

# OBSERVATIONS ON THE DISTRIBUTION, COLORATION, BEHAVIOR AND AUDIBLE SOUND PRODUCTION OF THE SPOTTED DOLPHIN, *STENELLA PLAGIODON* (COPE)

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**ABSTRACT:** The spotted dolphin ranges from off Cape May, New Jersey, to Panama. Present data indicate that it is generally restricted to a spatial zone from about five to 200 miles offshore of mainland North and Central American shores, although in the northeastern Gulf of Mexico it comes into shallow waters much closer inshore in late spring. The young are unspotted. Several forms of breathing behavior in captivity were observed which seem related to specific life needs in the wild. Audible sounds of several types were recorded from captive animals. A possible eastern Atlantic record is noted.

## INTRODUCTION

Although apparently it is a common species offshore, relatively little has been published on the biology of the spotted dolphin, *Stenella plagiodon* (Cope). Consequently, it seems appropriate to add additional information on the natural history of this species, particularly as observed in the northeastern Gulf of Mexico, and to describe certain captive behavior as it seems to correlate with known behavior by this species in the wild. In addition, we have had the opportunity to study the coloration of a number of individuals of different sizes, and to make tape recordings of two captive animals.

## ACKNOWLEDGMENTS

J. B. Siebenaler of Florida's Gulfarium at Fort Walton Beach generously allowed us free access to two captive spotted dolphins in his charge and was also most helpful in obtaining specimens and data on wild animals from that region. Leonard P. Hutchinson of the Gulfarium also helped gather information on wild spotted dolphins and provided several of the photographs used in this paper. B. C. (Cliff) Townsend of Marineland of Florida at St. Augustine was especially helpful in providing data on wild and captive animals and photographs of captives. Others who helped in various ways by providing data, photographs and/or other valued help and suggestions were: F. C. Fraser of the British Museum (Natural History); Winfield Brady of the

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Aquarium of Niagara Falls, New York; Richard W. Edgerton of Marineland of Florida; John H. Prescott of Marineland of the Pacific, Los Angeles; Raymond M. Gilmore of California Western University, San Diego; Dewey Destin, Marjorie Siebenaler, Gregory Siebenaler, Lowell Longaker, Ronald Ward and Chuck Ray of Destin (Florida), Fort Walton Beach and the Gulfarium; and Robert L. Brownell, Jr., and Armando Solis of the Los Angeles County Museum of Natural History. Partial support for certain phases of the study was received from the Los Angeles County Museum Associates and through grants from the National Institute of Mental Health (MH-07509-01) and the National Science Foundation (GB-1189).

#### GEOGRAPHICAL DISTRIBUTION

*Stenella plagiodon* was originally described by Cope (1866: 296) as *Delphinus plagiodon* from a skull of unknown geographical origin in the collections of the United States National Museum (No. 3884). True (1885: 323) compared the skull with one from a specimen of the typical Gulf of Mexico spotted dolphin (from off Pensacola, Florida) and found that they did not differ in any significant way. Later (1889: 66), and with the same results, he also compared the type of *plagiodon* with the skull from an animal, in external appearance apparently of the same spotted species as the Gulf specimen, collected off Cape Hatteras, North Carolina. In his 1885 paper he believed that *plagiodon* was a junior synonym of *Prodelphinus* (= *Stenella*) *doris* (Gray), but he changed this opinion in his later paper and concluded with some certainty that *doris* and *plagiodon* are distinct and that the specific name for the common spotted dolphin of the Gulf of Mexico and south Atlantic coast of the United States (the species under discussion and illustrated in the present report) should stand as *plagiodon*. Despite the lack of a definite type locality for this species, present evidence suggests that it usually occurs in offshore waters (but within somewhat restricted spatial limits) along the mainland Atlantic coasts of North and Central America from Cape May, New Jersey, to Panama. Consequently, the type locality for *plagiodon* almost surely lies within that spatial and geographical range. However, Dr. F. C. Fraser is studying the entire genus *Stenella* at this writing and any further restriction of a possible type locality for *S. plagiodon* should await his judgment. There apparently is no firm basis for published statements that the type locality is the eastern coast of the United States (e.g., Elliot, 1901: 31, 1904: 58).

The range of this species as presently understood apparently is restricted to the western North Atlantic and extends from 60 miles off Cape May, New Jersey (Schevill and Watkins, 1962: 9), southward to Golfo de San Blas, Panama (Miller and Kellogg, 1955: 657). We find no published records or specimens in collections to form the basis for the note of Hall and Kelson (1959: 818) that this species occurs in South America, although the record from nearby Panama in Central America may account for their statement.



General statements on geographical range for this species which are less extensive (usually indicating occurrence from Cape Hatteras, North Carolina, to the Gulf of Mexico) but which are included in the New Jersey to Panama limits, have been given by many writers. Included among these are: True (1889: 66, 165), Elliot (1901: 31; 1904: 58), Lyon and Osgood (1909: 9), Miller (1924: 508), Fraser (1937: 332), Gunter (1941; 1954: 548), Poole and Schantz (1942: 113), Lowery (1943: 256), Burt and Grossenheider (1952: 170), Palmer (1954: 332), Hall and Kelson (1959: 818) and Caldwell and Golley (1965:25).

It is interesting to note that none of the records that we have seen make reference to the occurrence of this species among the islands of the West Indies, although it is primarily an inhabitant of offshore waters and would seem to be expected there. Elliott (1904) did not include it from the West Indies, and in our studies of West Indian marine mammals made during the past several years we have also failed to find specimens or other reports of *S. plagiodon* in that region.

The possible occurrence of *S. plagiodon* in the eastern Atlantic has been suggested by Cadenat (1959) and Cadenat and Lassarat (1959). In late February, 1958, a rather robust male spotted dolphin was harpooned ten miles off the entrance to the port of Abidjan, Ivory Coast, Africa. This specimen, 188 cm. (about 74 inches) in snout to caudal-notch length, was photographically illustrated in several views by Cadenat (1959: figs. 34-37) and Cadenat and Lassarat (1959: figs. 1-4) and was questionably identified by those writers as *S. plagiodon*. Even considering possible postmortem changes which usually tend to darken delphinids that have been dead for more than a few hours, the pigmentation of this specimen appeared darker in the photographs than any specimen of *S. plagiodon* from the western Atlantic that we have seen alive or illustrated. On the other hand, the general conformation of the body of the African specimen, the general patterning of its light spots and the tooth counts are similar enough to western Atlantic *S. plagiodon* to warrant positive consideration for the possible occurrence of this species in the eastern Atlantic. However, until a direct comparison of specimens from both sides of the Atlantic is made, both on a living or freshly-dead and a skeletal basis, we prefer only to draw attention to the African specimen and for the present question the occurrence of *S. plagiodon* outside the western Atlantic.

#### ECOLOGICAL DISTRIBUTION

Caldwell (1960) summarized data which indicated that the spotted dolphin is primarily an offshore species (12 miles or more) in the Gulf of Mexico and elsewhere in its range. However, data were also presented which recorded the occurrence of this species much closer inshore than is usually expected (3 miles from the nearest land in mid-April, and 7 miles in mid-July). Sport fish-



ing captains working out of Destin, Florida, corroborated this general offshore distribution. It is the belief of these fishermen that spotted dolphins generally occur five miles or more offshore in waters of about five fathoms or greater, and that the dolphins are replaced inshore of these general points by the common inshore porpoise of the region, the Atlantic bottlenosed dolphin, *Tursiops truncatus* (Montagu). Raymond M. Gilmore told us in early 1966 that he had found a similar spatial distribution for *S. plagiodon* and *T. truncatus* off Rockport, Texas, in late March, 1951, and Cliff Townsend told us in early 1966 that these two species usually distribute themselves in a similar spatial manner in the vicinity of St. Augustine, Florida. However, Mr. Townsend added that in that region *S. plagiodon* are rarely seen closer inshore than about nine miles off the outer beaches, and then only in summer. He further stated that while typical *T. truncatus* of some eight to nine feet in maximum length are found in the back rivers and estuaries and within five or six miles offshore of the outer beaches, he has seen several very large *Tursiops*, some 12 feet in length, only at a point about 40 miles offshore of St. Augustine.

It is thus of considerable interest in this regard to record the seasonal occurrence of spotted dolphins close inshore in the vicinity of Destin and Fort Walton Beach, Florida.

During the period from mid-April to mid-May, spotted dolphins appear regularly each year so close inshore that they are collected for display by the same means that are used for capturing *Tursiops*; namely, by seines worked in very shallow water (usually wading depth) immediately adjacent to or within less than a mile of the beach (see Caldwell, Caldwell and Siebenaler, 1965: 4, for a description of technique).

Two animals were captured near the beach in the vicinity of Destin in late spring in 1964 and were sent to the Aquatarium at St. Petersburg Beach, Florida, where we observed them in late June of the same year. Several additional spotted dolphins were taken at the same time but these failed to survive for any length of time.

On May 10, 1965, a portion of a school of spotted dolphins was captured close to the beach near Crystal Beach pier, about five miles east of Destin. Two of these, both females, 51 and 89 inches in snout to caudal-notch length (Figs. 1 through 5), believed *not* to be mother and daughter by the collectors, were kept at the Gulfarium where we studied their phonations and general captive behavior in June of the same year. Several months after this, the adult of this twosome died of unknown causes and her skull and most of the postcranial skeleton are now in the collections of the Los Angeles County Museum of Natural History (No. 27057). Another from this school, a female of adult size but undetermined exact length (Fig. 6) died after about one day at the Gulfarium. Two more of this school, an adult female about 90 inches in length and a juvenile male about 63 inches in length, believed by the collectors to be mother and son because the young animal sometimes apparently attempted to nurse, were sent to Cape Coral (near Ft. Myers), Florida. Two additional





Figure 1 *Stenella plagiodon*. Live adult female (89 inches in snout to caudal-notch length) and juvenile female (51 inches in snout to caudal-notch length) collected near the beach on May 10, 1965, about five miles east of Destin, Florida, in the northeastern Gulf of Mexico. Shown here stranded on the bottom of their holding tank when it was drained at Florida's Gulfarium in late June, 1965. Dark flecks on the sides of the small animal are dirt and not pigment. Note the slightly darker trailing edges of dorsal and pectoral fins of juvenile. (Photograph by Leonard P. Hutchinson.)

animals (Fig. 7) from this school, both females, about 48 and 90 inches long, were sent to the Aquarium of Niagara Falls, New York. We were told that the school also included adult males, but the number was not noted and those captured were released as probably unsuitable for the display purposes intended for the others.

The Destin sport fishing captains were of the opinion that spotted dolphins are found all year round in that region offshore, but that the numbers markedly increase during the spring and summer months. This information, along with the especially noteworthy occurrence of the species close inshore in late spring, suggests corroboration for the suggestion by Moore (1953: 132) that there is an annual migration by this species into the waters of northern Florida during the warmer months, or even in the winter months when the water is unusually warm. On the other hand, data given us by Cliff Townsend indicate that the migration more likely may be a matter of inshore-offshore movement in the same latitudes rather than an alongshore migration between different latitudes. The comments of the Destin fishermen suggested this possibility, but Mr. Townsend's notes provide even more positive evidence for such a phenomenon. During the course of his collecting activities for Marineland of Florida, Mr. Townsend has noted that in January and February, off St. Augustine, most *S. plagiodon* are found some 90 miles offshore near the western edge of the Gulf Stream. By April and early May he found that they were present some 40 to 50 miles offshore, and that by late May or early June they were 10 to 20 miles off-





Figure 2. *Stenella plagiodon*. Same two animals as shown in Figure 1. Note immaculate ventral surfaces of juvenile.

shore. During the rest of the summer they occurred closest to the beach (about nine miles) and then as the year progressed the movement was reversed until by winter they were again most common some 90 miles offshore.

The Destin fishermen indicated that spotted dolphins are frequently seen up to 50 miles offshore. While in this case 50 miles is the usual offshore limit for the fishing boats, Caldwell (1955: 468; 1960: 135) failed to find spotted dolphins in the Gulf of Mexico at distances greater than 166 miles from the nearest land, and in most cases the distances were 70 miles or less. The cruises on which those data were gathered included numerous opportunities to look for cetaceans at much greater distances offshore and a cetacean watch was maintained from the bridge of the vessel during all daylight hours and when the ship was running at night. The first of these cruises included a complete transect across the Gulf of Mexico during which spotted dolphins were seen within the above limits of distribution as the vessel moved offshore and several days later when it again approached the land on the other side, but none were seen in the middle of the Gulf (Caldwell, 1955: fig. 1). Consequently, while *S. plagiodon* normally appears to be an inhabitant of offshore waters at distances greater than about five miles from the nearest land, present evidence suggests that there may also be a general maximum limit to the distribution of this species of about 150 to 200 miles, with a usual maximum of some 75 to 100 miles. Furthermore, the lack of West Indian records suggests that this species occurs within the aforementioned spatial limits only off mainland shores. The one possible record of this species from the eastern Atlantic fits this same distributional pattern.

Further evidence for a primarily offshore occurrence of *S. plagiodon*





Figure 3. *Stenella plagiodon*. Same two animals as shown in Figure 1. Note light caudal keel and dark underside of caudal flukes of juvenile; the trailing edge is darker than the rest of the fluke.

comes from the fact that there is only one positive report of a stranding, even though there has been a special effort in recent years to record such data. Caldwell and Golley (1965: 25) included an earlier stranding record by Brimley of an individual stranded at Cape Hatteras, North Carolina. The stranding of an offshore-living animal at Cape Hatteras is of reduced significance when one considers that dead or dying animals from more offshore waters are likely to be deposited on the shores of the Cape by the Gulf Stream as it flows north and washes the Cape. Moore (1953) and Layne (1965) failed to report strandings of the spotted dolphin in Florida, as did Gunter (1954) from anywhere in the Gulf of Mexico. There are skulls of *S. plagiodon* in collections from unstated circumstances of collection that possibly may represent strandings. However, with the Cape Hatteras exception, museum specimens which have good data on how they were obtained came from animals collected alive offshore (e.g., True, 1885, 1889; Moore, 1953; Schevill and Watkins, 1962; Caldwell and Golley, 1965), or, as in the case of the Destin records, from animals occurring close inshore as a regular part of their seasonal life history. It should be emphasized, however, that the seasonal distribution of *S. plagiodon* close inshore at Destin apparently is very unusual and perhaps unique.

While young animals are included in the schools of some 25 to 30 animals that move close inshore near Destin in the late spring, no young were observed in the wild that were still nursing. However, we have been told that rarely they apparently do try to nurse in captivity, although they readily take dead fish as food. The attempts by these animals to nurse apparently are so infrequent as to be of little significance other than an artifact, perhaps for emotional security,





Figure 4. *Stenella plagiodon*. Same two animals as shown in Figure 1, showing pigment pattern of dorsal surfaces.

from younger days (see Caldwell and Caldwell, 1966: 764, for a summary of data concerning long nursing periods, after weaning, in captive *T. truncatus*). Homosexual behavior, which can easily be misinterpreted as nursing behavior, may also be involved under these circumstances as well (see Brown, Caldwell and Caldwell, 1966: 14). These young spotted dolphins, while readily taking food fish instead of nursing (if that is what they are actually doing), still lack the spotting of the typical adult coloration.

The adult female captured on May 10, 1965, and kept at the Gulfarium (see above) gave birth to an unspotted female calf (Fig. 13) there on about August 10, 1965. J. B. Siebenaler reported that the calf made only feeble movements after birth and then immediately died. No details of the birth were



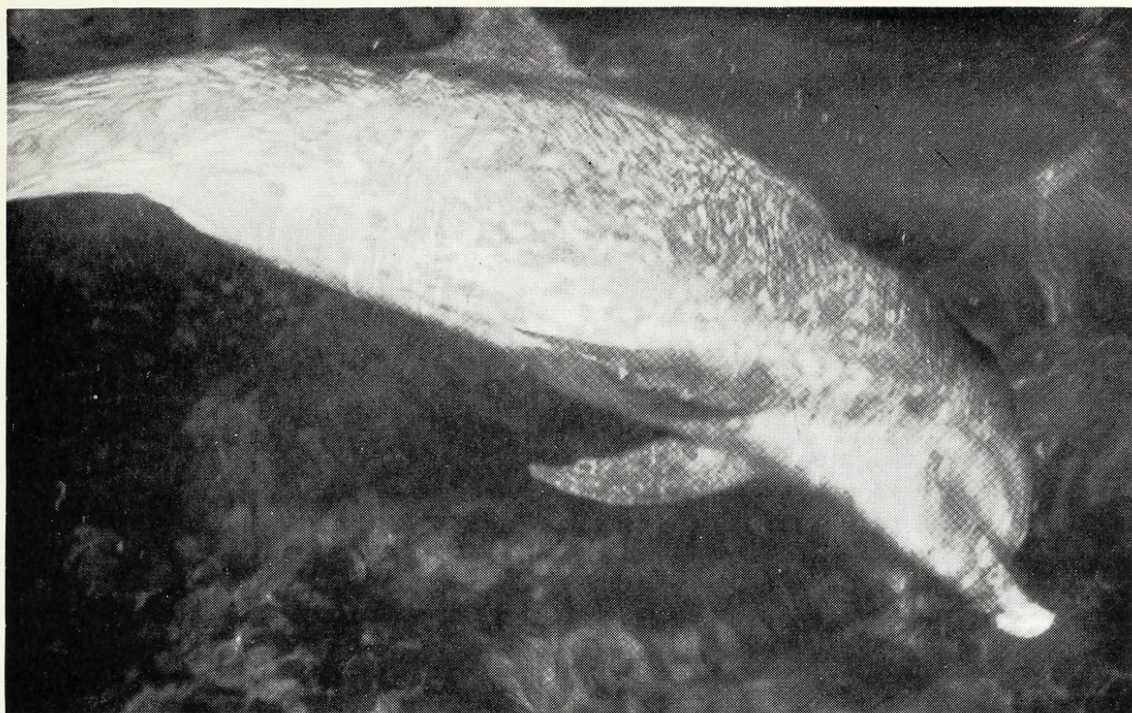


Figure 5. *Stenella plagiodon*. Same adult animal as shown in Figure 1. Photograph is distorted due to surface ripple on the water, but shows the degree of spotting on the ventral surface and immaculate area in genital region.

noted, and we do not even know if the small calf was full term. However, it was certainly nearly full term, and by August the school of spotted dolphins would have long been back in its expected offshore habitat and the calf would have been born at sea at that time or at still later date. The calf was much too well developed to have been conceived inshore in May of that same year.

We suggest, therefore, that the young are born offshore and that they are not brought close inshore by their parents until they are weaned. Consequently the seasonal move inshore in the Destin area is clearly not for the purpose of calving.

Over the years it has been the observation of Dewey Destin, a master commercial seine fisherman who captures both on a commercial basis in the Destin area, that the arrival of the spotted dolphins along the beach in May seems to coincide with the late spring arrival of large numbers of "hardtails," carangid fishes of the genus *Caranx*—usually *C. crysos* (Mitchill). However, while these fish usually remain in the area all summer, according to Mr. Destin, the dolphins soon move back offshore. Consequently, while feeding should be considered as a motive for the movement inshore, this possible source of food may be coincidence rather than the reason for the movement, *en masse*, by the dolphins into the shallow waters. The spotted dolphins that have been held in captivity at Destin and Fort Walton Beach do readily feed on dead "hardtails," but the one stomach of a wild-caught spotted dolphin that was examined, from an individual that died shortly after capture, contained large

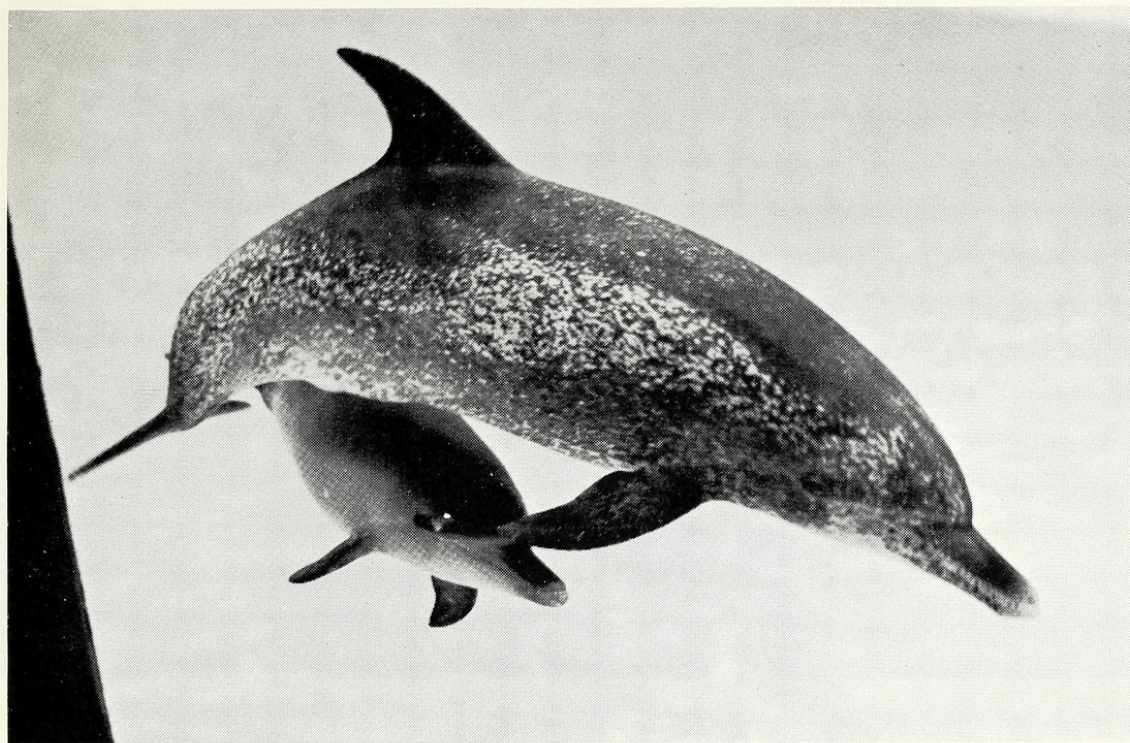




Figure 6. *Stenella plagiodon*. Autopsy of adult female collected with the animals shown in Figure 1. Especially note pigmentation on ventral surfaces of head. (Photograph by Leonard P. Hutchinson.)

numbers of small cephalopod beaks. Unfortunately, none of these beaks were saved, and a photograph of a mass of them lining the stomach of the dolphin was insufficient for Gilbert L. Voss of the University of Miami Institute of Marine Science to provide an identification. On the other hand, fish must form at least a portion of the natural diet of *S. plagiodon* as evidenced by observations made at sea by Mr. Townsend. He reported to us in 1966 that he had observed spotted dolphins off St. Augustine feeding on small fishes of the families Clupeidae (herrings) and Engraulidae (anchovies), and somewhat further offshore on carangid fishes of the genera *Decapterus* or *Selar*. Captive spotted dolphins at the Gulfarium readily take dead fishes of the latter two genera.





Figures 7. *Stenella plagiodon*. Live adult female (about 90 inches in length) and juvenile female (about 48 inches in length) in captivity at the Aquarium of Niagara Falls, New York. These animals were collected at Destin, Florida, with those shown in Figures 1 through 6. (Photograph courtesy of the Aquarium of Niagara Falls.)

When held in captivity, it has been observed and reported to us that pairs (either adults or adult and young, of any combination of sexes) or more spotted dolphins seem to survive better than single animals. Reportedly this holds true whether the spotted dolphins are segregated or in a community tank with other kinds of dolphins. However, that this is not always a prerequisite for survival in captivity is evidenced by the long-time survival of a single female spotted dolphin at Marineland of Florida (Figs. 11 and 12). This animal was collected on August 31, 1956, and at this writing (April, 1966) is still living and healthy although there have been many, often extended, periods when no other spotted dolphins were in the tank with her. When we visited Marineland in April, 1966, and observed this and one other spotted dolphin then with her, Mr. Townsend told us that the long-captive female furthermore is unusual because she has lived so well in a community tank with a number of *T. truncatus* (see Fig. 11). Mr. Townsend noted that most spotted dolphins are completely dominated by the bottlenosed dolphins in such a tank and that the spotted dolphins are usually unable to compete under these circumstances. He further noted that spotted dolphins as jumpers generally are erratic in their aim and hence are not satisfactory as performers under conditions where the attraction uses guest porpoise feeders. However, these dolphins will sometimes satisfactorily perform in this manner (Fig. 12).



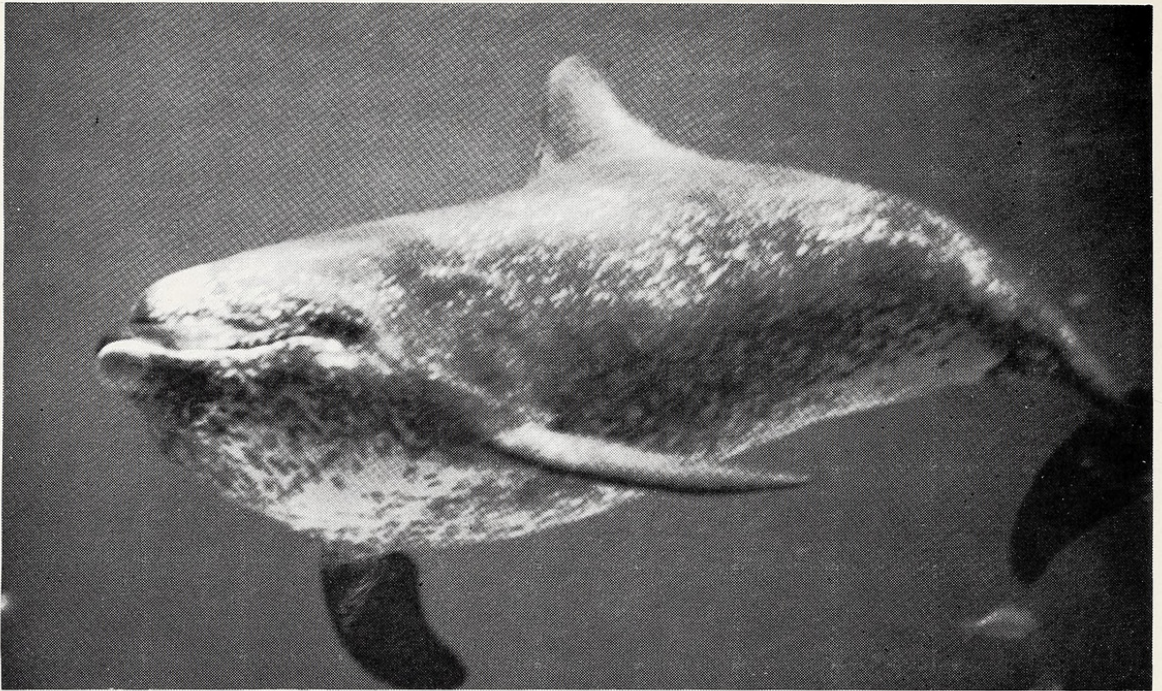


Figure 8. *Stenella plagiodon*. Adult of undertermined sex and size, probably collected at sea off St. Augustine, Florida. Photographed by D. K. Caldwell at Marine-land of Florida about 1955. Especially note the heavy lateral and ventral pigmentation in this animal as compared to the lighter pigmentation of the other illustrated animals.

#### COLORATION

Despite a large number of published illustrations, the color pattern of *S. plagiodon* has, until now, remained imperfectly known, particularly with regards its changes in relation to the size (and presumably age) of the animal.

The illustrations of adult *S. plagiodon* that we have seen range from somewhat inadequate and generalized drawings (*e.g.*, Elliot, 1904: fig. 21; Kellogg, 1940: 75; Burt and Grossenheider, 1952: 173; Hoffmeister, 1963: 47) through adequate drawings made from specimens or photographs (*e.g.*, True, 1885: pls. 1 and 2, 1889: pl. 18, retouched photograph; Elliot, 1901: fig. 9, based on True, 1889; Nishiwaki and Yabuuchi, 1965: 180f.) to actual photographs, from various angles, of living or freshly-dead animals (*e.g.*, McBride, 1940: 24, 26; Moore, 1953: 130; Schevill and Watkins, 1962: 9, and record cover; Schevill, 1962: 2f.; Belkovitch, Kleinenberg and Yablokov, 1965: between pages 120 and 121, same photograph as the one appearing herein as Fig. 8). Schevill told us in 1965 that the specimen illustrated in the booklet of Schevill and Watkins (1962: 9) is an animal taken from the group observed and recorded off Cape May, New Jersey, and that the skull is now in the collections of the Museum of Comparative Zoology at Harvard (MCZ 51074). Schevill further told us that the animals illustrated in Schevill (1962: 2f.) and Schevill and Watkins, 1962: record cover) were photographed at sea off Pensacola, Florida, in the northeastern Gulf of Mexico.





Figure 9. *Stenella plagiodon*. Adult female (83 inches in length) collected at sea off Rockport, Texas, on March 22, 1951. Note variations in pigmentation between this specimen and the animals shown in other figures herein. (Photograph courtesy of Raymond M. Gilmore.)

In addition to these various illustrations, the color pattern of adult *S. plagiodon* was described in considerable detail by True (1885: 318) and in much less complete, but useful, detail by Hall and Kelson (1959: 818), Kellogg (1940: 83), Gunter (1954: 548), True (1889: 164). The adult description by Palmer (1954: 332) is incorrect.

As shown by the photograph in Schevill (1962: 2f.) and Schevill and Watkins (1962: record cover) and by our own experience (see Figs. 1 through 12), the degree of spotting (*i.e.*, number of spots) is somewhat variable in adults although the general pattern of spotting remains the same. There is also some variation in the coloration of the snout and lower jaw (ranging from light to dark) as pointed out by Caldwell (1960: 136) and suggested by the photograph in Schevill, (1962: 2f.) and Schevill and Watkins (1962: record cover).

Fraser (1950: 63), using the descriptions of True (1885, 1889), compared *S. plagiodon* with a spotted dolphin from off the Atlantic coast of Africa which he referred to the species *S. frontalis* (Cuvier). True's descriptions and figures, while very useful, are lacking in certain specific and minute details and Fraser understandably erred in stating the *plagiodon* lacks white on the snout tip or chin (see our comments on this above) and that *plagiodon* lacks a dark band from the angle of the mouth to the flipper (while it is diffuse, such a band does exist in *plagiodon* as shown herein in Figs. 5, 9, 10, and 11). Fraser was correct in differentiating his specimen of *frontalis* from *plagiodon* on the basis of the gray belly of the former as compared to the white belly of the latter. However, for the sake of clarity it should be noted that while the base color of the belly of *plagiodon* is pure white, it is for the most part covered with large dark blotches and spots in the adult. In comparing the photographs of Fraser's *frontalis* with those of *plagiodon* included here (especially our Figs. 6 through 12), it becomes apparent that the spotting on the lower posterior surfaces of the mandible of Fraser's *frontalis* consists of light spots on a dark ground,





Figure 10. *Stenella plagiodon*. Captive of adult size of undertermined sex and exact size at Marineland of Florida; collected at sea off St. Augustine, Florida. Note unusually sparse spotting. Apparently this same individual, or one equally sparsely spotted, was figured less clearly by Lauber (1963: 25) and Kay (1964: 24). (Photograph courtesy of Marineland of Florida.)

while in *plagiodon* the spots are apparently always dark on a light ground. In addition, the mandibular spots on the specimen of *frontalis* appear to be relatively smaller than those of *plagiodon*.

Knowledge of the coloration of the young of *S. plagiodon* is much less complete, and as noted previously (Caldwell, 1955: 470), it is so different that it may well be the basis for some reports of mixed schools of dolphins offshore (e.g., Nichols, 1920). Kellogg (1940: 85) first noted that the small calf is gray and so illustrated it in general terms (p. 75). Palmer (1954: 332) stated that the calf is gray, but neither he nor Kellogg gave further details. Lowery (1943: 256) noted that *S. plagiodon* in Louisiana waters "is sometimes spotted," which suggests a knowledge of the ontogenetic differences in coloration in this species. Gunter (1954: 548) incorrectly indicated that the calves are uniformly gray, although in an earlier report (Gunter, 1941) he had included the more correct note that a 5-foot specimen from Texas had been described to him as having been solid grayish-black on top and lighter underneath. Actually, the color of the young shades from dark purplish-gray on the dorsal side to white on the ventral, and this can best be described by reference to the figures we include herein (Figs. 1 through 4, and 13). The trailing edges of the flukes of the young are notably darker than the rest of the fluke. As noted elsewhere, the darker ground colors of living animals contain considerable purple (see Kellogg, 1940: 75; Gunter, 1941) and this is the case for both adults and young (see Kellogg, 1940: 75; Caldwell, 1955: 470, 1960: 136). We were able to reconfirm this purplish ground color in our close-hand observations on captive animals.

Although their text indicated that it was spotted, and Gilmore told us in 1965 that Mahnken had told him such was the case, the photograph of a wild



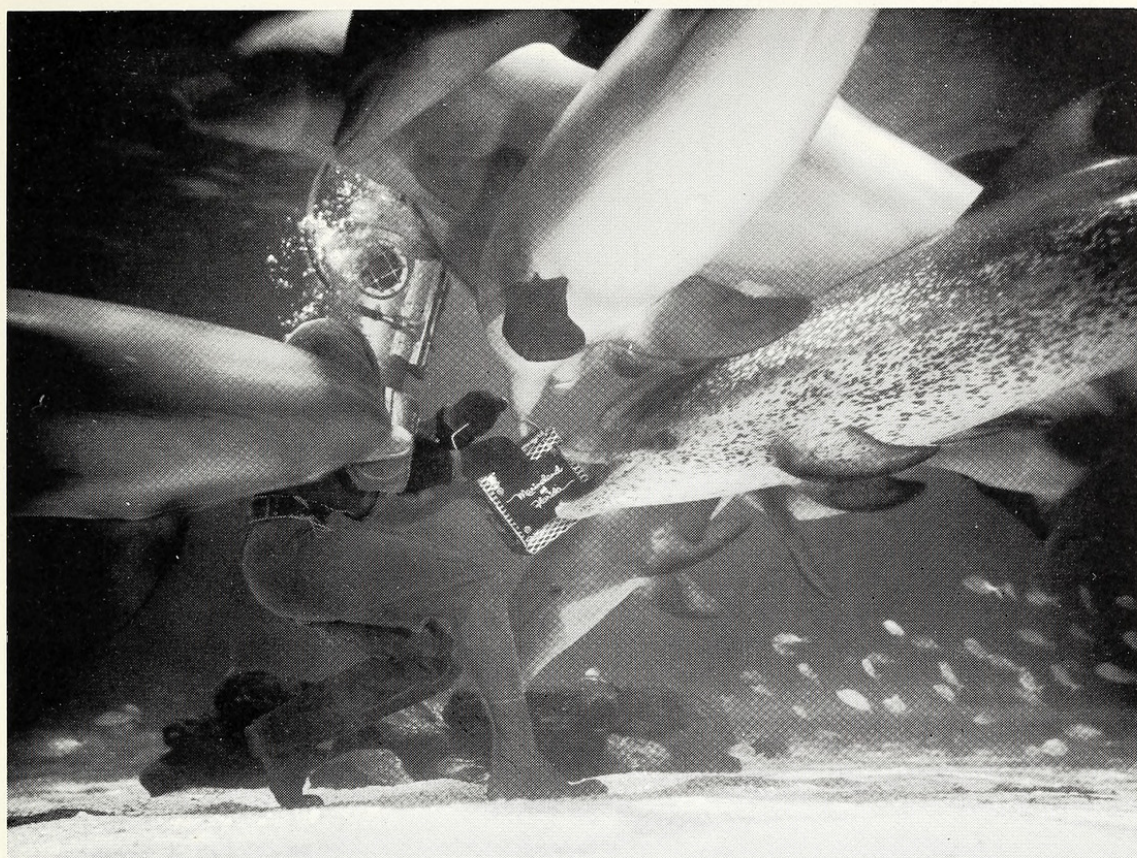


Figure 11. *Stenella plagiodon*. Captive female of adult size at Marineland of Florida; collected at sea off St. Augustine, Florida. This is the same animal that appears in Figure 12. (Photograph courtesy of Marineland of Florida.)

*S. plagiodon* included by Mahnken and Gilmore (1960) seems instead to be an unspotted young animal. It may be that the spotting was so faint or incomplete that it was just developing and so showed up more clearly at sea or on the original photograph than in the published reproduction. The size of the sucker-fish (*Remilegia australis* Bennett) attached to the dolphin would also indicate that the latter was a small animal even if the sucker-fish was a large example of its species (known to reach a maximum total length of some two feet, according to Radford and Klawe, 1965). The development of the spotted coloration takes place gradually, and while to our knowledge it has never been described in detail and to completion, Mr. Gregory Siebenaler told us in 1965 that a small captive animal that had been completely unspotted at capture in May was beginning to develop spots on the dorsum, posterior to the dorsal fin, about one month later. This animal, a male, was still partially unweaned and was approximately 63 inches in snout to caudal-notch length. Another young, a female captured at the same time (in May) as the small male just discussed, was 51 inches in snout to caudal-notch length when we studied here in mid-June. She had no spots at that time, but Mr. Siebenaler told us in mid-November of the same year (1965) that this animal was somewhat larger and was



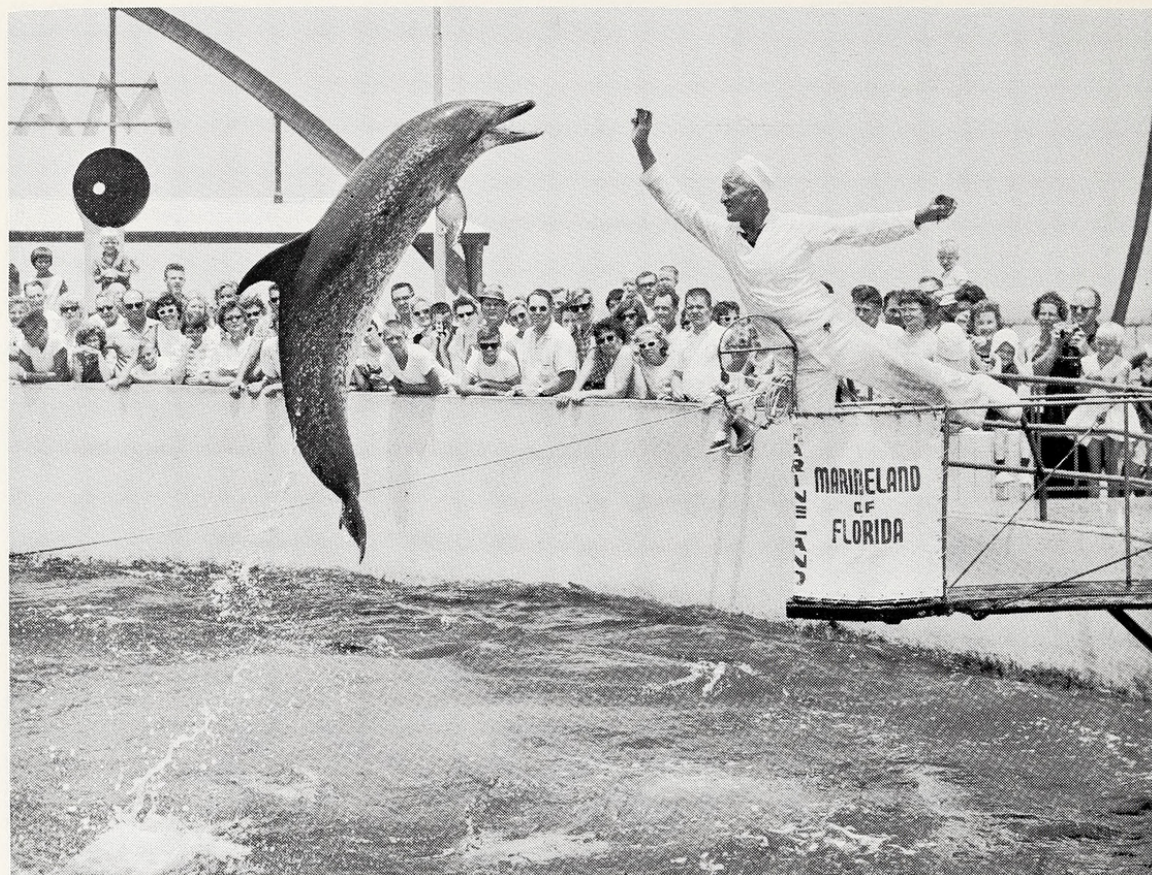


Figure 12. *Stenella plagiodon*. Captive female of adult size jumping for food at Marineland of Florida; collected at sea off St. Augustine, Florida. This is the same animal that appears in Figure 11. (Photograph courtesy of Marineland of Florida.)

beginning to develop the darker and somewhat spotted tongue pigmentation of the adult, and that sometime later she began to develop spots on the side of the head. Unfortunately, she died during the winter of 1965-66 so that this development could not be traced further. However, in early 1966 Mr. Townsend wrote, and later told us in conversation, that it was his impression that in captive subadult-size *S. plagiodon* at Marineland of Florida the spots first appear low on the sides of the animal, the full length of the body, and then gradually

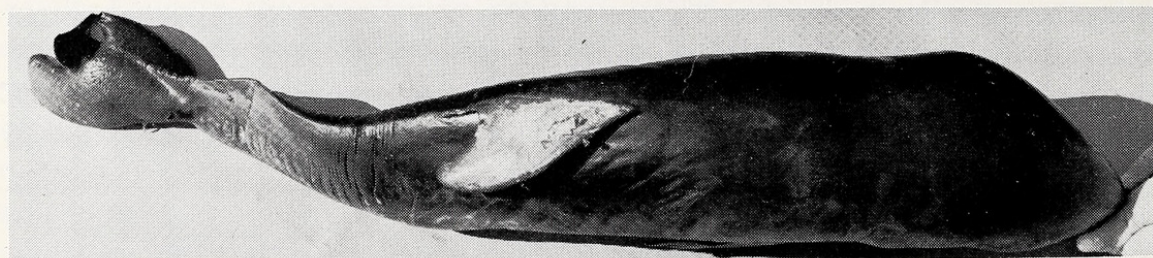
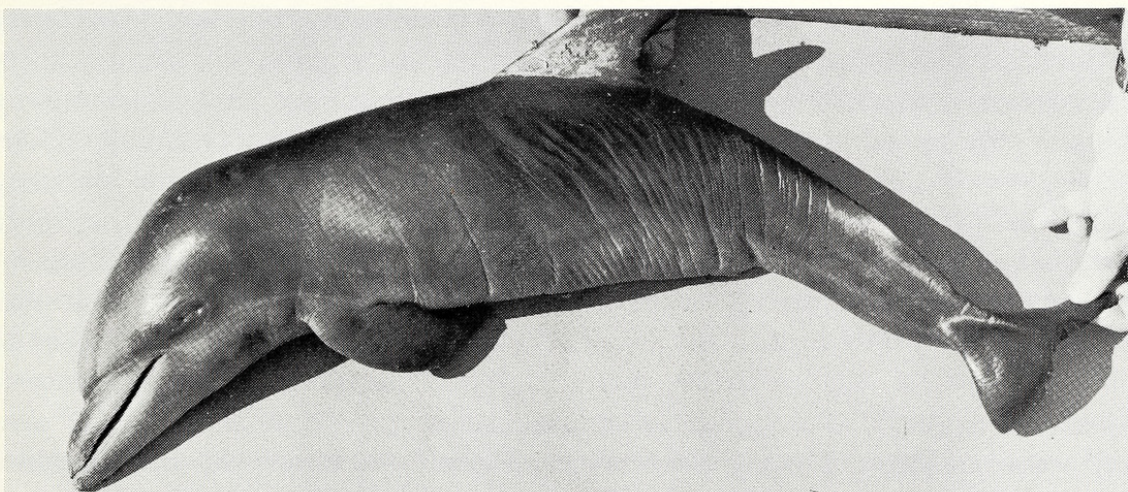
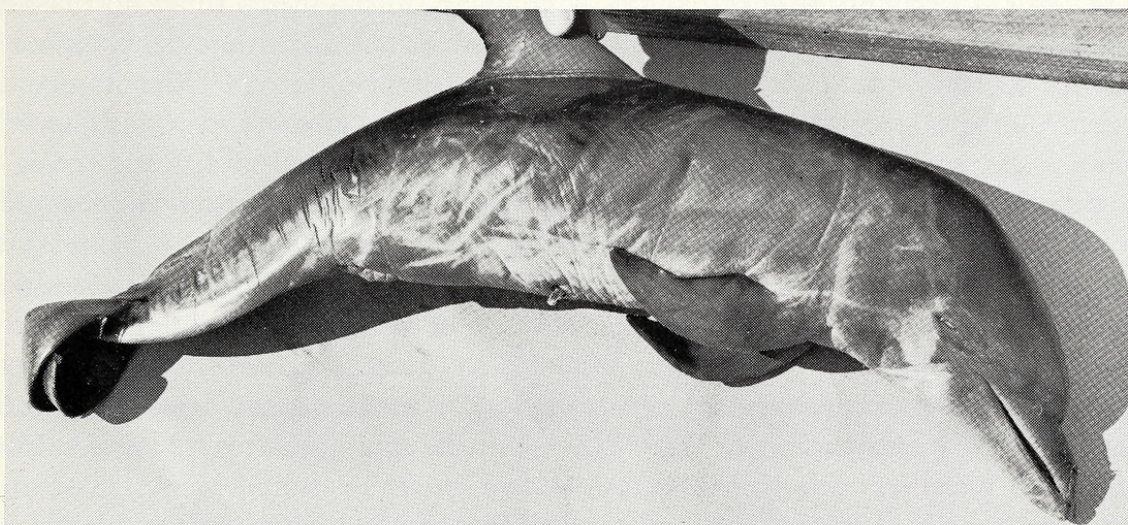
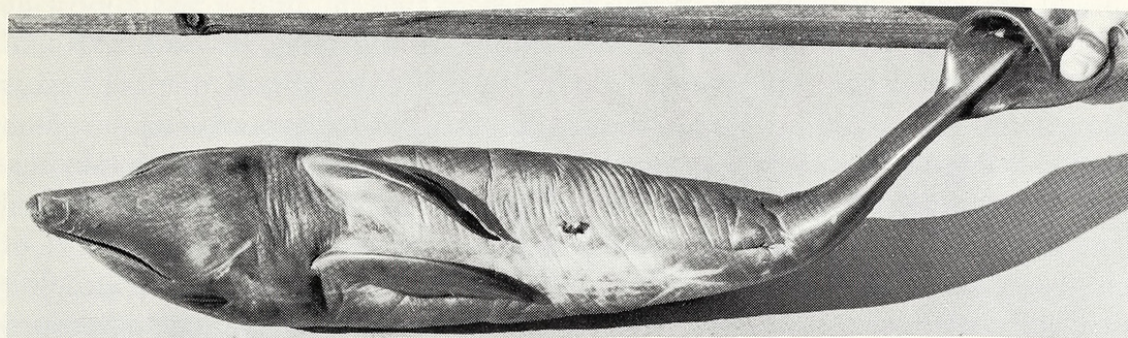


Figure 13. *Stenella plagiodon*. Dorsal, ventral and both lateral views of preserved unspotted female young (about 30.5 inches in snout to caudal-notch length) which died immediately after birth in captivity at Florida's Gulfarium. The spotted mother is the animal shown in Figures 1 through 5. Note the similarity of the pigment pattern





of this specimen to that of the juvenile *S. plagiodon* shown in Figures 1 through 4, and also note the text for important details of comparative pigmentations between the two unspotted animals. Also note the single row of hairs, typical of newborn delphinids, on the dorso-posterior part of the snout near its junction with the melon. (Photographs by Armando Solis, Los Angeles County Museum of Natural History.)



spread upward with increase in size and age so that an animal has almost its full complement of spots about the time it reaches adult size. It was Mr. Townsend's impression that the process from an unspotted to a spotted animal takes some six to eight months. He also noted that most of the spots are acquired on the ventral surface during this period, but that some additional ones may appear there after the lateral and dorsal spotting has fully developed. Special note should be made that according to Mr. Townsend the development of spotting does not take place until the individual has reached nearly an adult size, and that once the spotting has developed the particular pattern developed by an individual essentially remains the same throughout the remainder of its life. This is certainly true of captive animals and there seems to be no reason to assume that it would be different in wild individuals. The late development of the spotting could easily explain the report by Nichols (1920) of mixed schools of spotted and unspotted dolphins which he assumed consisted of more than one species. The size differential between the spotted and unspotted individuals possibly was not great enough to suspect that spotted adults and unspotted young were involved.

Unquestionable proof that the young of *S. plagiodon* are not spotted is shown by an event which took place at the Gulfarium. The spotted adult female (Figs. 1 through 5), that we studied there, later on gave birth to a totally unspotted calf (Fig. 13) that was clearly conceived in the wild since the mother's only companion in captivity was a juvenile female spotted dolphin captured with her. The calf died immediately after birth and is preserved intact in the collections of the Los Angeles County Museum of Natural History (No. 27058). We did not see the calf before it was preserved but except for the slightly darker overall pigmentation, especially on the under surfaces (which may be an artifact of preservation), the color pattern of the newborn calf is essentially the same as that of the live juvenile we studied (compare Figs. 1 through 4, of the juvenile, with Fig. 13, of the preserved calf). The newborn calf clearly lacks spots, has the light line running postero-ventrally from the eye to the pectoral flipper base, the separate dark line on the flank below the dorsal fin and is beginning to show the somewhat streaked patterning on the flank anterior to the dorsal fin. The pectoral flippers are dark in the calf as in the juvenile, and the low keel formed where the caudal peduncle joins the ventral surface of the flukes is lightly pigmented in both animals. There is no doubt that the pigmentation pattern of the unspotted newborn calf out of a spotted mother was the same as that of the live unspotted juvenile we studied, or, consequently, that the live juvenile from a school of spotted animals in turn was *S. plagiodon*.

The adult animal that we studied alive at Destin (Figs. 1 through 5) and the Texas adult (Fig. 9) captured by Gilmore had light spotting on the leading edges of the caudal flukes. Otherwise the flukes appeared to retain the homogeneous dark coloration (except for the darker trailing edge) shown by the



juveniles. True (1885: 318), on the other hand, indicated that the rest of the fluke of a dead specimen that he studied bore spotting like that of the other fins. Except for the ventral surface of the body around the genital region which remains white, the rest of the body of the adult (and including the dorsal and pectoral fins and the tongue) bore some degree of spotting from light on dark on the dorsal surfaces to dark on light on the ventral (Figs. 1 through 9).

The marked variation in color *pattern* between young and adult apparently is somewhat unusual in Cetacea. Similar variation, in which the young is essentially plain and the adult spotted, has been reported for the narwhal, *Monodon monoceros* Linnaeus (e.g., Fraser, 1937: 284; Kellogg, 1940: 80) and for *Stenella graffmani* (Lönnberg) in the eastern North Pacific (John H. Prescott, *pers. conversation*, 1966, told us that an unspotted calf of this species had been taken from the uterus of a spotted mother). The two varieties of *Prodelphinus* (= *Stenella*) *froenatus* (F. Cuvier) listed by Lütken (see True, 1889: pl. 19) may be another example of a spotted adult and an unspotted young (as suggested to us by F. C. Fraser, *pers. comm.*, 1965). Less marked differences, in which the young has a white belly and anterior part of the head while the adult is a solid color, have been reported in Risso's dolphin, *Grampus griseus* (G. Cuvier) (e.g., Flower, 1874: pl. 1; Millais, 1906: pl. following p. 310, after Flower; Richard, 1936: pl. 7). Species of cetaceans with adults and young of different colors or shades of the same color, but with the same color pattern, are not as unusual.

If in the development of coloration ontogeny follows phylogeny to some degree, then it appears that the plain gray coloration is the more primitive, followed by shades of gray and finally by complicated patterns of some kind such as the one shown herein for *S. plagiodon*. Another aspect of delphinid coloration that is found in several species and thus may be a primitive character is a "smear" of the lighter color usually found on the sides of the animals which extends dorso-ventrally into the darker dorsal coloration, in the region generally beneath the dorsal fin (see Figs. 1 through 4 and 7). Although not obvious in the figures included herein, the young *plagiodon* also showed this "smear" of lighter color into the darker. We have also seen this same kind of coloration in Atlantic and Pacific forms of *Tursiops* and in other species of *Stenella* from the Pacific, all of which have a basic coloration of a dark dorsal shading into a lighter ventral region.

Yablokov (1963: 41) noted that cetaceans with spots of the kind described herein for *S. plagiodon* are usually species with gregarious habits and suggested that the spots serve as recognition marks. *Stenella plagiodon* certainly is a gregarious species, but while there may be some basis for Yablokov's second suggestion, we believe that it is more likely that the spots serve as camouflage to help protect the animals from possible predators such as killer whales, *Orcinus orca* (Linnaeus), in the sparkling and often white-capped waves which are common in their normal open-sea environment.



## BREATHING

When observed unseen from the higher roof of an adjacent building, the two captive spotted dolphins were seen to engage in breathing in three ways.

First, when swimming around the tank in a leisurely and undisturbed manner with no humans in sight, the animals surfaced on an average of about once every 22 to 23 seconds. Although difficult to measure, the actual time of the blow while the animal was on the surface lasted about half a second, and no more than one second. The juvenile apparently blew *slightly* faster than the adult, but our equipment did not permit a precise measurement and this observation is subjective. Although the range of values for the interval between blows was essentially the same for the juvenile and adult animals, and only slightly more than one second difference was calculated in *mean* values for a number of blows, our data show that the young animal actually tended to blow more often than the adult. McBride and Kritzler (1951: 257) made similar, but more marked, observations on differences in average times between blows in *Tursiops truncatus* of different ages, and Layne and Caldwell (1964: 91) did the same in *Inia geoffrensis* (Blainville). While swimming in this leisurely manner, the two spotted dolphins gently rolled between breaths and showed progressively only their snout, blowhole, predorsal surface of the back, and dorsal fin. They did not show their flukes. Similar behavior by wild spotted dolphins was noted by Caldwell (1960: 135).

In the second type of breathing behavior, the two animals frequently engaged in a pattern which we called "standing on the head." At such times the animals would take from two to five short breaths at intervals of two to 12 seconds, and then arch over to stand vertically in the water, head down, for from 28 to 50 (usually the upper end of this range) seconds before returning to the surface for another series of short blows. When "standing on their heads," completely submerged, the two animals maintained their vertical position by gently waving their caudal flukes. In this position the tip of the rostrum did not touch the bottom of the deep pool, but instead the animals were actually suspended in the water. When they returned to the surface from this position, the animals stopped waving their flukes and their bouyancy brought them to the surface tail first—which they gradually arched into the horizontal plane parallel to the surface so that the entire body reached the surface while still submerged. At that time the head broke the surface for the series of short breaths. When the animal again dove, it showed its flukes momentarily above the surface as it completed the dive by either arching straight over and down or arching over and down in a corkscrew fashion so that once submerged its body axis was some 90° to its position on the surface before the dive.

We suspect that the first two forms of breathing are related in the first instance to normal swimming to get from one point to another, and in the second instance to deeper diving probably associated with feeding. The second form of breathing, in which the animal appears to hyperventilate in preparation for a deep dive, is reminiscent of the behavior of the sperm whale,



*Physeter catodon* Linnaeus, under such circumstances (see Caldwell, Caldwell and Rice, 1966).

In the third form of breathing, the captive animals at the Gulfarium sometimes rested in a horizontal fashion just below the surface, rising to blow only infrequently, but we never observed them to rise to blow as infrequently as the once every 120 seconds that Caldwell (1955: 468) observed in wild individuals.

Frequently, just before taking a food fish held in the hand of the feeder, the captive animals released large amounts of air in a single large bubble underwater. At this time the animal was usually positioned motionless underwater before the feeder and appeared to be uncertain as to whether or not to accept the fish. During the period of our study the animals had been captive for only about a month and appeared to still remain very wary of humans. The captive *Inia geoffrensis* studied by Layne and Caldwell (1964: 91) on occasion released similar large bubbles of air underwater.

Sometimes, when swimming at the surface, the spotted dolphins blew very explosively, and sometimes even caused a slight "spout" when water possibly present in the vestibule was blown out. Lawrence and Schevill (1956: 135) made similar observations in *T. truncatus*, as did Layne and Caldwell (1964: 91) for *Inia geoffrensis*. At the time, we suspected that this behavior, like the release of the large air bubble noted above, was related to the wariness of the spotted dolphins and that it served to convey the disturbed attitude of the animals.

#### PLAY

At Marineland of Florida the younger *T. truncatus* have devised a game of catch with human observers who are often positioned around the open top of the dolphin community tank in order to watch the feeding show. In this game the dolphins grasp a small rubber ball in their mouth and then toss it out of the tank in the direction of the human participant. The dolphins exercise remarkable aim, and the human is then apparently expected to catch the ball and return it to the waiting dolphin. Mr. Townsend told us in 1966 that the older adult *T. truncatus* do not participate in this particular activity (although they play with objects underwater), but that the fully adult *S. plagiodon* do. An adult female spotted dolphin ("Dottie"), who has been in captivity at Marineland of Florida for ten years, still takes part in this play. We observed this firsthand in early April, 1966, and also noted that a young male spotted dolphin, in captivity only about three weeks at that time, had also learned this activity and was performing it accurately.

#### SOUND PRODUCTION

The vocalizations of two female *S. plagiodon*, 51 and 89 inches in snout to caudal-notch length, were recorded at the Gulfarium. The animals were 28 days captive when the recording sessions began and they were recorded intermittently during the two weeks following.



Wood (1953: 122) noted that this species is less vocal than the oft-studied *T. truncatus*. Our studies reinforce this statement, particularly in the "whistle" component. However, on the rare occasions when whistles were emitted, there were several in succession and very loud. There were two contours that made up most, but not all, of the contour repertoire, and this leads us to believe that individual spotted dolphins are characterized by a signature whistle as has been suggested for *T. truncatus* by Caldwell and Caldwell (1965). Schevill and Watkins (1962: phonograph record) recorded "squeals" (= "whistles") from a number of wild *S. plagiodon* and a sonagram of these phonations has been published (Schevill and Watkins, 1962: 9; Schevill, 1962: 3).

During the times when the two animals that we studied at the Gulfarium were clearly in acoustical isolation, a "chirp" was also recorded. This is a brief pure tone that rises in frequency. We do not classify this as a true whistle contour because of its simplicity and universality. We have recorded the same chirp from captive *T. truncatus*.

Low intensity pulsed sounds (click trains) that were directly correlated with feeding were recorded. However, there is a possibility that acoustical isolation may have been broken at that time between the tank with the *S. plagiodon* and an adjoining tank containing *T. truncatus*. In view of this, additional confirmation is needed for the click train in this species.

Additional confirmation is also needed for a number of other audible sounds that we recorded under circumstances that we felt may have been acoustically contaminated by the nearby *T. truncatus*. However, we are reasonably confident that the two spotted dolphins emitted several types of pulsed phonations that we could separate audibly on playback, and these we have listed as "squawks," "squeaky-squawks," "barks," "growls," and "cracks." Under even less acoustically-isolated conditions, Wood (1952; 1953) listed "whistles" and "barks" which he attributed to *S. plagiodon*. Caldwell, Caldwell and Evans (1966) have discussed some of the problems in the use of subjective terms to describe cetacean phonations.

All of the sounds listed for the two *S. plagiodon* at the Gulfarium were recorded at a tape speed of 7.5 inches per second using a Uher model 4000-S Report recorder coupled with an Atlantic Research Corporation Model LC-57 hydrophone and a special preamplifier constructed for the system by William E. Sutherland of the Lockheed-California Company, Los Angeles. This system had a flat capability of 40 to 20,000 cycles per second with a good signal to noise ratio.

On August 17, 1963, a female spotted dolphin became entangled in a sport fisherman's line off Destin, Florida. This animal was brought to the Gulfarium, but only lived a few days before succumbing to injuries received at capture. However, before the animal died, Mr. Lowell Longaker of Ft. Walton Beach was able to record whistles and click trains from it. Mr. Longaker kindly allowed us to listen to his recordings, but we heard no additional phonations which were not duplicated in our own studies of the two other captive animals in 1965.



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#### ADDENDUM

After this paper was in galley proof, a publication by Philip Hershkovitz appeared (1966, Catalog of living whales. *Bull. U. S. Natl. Mus.*, 246:viii + 259) wherein, on page 40, he assigned the name *Stenella pernettyi* (Blainville) to the form we have discussed herein as *S. plagiodon*.

True (1885: 322) and Fraser (1950: 64) each briefly discussed *pernettyi*, which was described (1817, *Nouveau Dictionnaire d'Histoire Naturelle*, 9: 154) from a specimen collected in Atlantic South American waters at 16°44' S, 35°10' W. Another animal, believed at the time to have been the same species, was said to have been sighted earlier at 6°43' N, 25°17' W, somewhat closer to Africa than to South America. Neither True nor Fraser made a definite assignment for *pernettyi* to a species represented by specimens, but each writer suggested that it may have affinities with *plagiodon*.

None of the original material of *pernettyi* was saved, and so no direct comparisons with *plagiodon* can now be made, and the description of *pernettyi* is too incomplete to make non-specimen comparisons. We have examined collector Pernetty's figure (reproduced in Philippi, 1893, *Los delfines de la punta austral de la America del sur. Annales del Museo Nacional Chile*, (1) Zool., 6: 14, pl. 5, fig. 3) and find it too lacking in detail and unlike our present understanding of *plagiodon* to make a case for considering the two forms synonyms. Actually, in our estimation the figure is crude to the degree that it



is doubtful if it can be legitimately used to represent any known species of delphinid.

Consequently, as True (1885: 322) suggested, we do not believe that it is advisable at this time, if ever, to try to revive the name *pernettyi*, but instead suggest that it be added to Hershkovitz' list of cetacean *incertae sedis*. However, it must be pointed out that the capture and observational localities for the nominal form *pernettyi* are in the general geographical region of capture for the "*plagiodon* ?" of Cadenat (1959) and Cadenat and Lassarat (1959) discussed above, and consequently the same species could at least in part be involved—whatever it may be.

Even if the form named *pernettyi* could be shown to be the same as the form named *plagiodon*, it would be of significance only in providing a basis for listing *plagiodon* from South America. Under Article 23b of the International Code of Zoological Nomenclature for 1964, the name *pernettyi* should be considered a *nomen oblitum* inasmuch as it has been over 50 years (73 to be exact) since even the listed use of the name as a senior synonym was applied by Philippi in 1893. The only other use of the name that we can find is that of True (1885) and Fraser (1950) when they discussed it as a questionably-identifiable nominal species in their consideration of the possible identification of other specimens. To our knowledge, *pernettyi* has never been directly applied to the western North Atlantic form named *plagiodon*, until Hershkovitz did so in 1966. To try to apply the name of such a poorly-described form as *pernettyi* to a well-known species such as *plagiodon* serves no purpose.

Hershkovitz (1966: 36) is in error in placing the *Prodelphinus doris* of True (1885) in the synonymy of *Stenella frontalis* G. Cuvier. There is reason to consider the *doris* of Gray a synonym of *frontalis* (see Fraser, 1950: 68), but this is no basis for the inclusion of the *doris* of True (1885) in that synonymy. True (1889) clearly noted that his earlier application of the name *doris* was incorrect and his material from his 1885 paper should be referred only to the nominal form *plagiodon*. Hershkovitz (1966: 41) apparently was aware of this later correction by True.

Although we did not include his remark in our discussion of juvenile pigmentation in *plagiodon* above, because the species involved was uncertain, True (1885: 322) did mention in his comments on *pernettyi* that the lack of spotting on the back of the animal in Pernetty's figure was not a significant difference between that species and *doris* (= *plagiodon* in True's paper). True made this statement because he had been informed by a naturalist on board the research vessel *Albatross* that the young in schools of spotted dolphins (believed by True to be *plagiodon*) which had been seen off Cape Hatteras did not have the back spotted.

Also after our manuscript was in galley proof, Dale W. Rice pointed out a paper by Glover M. Allen (1931, Ocean dolphins. Bull. Boston Soc. Nat. Hist., 61: 3-7) in which he illustrated (p. 4) as *Prodelphinus froenatus*, a small dolphin harpooned at sea "south of Bermuda." The pigmentation of the small





Caldwell, David

K.

↑

and Caldwell, Melba C. 1966. "Observations on the distribution, coloration, behavior and audible sound production of the spotted dolphin, *Stenella plagiodon* (Cope)." *Contributions in science* 104, 1–28.

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