Stenella longirostris (Gray, 1828)

English: Spinner dolphin
German: Ostpazifischer Delphin
Spanish: Estenela giradora
French: Dauphin longirostre

Family Delphinidae

1. Description

Spinner dolphins can be detected from large distances as they spin high in the air and then land with a loud splash. The body is slender and the beak is extremely long and thin. Colouration consists of a dark grey cape, light grey lateral field and white ventral field. A dark band runs from the eye to the flipper, bordered above by a thin light line. The rostrum is tipped with black or grey. The dorsal fin is basically triangular, slightly falcate to erect or canted forward. The flippers are thin and recurved. Adults range from 129–235 cm and reach a body mass of 23–80 kg (Perrin, 1998; 2009).

2. Distribution

http://www.iucnredlist.org/apps/redlist/details/20733/0/rangemap

Distribution of Stenella longirostris. *Four different subspecies occur in tropical and subtropical waters in the Atantic, the Indian and Pacific Oceans (Hammond et al. 2008; © IUCN).*

Spinner dolphins are pantropical, occurring in all tropical and subtropical waters around the world between roughly 40°N and 40°S (Jefferson et al. 2008). The geographical variation in body configuration and colour pattern is more pronounced in spinner dolphins than in any other species of cetacean. Perrin (1990) and Perrin et al. (1999) recognized this variation by naming four subspecies:

S. l. longirostris: The nominate subspecies (all spinner dolphins aside from the other described subspecies) occurs mainly around oceanic islands in the tropical Atlantic, Indian, western and central Pacific east to about 145°W. It ranges north to New Jersey, Senegal, the Red Sea, Gulf of Oman, Arabian Sea, Sri Lanka, the Andaman Sea, Gulf of Thailand, southern Honshu, and the Hawaiian Islands (Rice, 1998). Smith et al. (1997a and 1997b) sighted individuals off Myanmar and Vietnam. It ranges south to Paraná in Brazil, Saint Helena, Cape Province, Timor Sea, Queensland, and Tonga Islands and is vagrant to New Zealand (Rice, 1998). It is found in relatively small and discrete communities around many islands throughout the Pacific. In island communities of the Society Archipelago, French Polynesia, gene flow among neighbouring communities is restricted, although some individual movement was documented (Oremus et al. 2007). Similarly around Hawaii, dolphins at almost every island were found to be significantly genetically differentiated from dolphins at every other island for one or more tests of population subdivision (Andrews et al., 2006). And finally, genetic data shows differences between American Samoa and the Hawaiian Islands (Johnston et al., 2008). The southernmost record is from New Zealand, more than 2000 km south of what is thought to be the normal range but still well north of

subantarctic waters. The distribution of *S. l. longirostris* in the Atlantic is very poorly known, especially in South American and African waters (Perrin and Gilpatrick, 1994 and refs. therein). Van Waerebeek et al. (2000) note a lack of recent sightings, strandings or by-catches off West Africa, whereas Ali and Jiddawi (1999) report sightings on the coast of Zanzibar in the Western Indian Ocean. Interspecific hybrids between *S. longirostris* and *S. attenuata* and between *S. longirostris* and *S. clymene* are reported from the Fernando de Noronha Archipelago, tropical West Atlantic (Silva et al. 2005).
Perrin (1990) proposed the name "Gray's spinner dolphin" for this race; the "Hawaiian spinner porpoise" is included here. The "whitebelly spinner porpoise" and the "southern spinner dolphin" are intergrades or hybrids between this race and *S. l. orientalis* (Rice, 1998 and refs. therein).

S. l. orientalis Perrin, 1990: Ranges in pelagic waters of the tropical Pacific east of about 145°W, from 24°N off Baja California south to 10°S off Peru, but exclusive of the range of the following race. This is the "eastern spinner dolphin" of Perrin (1990).

S. l. centroamericana (Perrin, 1990): Found in coastal waters over the continental shelf of the tropical Pacific from the Gulf of Tehuantepec in southern Mexico southeast to Costa Rica. This is the "Central American spinner dolphin" of Perrin (1990). However, Perryman and Westlake (1998) examined lengths of spinner dolphins taken from vertical aerial photographs in the eastern tropical Pacific and found three unique morphotypes. Two of these forms correspond, at least in average length and distribution, to the existing eastern and Central American subspecies. The third form is intermediate in length between the two recognised subspecies and is found along the edge of the continental shelf north of Cabo Corrientes, Mexico. They provisionally called this form the "Tres Marias spinner dolphin."

S. l. roseiventris (Wagner, 1846): is distributed in shallow innner waters of Southeast Asia, including the Gulf of Thailand, Timor and Arafura Seas, and similar waters off Indonesia, Malaysia and Northern Australia. It is replaced in deeper and outer waters by the larger pelagic subspecies *S. l. longirostris* (Perrin et al. 1999).

Based on morphological data, van Waerebeek et al. (1999) concluded that Oman spinner dolphins should be treated as a discrete population, morphologically distinct from all known spinner dolphin subspecies. Confirmed coastal range states off the Arabian Peninsula include the United Arab Emirates, the Sultanate of Oman, Yemen, Somalia, Djibouti, Saudi Arabia, Sudan and Egypt. It is likely that additional regional subspecies will be split off from the nominate subspecies in the future.

3. Population size

There are several abundance estimates for this circumglobal species, most of which are quantitative.

The largest population is reported from the eastern tropical Pacific (ETP). The 2003 estimate of the eastern spinner dolphin (*S. l. orientalis*) was 613,000 (CV=21.9) and for the whitebelly spinner dolphin (an intergrade between *S. l. longirostris* and *S. l. orientalis*) 442,000 (CV=44.6) (Gerrodette el al., 2005). This is higher than the 2000 estimates of about 428,000 eastern spinner dolphins (CV = 0.218). For the whole period from 1979 to 2000, annual estimates of abundance ranged from 271,000 to 734,000 (Gerrodette and Forcada, 2005).

Balance and Pitman (1998) conducted a cetacean survey in the pelagic western tropical Indian Ocean (WTIO) and reported that the cetacean community there was similar to that of the ETP and the Gulf of Mexico (GM). In the central and western Pacific, spinner dolphins are often the most abundant species. A 2002 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an estimate of 3,351 (CV=0.74) animals (Barlow 2006). In the nearshore waters of Manu'a Islands, Rose Atoll and Swains Island, American Samoa, spinner dolphins (n=34 groups, 46 animals), were the most abundant cetacean species in summer 2006 (Johnston et al., 2008). In Philippine waters it is also the most abundant species, with a population estimate of 31,512 (CV=26.63%) in the eastern Sulu Sea and 3,489 (CV=26.47%) in the Tañon Strait (Dolar et al., 2006). In the waters around the Marquesas Islands in French Polynesia, spinner dolphins were the second most abundant species (Gannier, 2002).

Off the Mergui (Myeik) Archipelago of southern Myanmar, spinner dolphins were the third most frequent species (Smith and Tun, 2008). In the northern Mozambique Channel around the island of Mayotte, spinner dolphins were also very numerous;118 animals were observed (Kiszka et al. 2007).

In the northern Gulf of Mexico (US EEZ), the current estimate of abundance for spinner dolphins in oceanic waters averaged over 2003 to 2004, is 1,989 (CV=0.48) (Mullin 2007). This estimate is significantly different ($P<0.05$) from that for 1996-2001 of 11,971 (CV=0.71), while the 1991-1994 estimate of 6,316 (CV=0.43) is intermediate. These temporal abundance estimates are difficult to interpret without a Gulf-of-Mexico-wide understanding of spinner dolphin abundance (Waring et al., 2009).

4. Biology and Behaviour

Habitat: In most tropical waters, nearly all records of spinner dolphins are associated with inshore waters, islands or banks. Around Hawaii spinner dolphins depend on the availability of sheltered shallow bays for use as resting areas during the day. In coastal waters of the Society Islands (French Polynesia), they are observed year-round during daytime in sheltered bays or within lagoons. Dolphins stay within the bay from early morning until the early afternoon, when they move slowly offshore. On average, they stay 400 m from shore, although they approach as close as 100 to 150 m. Dolphin presence and residence time seems to be negatively affected by surface water turbidity (river flow) and lagoon current strength. Seasonally, there are slight differences in presence with 81% of dolphin days in from May to November and only 67% between December and April (Cannier and Petiau, 2006). The dwarf form of the spinner dolphin in Thai waters apparently inhabits a shallow coral reef habitat (Perrin and Gilpatrick, 1994 and refs. therein).

In the eastern tropical Pacific, however, spinner dolphins, like pantropical spotted dolphins, occur in very large numbers on the high seas many hundreds of km from the nearest land. The spotted dolphin school may serve as a surrogate "protected bay" for the spinner dolphins to shelter them from predators during their daily quiescent period, thus allowing them to exist and make a living far from land. The habitat there, called by oceanographers "tropical surface water", is typified by unusual conditions of shallow mixed layer, shoal and sharp thermocline, and relatively small annual variation in surface temperature (Reyes, 1991, Perrin and Gilpatrick, 1994 and refs. therein).

Davis et al. (1998) characterised the physical habitat of cetaceans found along the continental slope in the north-central and western Gulf of Mexico. *S. longirostris* was found over

intermediate bottom depths, its distribution overlapping with that of purely pelagic and purely coastal species.

Schooling: The spinner dolphin society is composed partly of familial units and more broadly of learned associations beyond the family group. Mother-calf bonds are persistent, as in other dolphins. Around Hawaii, social groupings are very fluid, with individuals moving freely among several sets of companions over periods of minutes, hours, days or weeks. Large schools form, break down and re-form with different permutations of subgroups in the course of diurnal inshore-offshore and longshore movements related to nocturnal feeding. It is not known whether or not these broader associations are with members of dispersed kin groups (Psarakos et al. 2003).

There is some segregation by age and sex among schools of spinner dolphins in the far-offshore eastern Pacific. It has been suggested that such segregation may be temporary and more pronounced during migration in dolphins. There appears to be no consistent “leader” in a spinner dolphin school. Directional movement appears to be a group process, with direction imparted often from behind, to the sides or below in the school. In a time of stress, the school becomes what has been termed a “sensory integration system” (SIS) and direction may come from anywhere in the school. In the eastern tropical Pacific spinner dolphins are often found in close association with pantropical spotted dolphins, yellowfin tuna and birds of several species; the association varies in percentage occurrence with time of day (Perrin and Gilpatrick, 1994, and refs. therein). In mixed-species associations off Hawaii, spinner dolphins are typically present in greater numbers than spotted dolphins with ratios as high as 75:1. Interspecific behaviours observed include aggression, copulation, and travelling (Psarakos et al. 2003).

Around the Society Islands (French Polynesia), school sizes ranging from 15 - 30 to 100 - 140 individuals (Cannier and Petiau, 2006). At Midway Island, spinner dolphins live in stable bisexually bonded societies of long-term associates, with strong geographic fidelity, no obvious fission-fusion, and limited contacts with other populations. Their large cohesive groups change little over time and are behaviorally/socially discrete from other spinner dolphin groups. With deepwater food resources in close proximity and other atolls relatively far away for day-to-day access, it may be energetically more beneficial in remote atolls to remain "at home" than to travel to other atolls, explaining the observed school stability (Karczmarski et al., 2005).

Behaviour: The spinner dolphin performs spectacular leaps from the water while rotating around its longitudinal axis up to seven times. Although twisting of the body while airborne has been proposed as the mechanism to effect the spin, angular momentum to induce the spin is generated underwater, prior to the leap. The high rotation rates and orientation of the dolphin's body during re-entry into the water could produce enough force to dislodge unwanted remoras (Fish et al. 2006), one hypothesis of the function of the spinning behavior. Off Oahu, Hawaii, spinner dolphins at night actively aggregate their prey through cooperative foraging using their preys' avoidance behaviour to create distinct, high-density patches in the prey. Dolphins swim around the edge of a 28-40 m diameter circle at least 5 times, concentrating prey within this area before pairs of dolphins on opposite sides of the circle swap positions, swimming through the high density prey `donut' they have formed (Benoit-Bird and Au, 2003).

Food: Spinner dolphins feed primarily on small (generally less than 20 cm) mesopelagic fish, squids and sergestid shrimps, diving to at least 200–300m (Dolar et al. 2003). In Hawaii,

many prey organisms become available to spinner dolphins when the deep scattering layer moves toward the surface at night. Spinner dolphins in the Gulf of Thailand may have an entirely different trophic ecology, feeding on benthic and coral reef organisms (Perrin and Gilpatrick, 1994, and refs. therein). At Fernando de Noronha Archipelago in the southwestern Atlantic, twelve fish species in seven families are known to feed on dolphin offal. The black durgon (*Melichthys niger*) is the most ubiquitous waste-eater, recognizing the postures a dolphin adopts prior to defecating or vomiting and converging on an individual shortly before it actually voids. Offal is then quickly fed upon (Sazima et al. 2003).

Reproduction: Gestation lasts about 10 months, and nursing duration is 1-2 years. Females reach sexual maturity at 4-7 years and may calve every 3 years. Males are sexually mature at 7-10 years (Perrin, 2009). The oldest eastern spinner dolphin by-caught in the ETP tuna fishery was estimated to be 24.5 years old and the oldest whitebelly spinner dolphin was 26 (Larese and Chivers, 2008). Smaller testis size in the eastern spinner than in the whitebelly spinner suggests that the breeding system in the former may tend more toward polygyny (Perrin and Mesnick, 2003).

5. Migration

Norris et al. (1994) concluded that spinner dolphin distribution and abundance is related to certain local oceanographic phenomena. For example, divergence zones at current margins and current ridges both concentrate food organisms and are heavily frequented by dolphins of various species, including spinners. Whereas one scientific view suggests that populations remain geographically stable over rough bottom topography, another view suggests that at least some populations may move widely without reference to the bottom. Where a warm current swings away from the tropics along an ocean margin - for example where the Kuroshiro current moves northward along the eastern shore of Japan - oceanic dolphin populations, including the spinner dolphin, migrate in such water masses and move considerable distances.

Perrin and Gilpatrick (1994, and refs. therein) noted that in different regions such as Hawaii and Fernando de Noronha Island (northern Brazil) spinner dolphins usually spend the daytime hours resting in shallow bays near deep water. They move offshore at dusk to feed. During feeding, they may move some distance along the shore, so the same animals may not be present in the same bay on two successive days. Not all animals go into the rest coves every day; some move slowly along the shore between successive nights. Maximum net movement observed was 113 km over 1,220 days. In general , site-fidelity in Hawaiian animals is strong. At least one and up to three animals were re-sighted northwest of Oahu 20 years after the first reported sighting (Marten and Psarakos, 1999). Capture-recapture analyses at Moorea (Society Archipelago, French Polynesia) based on long-term observations of marked individuals and molecular data also indicated a local and relatively closed community (of about 150 dolphins). This is also confirmed by resightings of individuals across 15 yr (Oremus et al. 2007).

In the eastern tropical Pacific, however, tagged spinner dolphins moved minimum distances of 12 to 275 nautical miles (within 16h and 365 days, respectively). The number of tag returns (seven of 340) was insufficient to allow detection of a migratory pattern if one exists. Minimum distances moved were less than for pantropical spotted dolphins at liberty for similar periods of time; the spinner dolphin may be less migratory (Perrin and Gilpatrick, 1994, and refs. therein).

6. Threats

Directed fisheries: Small numbers of spinner dolphins are taken in localised harpoon fisheries in many places around the world, e.g. the Lesser Antilles, the Philippines, and Indonesia. They were formerly taken in small numbers in drive fisheries in Japan. 117 by-caught spinner dolphins were landed in India in 1986–87, presumably for human consumption. Dolphins taken incidentally in Venezuela are utilised for shark bait and human consumption (Dolar et al., 1994; Perrin and Gilpatrick, 1994 and refs. therein).

Ilangakoon (1997) reported on the interaction between small cetaceans and the fisheries industry in Sri Lanka. He found *S. longirostris* to be the most abundantly caught species at all investigated sites. The post-monsoonal period from the end of August to November was the season when peak catches were recorded. Deliberate harpooning was found to account for a sizeable proportion of the small cetacean catch, and the practice seems to be spreading to new areas.

By-catches: There has been no reported fishing-related mortality of spinner dolphins during 1998-2006 in the Northern Gulf of Mexico US EEZ (Waring et al., 2009). In the Hawaii-based longline fishery during 1994-2005, annual fishing effort was roughly constant at about 12,000 sets through 2001 and then increased to over 18,000 sets through 2005. During 24,542 observed sets, 67 cetaceans were observed hooked or entangled, of which only 2 were spinner dolphins (Forney and Kobayashi, 2007).

Since the Inter-American Tropical Tuna Commission (IATTC) implemented per-vessel mortality limits on the international fleet, the mortality for the eastern and whitebelly forms combined decreased, from 30,500 in 1986 to 288 in 2007 (IATTC, 2009). Although current mortality is greatly reduced, the eastern form appears to be recovering very slowly. Possible reasons include underreporting of dolphin bycatch, effects of chase and encirclement on dolphin survival and reproduction, long-term changes in the ecosystem, and effects of other species on population dynamics (Gerrodette and Forcada, 2005).

Reproductive data from the eastern tropical Pacific shows that proportion with calves is related to number of dolphins in the school and/or proportion of the school made up of the focal species. Annual number of purse-seine sets on dolphins was a predictor of both proportion with calves and length at disassociation. Because the spinner dolphin is one of the two main species targeted by the fishery, the link between fishing activity and both measures of reproductive output indicates that the fishery has population-level effects beyond reported direct kill and may be responsible for the failure of dolphin populations to recover at rates expected after reduction of high bycatch levels (Cramer et al., 2008).

Dolphin mortality seems to increase with the number of dolphins encircled, because of increased risk of entanglement and longer duration of the backdown procedure, including the risk of entrapment in net-canopies. Therefore, large herds are particularly threatened by the tuna fishery (Lennert-Cody et al. 2004). Gerrodette (2002) also mentioned cryptic effects of repeated chase and encirclement on survival an/or reproduction (internal injuries, stress, hyperthermia and separation of nursing calves from their mothers during the fishing process).

A total of 96 dolphins were reported to have been incidentally caught in gillnet fisheries off Zanzibar (Unguja Island) between 1995 and 1999, including 29 spinner dolphins (Amir et al., 2003). Reports on incidental catches monitored at 12 landing sites between 2000 and 2003

numbered 44 (31% of all by-caught cetaceans) spinner dolphins. Most of the bycatches (71%) were in nets set off the north coast of Unguja Island (Amir et al., 2005). Significant catches of spinner dolphins also occur in the Caribbean, Australia, Japan, the Philippines, and Sri Lanka; in the last area up to 15,000 are killed each year in gillnets and by hand-harpooning. There are likely to be fisheries interactions off West Africa (Jefferson et al. 1993; Perrin and Gilpatrick, 1994; Carwardine, 1995). A trawl shrimp fishery in the Gulf of Thailand takes a yet unknown number of *S. l. roseiventris* (Reyes, 1991). Zerbini and Kotas (1998) reported on by-catches in Brazilian drift-net fisheries and Cockroft (1990) on animals entangled in shark nets off Natal.

Pollution: Relatively high levels of mercury and contamination with DDT, Dieldrin and PCBs have been reported for the species (e.g. Tanabe et al. 1993). The high level of Hg has been attributed to natural sources, but in the case of DDT and PCBs the agricultural and industrial development in Central America may be the cause (Velayutham et al. 1994; Velayutham and Venkataramanujam 1995; Perrin and Gilpatrick, 1994 and refs. therein; Reyes, 1991). Blubber samples of animals from the Bay of Bengal (southeast coast of India) contained considerable levels of organochlorines with DDT in the range of 3330-23 330 ng/g; HCHs in the range of 95-765 ng/g; and PCBs in the range of 210-1220 ng/g (wet weight basis) (Karuppiah et al. 2005).

Specimens stranded along the coasts of the lower Gulf of California, Mexico contained mercury (Hg) and methylmercury (MeHg) in their tissues, albeit at low levels (Ruelas et al. 2003). Lately, polybrominated diphenyl ethers (PBDEs), one of the flame retardants widely used in plastics, textiles, electronic appliances, and electrical household appliances were detected in the blubber of cetaceans found stranded along the coasts of Japan, Hong Kong, the Philippines and India during the period from 1990 to 2001. However, concentrations of PBDEs in spinner dolphins were low, with 6.0 ng/g lipid wt (Kajiwara et al. 2006).

Tourism: Tourist development may affect the near-shore habitat of some spinner dolphin populations, for example, at Fernando de Noronha Island, Brazil (Reyes, 1991). Although increasing levels of human activity has a limited but measurable effect on the movement patterns of Hawaiian spinner dolphin groups at Kealakekua Bay (Delfour, 2007; Timmel et al. 2008), Ali and Jiddawi (1999) reported that in Zanzibar tourism was beneficial for the species: their touristic value far exceeds that of using them as bait for sharks. As many as 2,000 tourists visit the dolphin site at Kizimkazi per month.

7. Remarks

Range states (Hammond et al. 2008) :

American Samoa; Anguilla; Antigua and Barbuda; Aruba; Australia (Queensland); Bahamas; Bangladesh; Barbados; Belize; Benin; Bermuda; Brazil (Paraná); British Indian Ocean Territory; Brunei Darussalam; Cambodia; Cameroon; Cape Verde; Cayman Islands; China; Cocos (Keeling) Islands; Colombia; Comoros; Congo; Congo, The Democratic Republic of the; Cook Islands; Costa Rica; Côte d'Ivoire; Cuba; Djibouti; Dominica; Dominican Republic; Ecuador (Galápagos); Egypt; El Salvador; Equatorial Guinea; Fiji; French Guiana; French Polynesia; Gabon; Gambia; Ghana; Grenada; Guadeloupe; Guam; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hong Kong; India (Andaman Is., Nicobar Is.); Indonesia; Iran, Islamic Republic of; Jamaica; Japan (Honshu); Kenya; Kiribati; Liberia; Madagascar; Malaysia; Maldives; Marshall Islands; Martinique; Mauritania; Mexico; Micronesia, Federated States of; Morocco; Mozambique; Myanmar; Namibia; Nauru; Netherlands Antilles; New Caledonia; Nicaragua; Nigeria; Niue; Northern Mariana Islands;

Oman; Pakistan; Palau; Panama; Papua New Guinea; Peru; Philippines; Pitcairn; Puerto Rico; Saint Helena; Saint Kitts and Nevis; Saint Lucia; Saint Pierre and Miquelon; Saint Vincent and the Grenadines; Samoa; Sao Tomé and Principe; Senegal; Sierra Leone; Singapore; Solomon Islands; Somalia; South Africa (KwaZulu-Natal); Sri Lanka; Sudan; Suriname; Taiwan, Province of China; Tanzania, United Republic of; Thailand; Timor-Leste; Togo; Tonga; Trinidad and Tobago; United Arab Emirates; USA (Hawaiian Is., New Jersey); United States Minor Outlying Islands; Uruguay; Venezuela; Viet Nam; Virgin Islands, British; Virgin Islands, U.S.; Wallis and Futuna; Western Sahara; Yemen (Socotra)

The species is listed in Appendix II of CITES. The IUCN lists the species as "Data Deficient" (Hammond et al. 2008). The eastern tropical Pacific populations and south-eastern Asian populations of *S. longirostris* are listed in Appendix II of CMS.

8. Sources

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