing whip antenna were fixed on the back of the thrushes, and used to track the birds during their Spring migration through Illinois and Michigan. Information gained from Cochran's studies, unobtainable by anything but radio-telemetry answered many questions related to small bird migration. For example, the migration is entirely nocturnal. Thrushes are capable of sustained flights at an altitude of 3,000 to 5,000 ft. at air speeds of 25 to 35 mph for over 300 miles. Though ground cues were not used as route check-points, these small birds were capable of changing their heading unrelated to wind change when conspicuous land marks were below. One such example was given of a change when the thrush was within sight of Lake Michigan and the night lights of Chicago. Several observations were made of thrushes taking off in bad weather, one in a thunderstorm, for short flights. It is remarkable that these small birds were able to sustain flight for as much as one-half hour in heavy rain.

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[5] Cochran, W. W., Montgomary, G. G. and Graber, R. R. 1967. Migratory flights of <u>Hylocichla</u> thrushes in Spring. A radiotelemetry study. <u>Living Bird</u>, 6: 213-225

In response to a suggestion that the radios were responsible for some of the behavior observed which appeared contrary to non-telemetry data, Cochran et a1[5] reply

> "This point is well taken, for the near impossibility of providing controls dictates that studies using radio-tags are studies, not of birds, but of radio-tagged birds"

This problem is a common one regardless of the size of the bird. We have been using transmitters made by Cochran weighing up to 90 gms with six months life on Whistling Swans, Cygnus colunbianus columbianus,[6] [7] This only adds about 2% to the weight of the bird. These radios had a range of 70 miles when the swan was flying and being tracked from an aircraft. Several swans have been followed with these on their Spring migration from the Chesapeake Bay as far as the Great Lakes and into N. Dakota. One swan was then tracked 581 miles by our Canadian colleague William Gunn from N. Dakota to northern Saskatchewan[7]. It made two brief stops during this flight. The actual flying time was calculated at about 11 hours 10 minutes for an average speed of 51 mph. During this period the swan flew non-stop for 464 miles in 9 hours 5 minutes. The plane that followed this bird stopped twice for refueling; a humbling thought. Thus, we have been able to follow an individual swan for over 2,200 miles and discover that the Spring migration is performed in a succession of long flights of between 250 and 700 miles, each interspersed with feeding periods of from 10 to 25 days. Sometimes these long flights are broken by brief rest periods of a few hours.

We are still not satisfied that these experimental swans are behaving normally. Like Cochran's thrushes, we are presently not studying swans but radio-tagged swans. For example, the bird tracked farthest was a late migrant, taking off when most other swans were further north. It lingered longer than usual in N. Dakota for feeding. Yet it was accompanied by its mate (marked with dye and a numbered tarsus band) all the way from the Chesapeake Bay. Examination of recaptured swans showed that there was no visible harm to skin or feathers from the harness or radio, but we still do not know what effect these are having on sustained flight, especially when they encounter - as they often do - bad weather. More needs to be done with physicists and biologists working together in the field.

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[6] Sladen, W. J. L. and Cochran, W. W. 1969. Studies of the Whistling Swan 1967-1968. Trans. 34th N. Amer. Wildlife & Natural Resources Conf., Wash., D.C. 1969. pp 42-50.

[7] Sladen, W. J. L., Gunn, W. W. H. and Cochran, W. W. 1970. Studies on the migration of the Whistlin Swan, 1969. Proc. World Conf. on Bird Hazards to Aircraft. Sept. 1969, Kingston, Ont. Canada. Nat. Research Council of Canada p-p 231-244.

We are presently trying to answer by telemetry the question; how high does a swan fly?[8] This is of practical importance because there has been at least one fatal collision, with 17 human lives lost, when a Whistling Swan hit a Viscount airliner over Maryland in 1962 at 6,000 feet. The swans were completing a long migration into the Chesapeake Bay. The aircraft was descending to land at Washington, D. C. Evidence from field studies indicates that the Autumn migration is flown at a quite high altitude, perhaps even 12,000 feet.

An ingenious device has been made by Walter Good and John Hamblen8 of the Applied Physics Laboratory, Johns Hopkins University, for measuring altitude. A small pressure switch was added to the telemetry transmitter whereby the pulse rate was doubled when a specific altitude (set at 5,000 feet or 10,000 feet) was reached and then returned to normal when the bird again flew lower. Some of the technical problems are still being ironed out and our two groups are enjoying the exchange. We are learning that complex equipment can be used with good effect in animal telemetry. They are learning that the swan is far less predictable than a highly sophisticated man-made satellite.

My final example comes from the long interest ornithologists have had in learning how pelagic birds move across the oceans. These sea birds vary in size from the Wilson's Petrel, Oceanites oceanicus, no larger than a swallow, which migrates 20,000 miles every year from and back to its Antarctic breeding grounds via the North Atlantic, to the Wandering Albatross, Diomedia exulans, with a wing-span of 11 feet, which moves around the world in the southern oceans. A great amount of data have been collected from the banding of 3 species of albatross (D.exulans, the Black-browed Albatross, D. melanophris, and the Grey-headed Albatross, D. chrysostoma) in the southern seas which show that they have characteristic movements[9] [10]. For example, the Black-browed Albatross moves in a segmentary manner, 88% of recoveries of birds banded in the Falkland Islands coming from the Atlantic coast of S. America, whereas 95% of the South Georgia-banded birds being reported from the waters off South Africa. There is good circumstantial evidence that the Wandering Albatross circumnavigates the world eastward in the westwind zone, and this seems to be true also for first year Giant Petrels, Macronectes giganteus, but after the banding of many thousands of recoveries positive

[8] Good, W. A. and Hamblen, J. W. 1970. How High does the Whistling Swan Fly? APL Technical Digest, 10: 2-10

[9] Tickell, W. L. N. 1967. Movements of Black-browed and Grey-headed Albatrosses in the South Atlantic. Emu, 66: 357-367.

[10] Tickell, W. L. N. and Gibson, J. D. 1968. Movements of Wandering Albatrosses Emu, 68: 6-20.

evidence is still lacking. Tracking these birds by satellite has been suggested[11 12]. However, there is little hope for this until the system has been tried out on larger animals and until the weight of the transmitter is reduced to about 100 gms. In the mean time, one approach is to gain needed experience by testing harness and tracking devices on large birds such as the Whistling Swan which fly over land, can be resighted again for checking, and that can be followed moderately safely from a tracking plane.

Another more courageous and dramatic approach is being taken by William Cochran (personal communication) who has attached a transmitter to a Frigatebird, Frageta magnificens, and tracked it for 800 miles from Wake Island to the vicinity of Marshal Island in the Pacific. The tracking was done from two stations, one on Midway Island, the other on Hawaii Island and the range of tracking was over 2,000 miles. Important information is being gleaned for future satellite tracking, but at a fraction of the cost.

[11]Warner, D. W. 1963. Space tracks. Nat. Hist. N. Y., 72: 8-15.

[12] Sladen, W. J. L. and LeResche, R. E. 1970. New and developing techniques in Antarctic ornithology. Antarctic Ecology, Martin Holdgate (Ed.) Academic Press, London. pp. 585-596.