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A DWARF FORM OF THE SPINNER DOLPHIN (*STENELLA LONGIROSTRIS*) FROM THAILAND

WILLIAM F. PERRIN
Southwest Fisheries Center,
U.S. National Marine Fisheries Service,
P.O. Box 271, La Jolla, California 92038

NOBUYUKI MIYAZAKI
Department of Zoology,
National Science Museum,
3-23-1 Hyakunin-cho, Shinjuku-ku,
Tokyo 160, Japan

TOSHIO KASUYA
Far Seas Fisheries Research Laboratory,
Japan Fisheries Agency,
5-7-1 Orido, Shimizu-shi, Shizuoka-ken,
424 Japan

ABSTRACT

A very small form of the spinner dolphin has been found to inhabit the Gulf of Thailand. Ten specimens taken incidentally in a local shrimp fishery differ from specimens of this species collected elsewhere in body size and shape, skull size and shape, number of teeth and numbers of thoracic and lumbar vertebrae. Four cranially adult males were 129–137 cm long, well below the ranges for the Indian Ocean, western Pacific, central Pacific, eastern Pacific and Atlantic. The skull is also very small. Tooth counts and vertebral counts average lower than in other series. The color pattern is not significantly different from that of spinner dolphins in the central and western Pacific, Atlantic and Indian Oceans but differs from that of the small eastern spinner of the eastern Pacific. The Gulf of Thailand specimens are morphologically separable from all other specimens, but it is to be expected that when larger samples are available there will be some overlap. The dwarf form may overlap in body and skull size with small spinner dolphins taken incidentally in a gillnet fishery for sharks off northern Australia. The geographic range of the dwarf spinner may be restricted. The size and status of the population and the impact of the shrimp fishery are unknown and should be investigated. The dwarf spinner may have an ecology different from that of other spinners, feeding mainly on reef-associated and benthic organisms rather than mesopelagic animals.

Key words: *Stenella longirostris,* dwarf spinner dolphin, Gulf of Thailand, morphometrics.

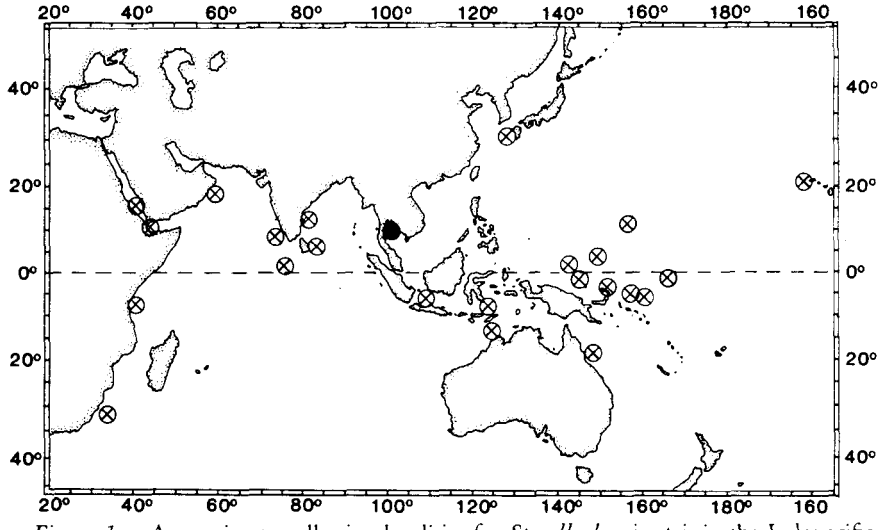


Figure 1. Approximate collection localities for *Stenella longirostris* in the Indopacific west of 160°W (Howell and Pearson 1977; Alling 1985; Miyazaki and Wada 1978; Masaki and Kato 1979; Mizue *et al.* 1964; Miyazaki 1986; Natarjan and Rajaguru 1983; Ogawa 1936; Mohan 1985; Robineau and Rose 1983; Hembree 1980, 1986; Gilpatrick *et al.* 1987). Solid symbol is in Bight of Bangkok. (See Gilpatrick *et al.* 1987 and Perrin and Gilpatrick, in press, for precise locations and other sighting localities).

Pronounced geographical variation in small odontocetes has been found to be the rule rather than the exception (Perrin 1984); this existence of numerous morphologically distinct populations has obvious and important implications for conservation and management of cetaceans (Perrin and Reilly 1984). The spinner dolphin occurs around the world in the tropics (Perrin and Gilpatrick, in press) and is involved in exploitation and conservation problems in several regions (Perrin 1988). The purpose of this paper is to report the discovery of a population of exploited spinner dolphins in the Gulf of Thailand that differ sharply in adult size and other features from spinner dolphins as previously described from other regions.

Materials and Methods

The material examined consists of 10 specimens taken incidentally in shrimp trawls during night fishing in 1970–1971 in the Bight of Bangkok by small local trawlers (5–10 gross tons, 6–7 m) based at Sakhon in western Bangkok (Fig. 1). The dolphins were returned to port at the request of K. Morishima, who forwarded external photographs, external measurements (for 9 individuals), weights (for 7) and prepared skulls and postcranial skeletons to M. Nishiwaki at the Ocean Research Institute of the University of Tokyo. The material was later transferred to the National Science Museum, Tokyo (NSM, catalog numbers M24851, M24971–79). Skull and skeletal measurements and counts were taken as described in Perrin (1975). Specimens with all vertebral ephiphyses

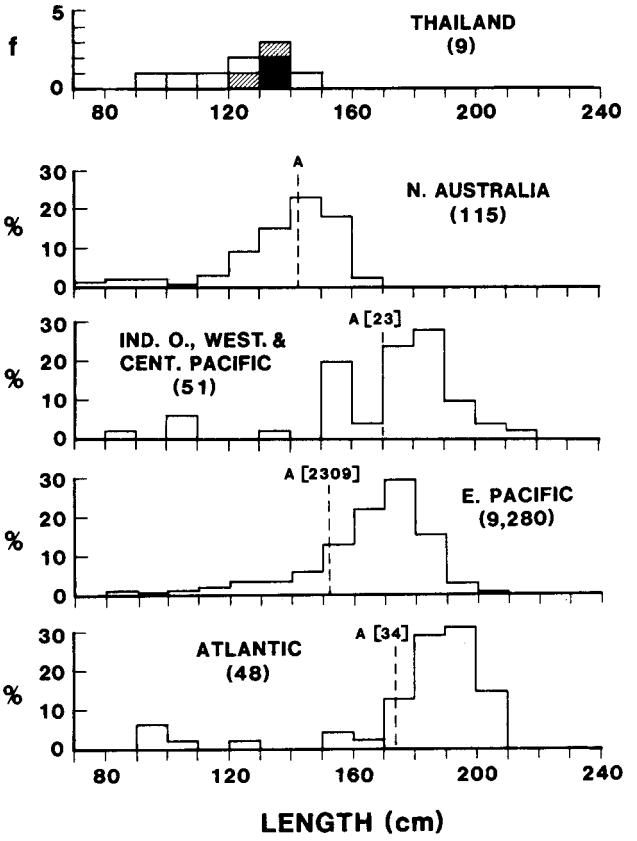


Figure 2. Comparison of distribution of body length and minimum adult length for males and females combined (A) in Gulf of Thailand specimens of *Stenella longirostris* with those for spinner dolphins from northern Australia (Hembree 1986), the Indian Ocean and western and central Pacific (see Fig. 1 for sources), eastern Pacific (unpublished data and Perrin *et al.* 1985), and Atlantic (sources listed in Perrin *et al.* 1981). Sample sizes in parentheses. Number of adults included in estimate of minimum adult size in square brackets. Solid rectangles represent physically mature specimens; hatched are sexually mature but not physically mature; open are immature or of unknown status.

fused to the centra (evidenced by absence of a visible seam at the surface) were judged physically mature. Distal fusion of maxilla and premaxilla was used as an approximate index of sexual and cranial maturity (Perrin 1975). Comparative data came from the literature and museum specimens. We also had access to three bodies of unpublished data. Length data and partial data on maturity and stomach contents for 115 spinner dolphins killed incidentally in a former Taiwanese gillnet fishery for sharks in the Timor and Arafura Seas off northern Australia are contained in a contract report to the Australian National Parks and Wildlife Service by the late Durant Hembree (1986). Length and maturity data for 9,280 spinner dolphins (of all stocks) killed incidentally in the tuna purse-seine fishery in the eastern tropical Pacific came from life-history data

Table 1. Ranges of selected external measurements (in cm) of adult spinner dolphins from Thailand, other regions in Indopacific, eastern Pacific and Atlantic, and maximum values for spinner dolphins from northern Australia. Data for other than Thailand specimens from Hembree (1986), Howell and Pearson (1977), Masaki and Kato (1979), Miyazaki (1986), Miyazaki and Wada (1978), Perrin (1975), Perrin *et al.* (1979, 1981, 1985) and unpublished data from K. S. Norris. Thailand specimens are males; sexes pooled for other areas. Sample sizes in parentheses.

	Thailand	Indopacific	E. Pacific	Atlantic	N. Australia
	(minimum and maximum)				(maximum)
Total length	129–137 (4)	172–209 (17)	152–235 (2,309)	173–208 (34)	158 (41)
Tip of upper jaw to:					
Apex of melon	14 (3)	15–19 (9)	11–17 (91)	13–20 (32)	—
Center of blowhole	22–27 (4)	32–38 (8)	25–36 (90)	30–39 (32)	—
Center of eye	25 (4)	29–35 (10)	26–35 (86)	30–36 (34)	31 (40)
End of gape	22–25 (4)	27–31 (9)	23–31 (92)	25–33 (35)	—
Anterior insertion of flipper	33–34 (4)	42–50 (8)	37–47 (92)	41–53 (35)	46 (40)
Umbilical scar	67 (4)	87–101 (9)	75–97 (92)	85–101 (23)	80 (39)
Anterior length of flipper	22–23 (4)	19–27 (10)	—	25–38 (34)	27 (40)
Posterior length of flipper	17–18 (4)	—	16–22 (83)	—	21 (40)
Width of flipper	8 (4)	9 (1)	—	8–11 (34)	11 (40)
Width of flukes	28–38 (4)	38–46 (9)	31–45 (84)	36–53 (33)	42 (39)
Height of dorsal fin	13–16 (4)	17 (1)	—	15–25 (34)	18 (41)

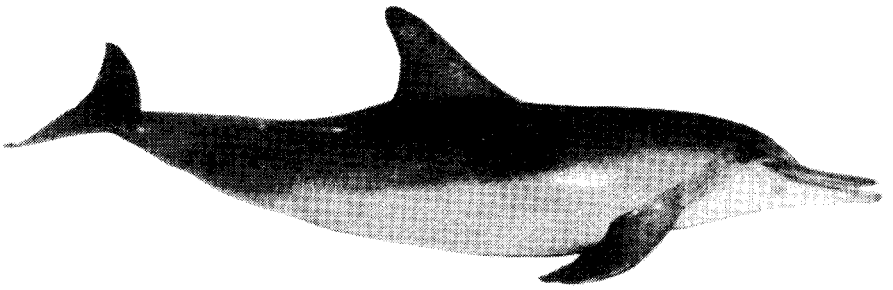


Figure 3. Dwarf spinner dolphin from the Gulf of Thailand (photograph not identified to specimen).

bases maintained in the Fishery/Marine Mammal Interactions Division at the Southwest Fisheries Center; length frequencies were computed using the program BMDP2R—Detailed Data Description of the BMDP series (Dixon *et al.* 1985). We also had access to data and specimens collected on the *Westward* cruise to the southeastern Central Pacific in 1970–1971, provided by K. S. Norris, University of California, Santa Cruz, CA 95064.

Comparative specimens examined—Eastern Pacific and Atlantic: listed in Perrin (1975) and Perrin *et al.* (1979, 1981) and SWFC 0025 (DAB 100) from 140°19'N, 93°10'W. Indian Ocean: Sri Lanka, 4 (BMNH 1891.10.13.2, 1948.4.20.1, 1949.10.27.1 and 2); Maldives, 5 (BMNH 1959.7.9.1, 3, 4, 5 and 6). Western Pacific: Japan, 1 (NSM M24800); between 5°N and 9°S and between 142° and 160°E, 5 (NSM M24930, M24931, M24933, M24934); Eniwetok, 1 (USNM 395404). Central Pacific: Hawaii, 28 (LACM 27093, 27095, 54049, 54050, 54056, 54057, 54060 and 72296; CAS 10529, 16455, 16456, 16457 and 16458; SWFC WFP 605, 606, 623, 669 and 671; MCZ 5170; USNM 339649 and 504140; MMBL 1194; NSM 24615 and 24815; BMNH 1965.8.25.1); Christmas Island, 2 (ANS 019194 and 019915); Washington Island, 1 (USNM 504251); Rangiroa (Tuamotu Islands), 1 (USNM 504252); Hiva Oa (Marquesa Islands), 1 (USNM 504253).

Museum acronyms—ANS, Academy of Natural Sciences, Philadelphia, Pennsylvania; BMNH, British Museum (Natural History), London; CAS, California Academy of Sciences, San Francisco; LACM, Los Angeles County Museum of Natural History, Los Angeles, California; MCZ, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts; MMBL, U.S. Marine Mammal Laboratory, Seattle, Washington; NSM, National Science Museum, Tokyo; SWFC, Southwest Fisheries Center, La Jolla, California; UF, University of Florida, Gainesville; USNM, U.S. National Museum of Natural History, Smithsonian Institution, Washington, DC.

Results

External size, shape and coloration—The adult Thailand specimens were on the average smaller than the specimens from northern Australia and below the

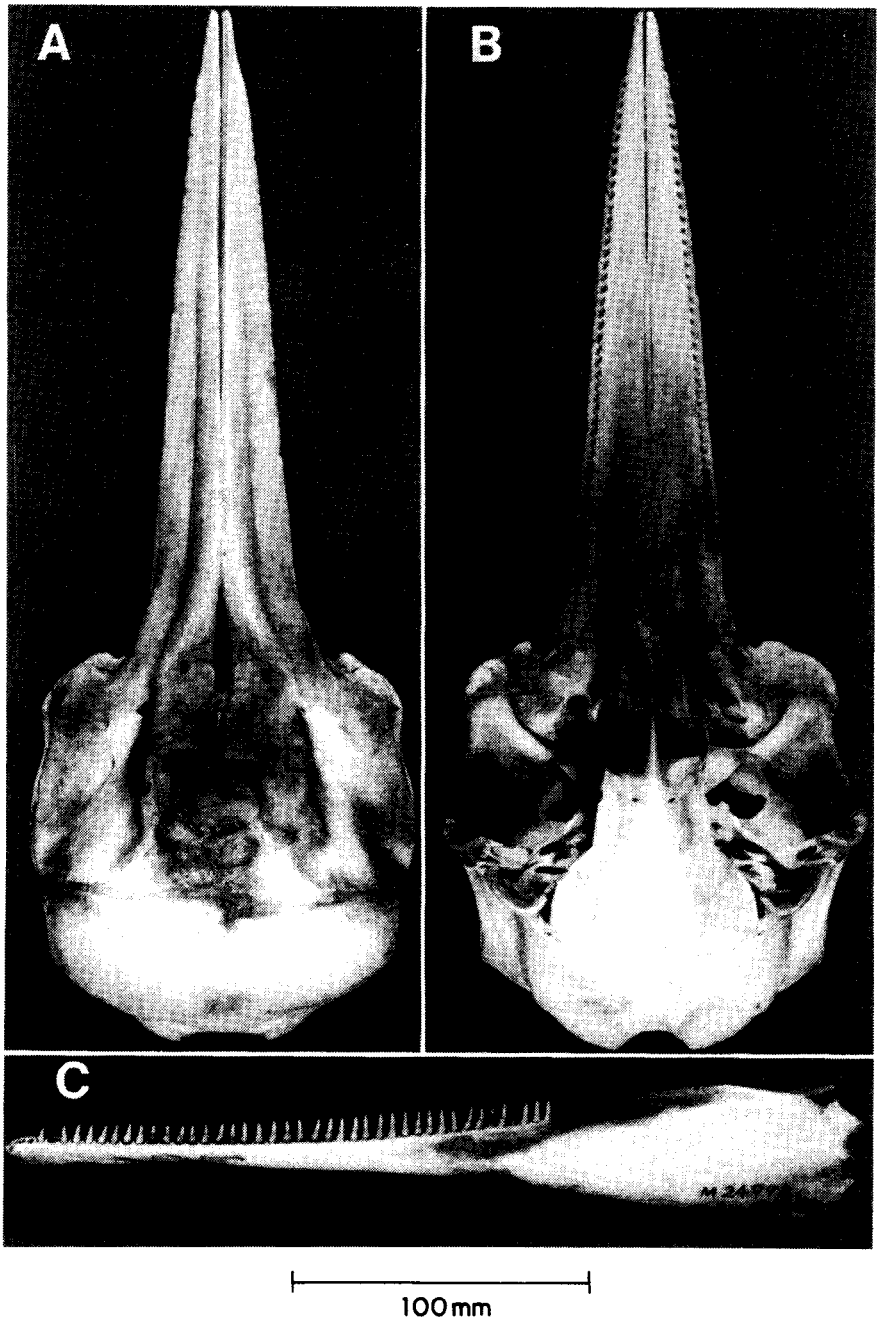
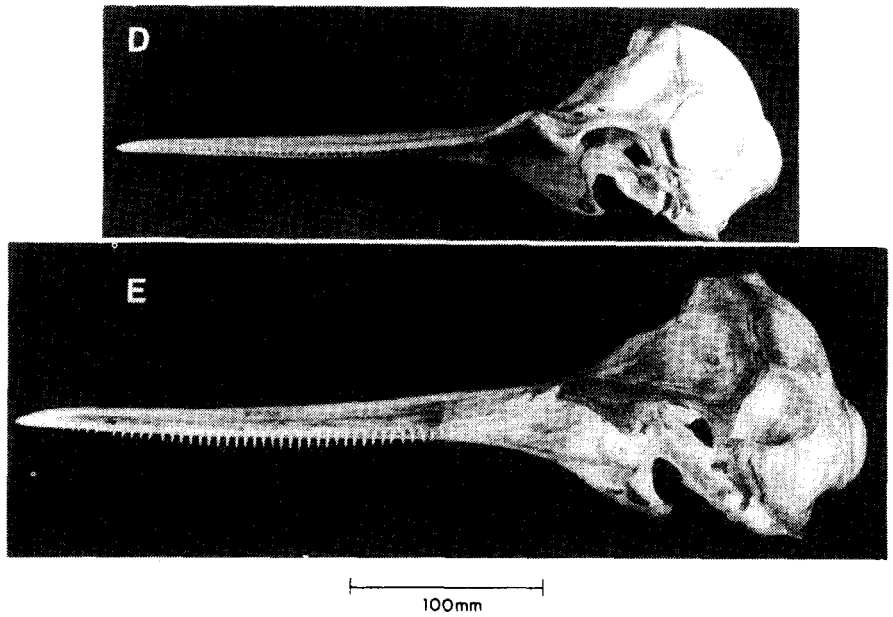


Figure 4. A, B, C, D: skull of dwarf spinner dolphin from the Gulf of Thailand (NSM M24978, physically male, 136 cm, condylobasal length 343 mm). E: lateral view of skull of spinner dolphin from the Atlantic coast of Florida (UF R-3-SLS, sexually adult female, 189 cm, condylobasal length 437 mm).



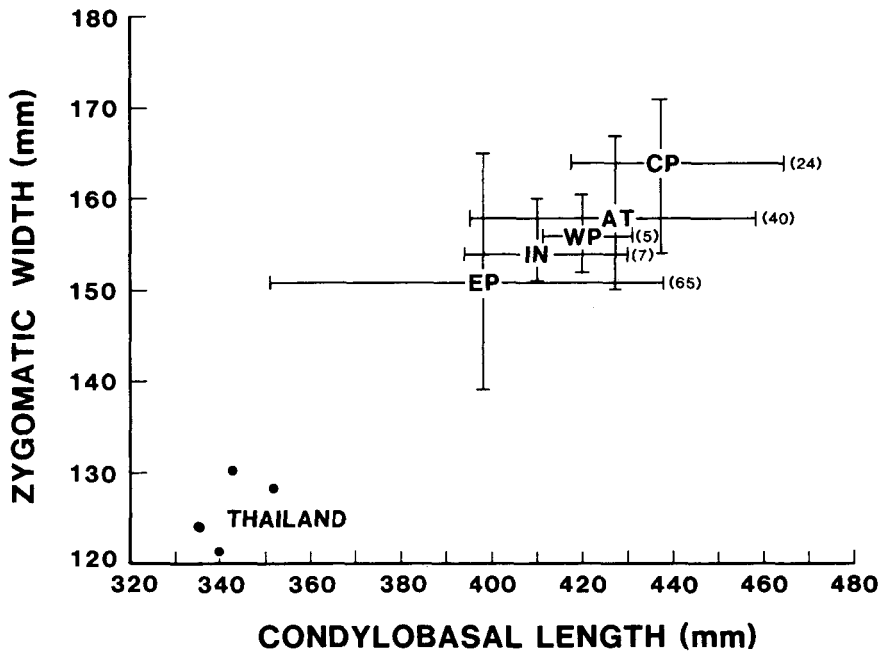


Figure 5. Comparison of adult skull length and width in Thailand specimens of *Stenella longirostris* with ranges and means for series from Indian Ocean (IN), western Pacific (WP), central Pacific (CP), eastern Pacific (EP; several populations pooled), and Atlantic (AT). See Table 2 for sources of data.

Table 2. Means, standard deviations (for sample sizes ≥30), sample sizes (in parentheses), and maximum and minimum values for selected skull measurements (cranially adult specimens only; in mm) and postcranial measurements (physically mature specimens only) for series of *Stenella longirostris* from the Gulf of Thailand and other regions. Data

	Thailand	Indian Ocean	Western Pacific
Condylobasal length	342.5	409.2	420.1
	(4) 335–352	(7) 394–430	(7) 411–431
Length of rostrum	219.8	264.9	272.1
	(4) 215–224	(7) 250–281	(7) 262–281
Width of rostrum at base	61.0	74.0	78.3
	(4) 57–66	(7) 71–76	(7) 73–84
Width of rostrum at ½ length	35.0	43.3	47.9
	(4) 33–37	(7) 42–45	(7) 44–54
Length of pmx's at ½ length	16.8	19.4	21.0
	(4) 15–18	(7) 18–20	(6) 19–23
Width of rostrum at ¾ length	25.0	31.0	31.4
	(4) 24–27	(7) 28–34	(5) 26–36
Greatest preorbital width	115.5	141.6	144.6
	(4) 111–120	(7) 135–146	(5) 140–150
Greatest postorbital width	128.3	155.4	160.8
	(4) 124–131	(7) 153–160	(6) 155–169
Greatest width of ext. nares	34.3	39.6	42.8
	(4) 33–36	(7) 38–42	(5) 40–45
Zygomatic width	125.8	154.0	156.2
	(4) 121–130	(7) 151–160	(5) 152–161
Greatest width of pmx's	52.3	61.4	62.2
	(4) 49–55	(7) 59–64	(5) 60–65
Parietal width	104.8	128.7	127.6
	(4) 103–108	(7) 122–133	(5) 125–131
Height of braincase	77.3	89.7	88.4
	(4) 76–78	(7) 88–95	(5) 86–93
Internal length of braincase	88.8	102.9	104.6
	(4) 81–92	(7) 100–106	(5) 102–108
Length of temporal fossa	45.8	50.0	47.4
	(4) 42–49	(7) 46–58	(5) 44–51
Height of temporal fossa	38.0	41.4	41.0
	(4) 36–40	(7) 39–45	(5) 36–44
Length of orbit	38.8	42.3	43.0
	(4) 38–40	(7) 40–44	(5) 40–46
Length of antorbital process	31.8	41.7	42.6
	(4) 30–34	(7) 40–45	(5) 39–47
Width of internal nares	34.8	42.0	44.6
	(4) 34–35	(7) 39–45	(5) 42–47
Length of upper toothrow	192.8	232.3	237.2
	(4) 185–198	(7) 224–242	(6) 219–246
Length of ramus	293.3	352.0	366.3
	(4) 287–303	(7) 336–370	(7) 360–371
Height of ramus	46.3	55.9	55.8
	(4) 45–47	(7) 55–57	(6) 55–57
Diameter of tooth (at midlength of lower row, transverse at alveolus)	3.00	—	3.00
	(3) 2.8–3.1		(2) 2.9–3.1

Table 2. Continued.
from Masaki and Kato (1979), Mizue *et al.* (1964), Mohan (1985), Ogawa (1936), Perrin (1975), Perrin *et al.* (1979, 1981), Robineau and Rose (1983), Ross (1984) and museum specimens listed in Materials and Methods.

Central Pacific	Eastern Pacific			Atlantic
	Costa Rican	Eastern	Whitebelly	
436.9	428.6	386.5	405.1	427.0 ± 13.10
(24) 417–464	(5) 416–439	(26) 351–407	(25) 365–438	(41) 395–458
282.6	279.0	245.5	258.0	276.8 ± 11.00
(24) 263–304	(5) 269–288	(26) 218–262	(25) 227–278	(41) 251–304
79.3	72.4	72.1	75.1	76.6 ± 3.41
(24) 74–86	(5) 70–77	(29) 66–77	(28) 69–83	(42) 68–83
47.0	42.0	41.6	42.6	44.4 ± 2.30
(24) 42–56	(5) 39–43	(26) 37–47	(22) 39–51	(41) 41–50
21.1	21.4	19.6	20.3	21.0 ± 2.32
(24) 17–23	(5) 21–22	(26) 16–22	(23) 17–24	(37) 17–32
32.3	29.8	30.5	31.9	31.9 ± 2.63
(24) 27–37	(5) 28–32	(26) 26–36	(23) 29–36	(39) 25–39
150.8	134.2	132.3	140.9	145.6 ± 3.86
(24) 140–158	(5) 131–138	(29) 127–138	(28) 132–150	(42) 137–153
165.2	151.2	148.1	156.7	161.1 ± 4.03
(25) 158–172	(5) 149–152	(29) 140–154	(29) 148–167	(41) 152–169
42.5	40.6	40.2	40.9	41.8 ± 1.63
(25) 39–47	(5) 39–43	(29) 33–44	(29) 37–46	(38) 38–45
163.5	150.4	146.4	155.5	159.2 ± 3.92
(25) 154–171	(5) 149–152	(29) 139–153	(28) 145–165	(40) 150–167
66.1	64.4	60.6	63.0	64.8 ± 2.38
(24) 62–70	(5) 61–66	(29) 49–67	(29) 58–67	(42) 60–71
131.4	128.8	125.9	130.2	130.5 ± 4.25
(25) 122–140	(5) 127–130	(29) 119–132	(28) 120–139	(41) 121–140
91.0	86.6	86.4	89.9	93.1 ± 3.94
(24) 84–98	(5) 85–89	(29) 83–92	(28) 80–98	(38) 85–107
105.5	99.8	100.0	103.7	106.4 ± 3.77
(24) 100–110	(5) 97–103	(29) 95–108	(28) 94–113	(37) 99–114
53.3	49.6	48.5	49.7	48.1 ± 3.30
(25) 45–61	(5) 46–57	(29) 41–57	(28) 41–56	(42) 42–56
42.9	36.4	36.6	40.6	38.3 ± 3.52
(25) 37–50	(5) 34–42	(29) 29–47	(28) 32–46	(42) 30–49
42.8	42.0	39.8	40.6	41.8 ± 2.10
(25) 40–47	(5) 40–44	(29) 38–43	(29) 37–45	(39) 39–50
44.7	42.6	39.9	40.9	43.4 ± 2.23
(25) 40–49	(5) 41–45	(29) 33–45	(15) 35–45	(39) 38–48
44.1	44.8	41.2	44.8	46.5 ± 2.26
(25) 39–48	(5) 42–47	(29) 38–45	(29) 39–50	(37) 42–53
245.6	245.0	212.2	224.0	243.5 ± 10.30
(24) 224–263	(5) 238–255	(25) 192–229	(23) 192–246	(41) 221–265
372.4	369.6	329.1	343.0	368.4 ± 11.68
(23) 352–399	(5) 358–379	(27) 301–348	(29) 308–374	(40) 343–399
58.4	55.2	52.3	54.7	56.4 ± 2.28
(23) 53–64	(5) 53–57	(29) 47–57	(29) 50–60	(41) 51–61
2.58	—	—	—	2.47
(23) 2.1–3.1				(29) 2.1–3.0

Table 2. Continued.

	Thailand	Indian Ocean	Western Pacific
Width of atlas	59 (1)	75.0 (2) 74–76	72 (1)
Height of atlas	35.0 (2) 33–37	46.0 (2) 46	46 (1)
Height of first lumbar	33.5 (2) 32–35	44.5 (2) 44–45	71 (1)
Width of first lumbar	122.5 (2) 120–125	174.0 (2) 163–185	169 (1)
Length of longest rib	184.0 (2) 180–188	251.0 (2) 234–268	262 (1)

minimum adult lengths for the very large eastern Pacific sample and the samples from other parts of the Indopacific and the Atlantic (Fig. 2, Table 1). (Minimum adult size was not available for the Australian series.) Four cranially adult males from Thailand were 129–137 cm long; two of these were physically mature, and all were below the minimum adult lengths of 142 cm for females and 144 cm for males given by Hembree (1986) for the northern Australian specimens. The Thailand sample is very small, however, and some overlap could be expected when larger samples become available. Four of the five females in the sample (94–133 cm) were cranially immature; the skull of a fifth female (141 cm) was too heavily damaged to allow estimation of maturity. The four adult males weighed 21.5–26.5 kg, far below the range of 47.7–76.7 kg for 20 adult males from the eastern Pacific (unpublished data, WFP) and 55.8–75 kg for 9 adult or maturing males from the Atlantic (Mead *et al.* 1980).

In other external dimensions (Table 1), the Thailand dolphins fell below the ranges of the series from the Indopacific, eastern Pacific and Atlantic in several anterior measures (tip of upper jaw to eye, to anterior insertion of flipper and to umbilical scar) but overlapped them in others, including dimensions of the appendages. Since the series did not overlap in total body length, this suggests that the appendages were on the average proportionately larger in the Thailand animals than in the others.

The maximum values of all dimensions for the northern Australian series fall outside the ranges for the Thailand animals, by several cm in most cases. (The minimum values for adults were not given by Hembree.) While, again, the Thailand sample is very small and overlap may be expected when more extensive and complete data become available, it is likely that the northern Australian form will prove to be larger on the average in several external dimensions in addition to total length.

The external photographs (Fig. 3) are not identified to specimen. They show the tripartite pattern typical of the species in the central and western Pacific, Atlantic and Indian Oceans, consisting of dark-gray dorsal cape, lighter-gray lateral field and a white underside (Perrin 1972, and 1975; Perrin *et al.* 1981). Thus, while small in size, the Thailand spinner does not resemble the small

Table 2. Continued.

Central Pacific	Eastern Pacific			Atlantic
	Costa Rican	Eastern	Whitebelly	
74.0	—	69.7	70.5	—
(3) 72–75		(6) 67–74	(8) 65–74	
44.0	—	43.0	43.3	—
(3) 43–45		(6) 40–47	(8) 40–46	
43.8	—	40.3	41.3	—
(3) 42–46		(6) 39–41	(7) 38–43	
181.0	—	166.0	166.8	—
(3) 177–184		(6) 162–171	(8) 162–171	
264.3	—	222.8	243.1	—
(3) 257–269		(6) 217–229	(8) 228–261	

eastern spinner of the eastern Pacific (152–199 cm for 1,128 adults; Perrin *et al.* 1985) in coloration; the latter is uniform gray with light patches in the genital and axillary regions (Perrin 1972). The eastern spinner also differs in shape of the dorsal fin, which is more erect than in the Thailand specimens (Perrin 1975).

Skull and skeleton—The Thailand spinner also has a very small skull (Fig. 4, 5); in condylobasal length, rostrum length, rostrum width at the base and at midlength, width of the premaxillae at rostrum midlength, width of external nares, length of the antorbital process, and length and height of the ramus, the four adult specimens overlap only the range for the eastern spinner (by 1–6 mm; Table 2). They fall below the ranges of zygomatic width, pre- and post-orbital width, parietal width, height and length of the braincase, and width of the internal nares for all the series from the Indian Ocean, western Pacific, central Pacific, eastern Pacific (Costa Rican, eastern and whitebelly forms) and Atlantic. However, the Thailand skulls overlap all of the geographical series in length and height of the temporal fossa and length of the orbit. While the sample is very small, this suggests that the Thailand spinner skull differs in shape as well as size from those from other regions, with proportionately larger temporal fossae and orbits. For example, the ratio of the mean orbit length to mean condylobasal length is 0.113 as compared to the range for the other samples of 0.098 (central Pacific, Costa Rican and Atlantic) to 0.103 (Indian Ocean and eastern). In maximum premaxilla width, rostrum width at ¾ length, and length of the upper tooth row, the Thailand skulls overlap some of the other series as well as the eastern series, to a very slight extent. We did not have available to us skull measurements for the spinner dolphins collected from the gillnet fishery off northern Australia; judging from the distribution of body lengths (Fig. 2), these animals may also have small skulls.

The Thailand skulls have on the average about 5–8 fewer teeth per upper row and about 6–11 fewer per lower row than skulls in the other series (Table 3). In upper count, they overlap only the lower ends of the ranges for the eastern and Atlantic series (by 3 and 1, respectively); in lower count, they overlap slightly all but the small Costa Rican series.

The Thailand specimens are smaller than all of the other specimens in all of five postcranial dimensions (Table 2); the difference in length of the longest rib (a good index of girth) is especially striking.

The average total number of vertebrae in the seven skeletons available from Thailand is about 2–4 lower than in the other series. The range does not overlap that for the large eastern Pacific series. The difference appears to be mainly in the thoracics and lumbars. Nine Thailand specimens each have 14 thoracic vertebrae, whereas the averages for the other series range from 14.5 to 15.8. The caudal vertebrae and chevron bones are disarticulated for most of the specimens in all the series, precluding accurate determination of the beginning of the caudal series. However, placement of the first vertebra bearing a vertical foramen (on about vertebra number 46 on average in the Thailand series, versus 48–50 in the other series) indicates that there are probably fewer lumbars in the Thailand specimens than in the others.

Discussion

The Gulf of Thailand spinners may comprise a discrete breeding population, or they may be part of a large continuous population extending into other East Indian/Australasian waters. Larger samples may demonstrate more morphological congruence with the small spinners involved in the gillnet fishery in the Timor and Arafura Seas off northern Australia, or, if there is a single continuous population, a north/south cline in body size may exist. In any case, the northern Australian osteological specimens should be compared with larger samples from the Gulf of Thailand and, if possible, with material from localities between the two regions.

The question of population discreteness is not only important taxonomically but also has implications for conservation and management. If there is a separate population in the Gulf of Thailand, the impact of the shrimp fishery, if it is still operating, will be greater than would be the case were a more extensive population involved. Neither the size and status of the population nor the size and impact of the incidental kill can be estimated with existing data; the needed additional data should be collected (Perrin 1988).

The feeding ecology of the small spinners of this part of the Indopacific may be different than that of spinner dolphins in other parts of the world. Stomach contents of spinners from the eastern Pacific, Hawaii, India, and the Atlantic have contained primarily small mesopelagic fishes, squids and crustaceans (Perrin and Gilpatrick, in press). Spinner dolphins in Hawaii move offshore diurnally to feed on deep-living organisms that migrate toward the surface at night (Norris *et al.* 1985). However, the stomachs of dolphins captured in gillnets off northern Australia contained mainly reef-living and benthic organisms (Hembree 1986). The Gulf of Thailand dolphins were captured in demersal shrimp trawls and may also have been feeding on shallow-water benthic rather than mesopelagic animals (the entire Bight of Bangkok and most of the rest of the Gulf of Thailand is less than 50 m deep, Bartholomew 1958). This benthic feeding habit may be correlated with small size in the species.

Table 3. Means, standard deviations (for sample sizes ≥30), sample sizes (in parentheses), and maximum and minimum values for selected meristic characters for series of *Stenella longirostris* from Thailand and other regions. See Table 2 for data sources.

	Upp. teeth (per row)	Low. teeth (per row)	Total vertebrae	Thoracic vertebrae	First vert. foramen on #
Thailand	46.3 (9) 43–48	45.0 (8) 42–49	69.7 (7) 69–71	14.0 (9) 14	45.8 (9) 43–48
Indian Ocean	52.9 (15) 49–59	50.6 (15) 45–58	72.0 (5) 71–73	15.0 (4) 15	49.0 (4) 48–50
W. Pacific	53.3 (12) 48–61	51.4 (14) 47–60	72.2 (10) 71–75	14.8 (10) 14–16	48.0 (1)
C. Pacific	55.0 (29) 50–62	52.5 (29) 48–57	71.8 (9) 69–75	14.5 (10) 14–15	48.3 (11) 47–50
E. Pacific:					
Costa Rican	55.3 (5) 50–59	56.3 (5) 51–59	—	—	—
Eastern	52.6 ± 3.18 (32) 46–61	50.5 ± 2.39 (37) 45–56	74.3 (13) 73–76	15.4 (15) 14–17	50.3 (16) 47–54
Whitebelly	52.9 ± 2.51 (30) 49–59	51.3 ± 2.91 (32) 44–59	73.9 ± 1.27 (35) 72–77	15.8 ± 0.60 (34) 14–17	49.9 (20) 48–53
Atlantic	55.4 ± 3.01 (41) 48–64	53.9 ± 3.32 (43) 47–62	71.7 (27) 69–75	14.6 (26) 13–16	49.7 (6) 47–52

Average water temperatures to which the spinner dolphins in the shallow Gulf of Thailand are exposed could be expected to be generally higher than those to which mesopelagically feeding spinner dolphins in other regions are exposed. The proportionately larger appendages and the overall smaller size of the Thailand animals may be a manifestation of the general pattern recognized in "Allen's rule," *i.e.*, greater surface-to-volume ratios in warmer environments.

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