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SPEED-INDUCED SKIN FOLDS IN THE BOTTLE-NOSED PORPOISE, *TURSIOPS TRUNCATUS*[1]

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While engaged in a study of the behavior of bottle-nosed porpoises, *Tursiops truncatus* (Montagu), at Marine Studios, Marineland, Florida, over a period of three to four years, the author has observed on hundreds of occasions a remarkable modification of the skin contour of these animals whenever they resorted to rapid movement about the tank (Essapian 1953, p. 399). The circular tank, where the porpoises are on exhibit, is seventy-five feet in diameter and about fourteen feet deep at the center. It houses an average of ten animals.

Generally lost to view due to swiftness of action, this transformation of the skin contour takes place when an animal accelerates its speed in excess of its normal rate, or, when swimming rapidly, comes to a sudden stop. It is then that transverse skin folds may stand out in relief on part of an animal, or may extend over its entire length, from head to tail. The pattern of these formations depends on the speed and sex of the swimming animal, but is not restricted to any age group. The folds may be seen even in an animal only a day or two old.

The skin folds generated by a sudden burst of speed are by far the more common of the two categories, and are usually occasioned when the animals engage in pursuit of one another, are frightened and trying to escape, or when racing for a food fish tossed into the tank. The duration of folds is then conditioned

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by the factors which motivate the animals' movements. In the case of a brief dash, for example, when an animal exerts itself to snatch a fish, the skin folds may last only a second, or even a fraction of a second (Pls. 1 and 2). However, in the case of prolonged rapid movement around the tank, the animals may intermittently exhibit skin folds for a period of one or two or more seconds. Often an animal at play or during the mating season may suddenly leap out of water, exhibiting folds at the peak of acceleration, just prior to its emergence from water, and again after it has reentered the water (Pls. 3 and 4). At this point it may be of interest to note that the fat adult females tend to exhibit fewer folds, but greater in size and at less regular intervals, than are produced in the adult male or in the younger slimmer animals when swimming at comparable speeds. The same female in Plate 4 is also shown in Plate 5; here this animal's folds are shown in a transitory stage, just prior to full acceleration.

The skin folds of the second category occur at less frequent intervals and are of very brief duration. These take place when an animal swimming rapidly without exhibiting any folds comes to an abrupt halt. Then the folds may suddenly be displayed (Pl. 6). The duration of folds of this sort is indicated by the fact that this entire sequence occupies only twelve frames of 16 mm. film at 16 frames per second. This would indicate a total elapsed time of three quarters of a second for the formation and disappearance of folds. Plate 6 is the fourth frame, showing that these folds were fully formed in one quarter of a second.

One feature in the production of skin folds is of particular interest. In an animal maintaining a high and sustained rate of speed the folds are stationary and do not progress wave-fashion. At times, when extremely high speeds are achieved by adult animals, the skin folds tend to slope posteriorly. Observations also indicate that the folds are more likely to occur on ventral and lower lateral surfaces.

While the superficial layer of the porpoise's skin is extremely thin, the blubber is of considerable thickness and is tough and fibrous. In a *Tursiops truncatus* fifteen days old and weighing thirty pounds, the skin, including blubber, is approximately half

an inch thick. In an adult it is nearly one and a half inches thick on the ventral surface. Although normally not apparent to the view or touch, the porpoise's skin is, nevertheless, pliant and loose on the body. This slackness of the skin in a live animal held out of water in a sling is shown in Plate 7.

Discussion

It is tempting to speculate upon the causes of this phenomenon. The answer may lie in the possibility that these folds are caused by the unequal pressure of water upon the body of the animal, in which case the production of folds would appear to be beyond the muscular control of the animal. Clarke and Ruud (1954, p. 144), in discussing different types of marks used in whale marking, say: "... whenever a whale is moving naturally the envelope of blubber is always sliding, more or less, over the contracting and relaxing muscle beneath, so that a mark with stoppers which is set partly in blubber and partly in muscle would almost certainly be worked out." The Marineland porpoises while swimming normally do not display such looseness of skin as is here ascribed to the great baleen whales. However, this similarity in the flexibility of skin in such divergent species suggests that all animals of the order Cetacea may share this characteristic.

These speed-induced folds are to be distinguished from those caused simply by flexure, such as the ones shown in Plates 8 and 9.

Racovitza (1903, pp. 43-44, pl. 3, fig. 17) mentions a group of four *Hyperoodon* (bottle-nosed whales) of which one individual is sketched emerging from water and exhibiting an exaggerated likeness of skin folds on its trunk. Unfortunately the author has failed to explain whether this particular animal was swimming rapidly at the time or whether this deformity in the skin contour was apparent even when the animal had raised itself partly out of water. The author furnished no further explanation beyond expressing his astonishment and a conviction that the animal didn't appear to be sick or emaciated and that the projections on its trunk appeared to be composed of soft material. This animal didn't differ from the three other individuals in any other respect.

At sea, in conditions of greater freedom of movement, the porpoises may exhibit skin folds for more protracted periods than is feasible in the confines of a tank. In any case, these folds should be of interest to hydrodynamicists.

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All photographs by courtesy of Marine Studios; the porpoises shown are all *Tursiops truncatus* on exhibition at Marineland, Florida. Plate 7 is from a photograph by Bob Neelands; all the others are by the author.