

# Mixed-species associations between Pantropical spotted dolphins (*Stenella attenuata*) and Hawaiian spinner dolphins (*Stenella longirostris*) off Oahu, Hawaii

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## Abstract

Mixed-species interactions were observed between Pantropical spotted dolphins, *Stenella attenuata*, and spinner dolphins, *Stenella longirostris*, in Hawaiian waters between 1996 and 1998. Year-round observations were made of spinner dolphins entering a shallow bay off the Waianae (western) coast of Oahu. Mixed-species observations occurred on 19 days between 1996–1998. Spinner dolphins were typically present in greater numbers than spotted dolphins with ratios as high as 75:1. Inter-specific behaviours observed include aggression, copulation, and travelling. Five aggressive interactions are described in detail. These behavioural observations are similar to those observed between other delphinid species around the world and suggest that sympatric delphinid species may be more common than previously reported and may have common communication and social signals.

Key words: *Stenella attenuata*, *Stenella longirostris*, interspecific, behaviour, aggression, Hawaii.

## Introduction

Mixed-species interactions have been reported between odontocete cetaceans in captivity (Wood, 1953; Caldwell *et al.*, 1971; Terry, 1984; Sylvestre & Tanaka, 1985) and in the wild (Norris & Prescott, 1961; Saayman & Tayler, 1973; Perrin *et al.*, 1973; Norris *et al.*, 1994; Würsig & Würsig, 1980; Cockeron, 1990; Jefferson *et al.*, 1991; Shane, 1995; Bearzi, 1996; Shelden *et al.*, 1995; Ross & Wilson, 1996; Weller *et al.*, 1996; Herzing & Johnson, 1997; Baraff & Asmutis-Silvia, 1998; Orr & Harwood, 1998) and between cetaceans and humans (Lockyer, 1990).

Pantropical spotted dolphins (*Stenella attenuata*) and spinner dolphins (*Stenella longirostris*) have been reported in mixed-species aggregations in the larger Eastern Tropical Pacific, ETP, (Perrin *et al.*,

1973). Although these two species are occasionally sighted in close proximity to each other in Hawaiian waters, the degree to which they intimately interact around island chains such as the Hawaiian archipelago is unknown. While spinner dolphins are well known for their propensity to rest in shallow bays around most islands in the Hawaiian chain (Norris *et al.*, 1994), Pantropical spotted dolphins are generally believed to be more pelagic in nature. Baird *et al.* (2001) also reported differences in subsurface and night-time behaviour of pantropical spotted dolphins. Other *Stenella* sp., including the striped dolphin (*Stenella coeruleoalba*) have been observed interacting with short-beaked common dolphin (*Delphinus delphis*) and Risso's dolphin (*Grampus griseus*) in the Gulf of Corinth, Greece (Frantzis & Herzing, 2002).

It is not unusual for sympatric species to have a variety of types of interactions. Detailed behavioural interactions between two sympatric cetaceans (Atlantic spotted dolphins, *Stenella frontalis*, and bottlenose dolphins, *Tursiops truncatus*) have been described in the northern Bahamas (Herzing & Johnson, 1997). Such regular interactions include foraging, travelling, play, alloparental care, and aggressive activity. Although spinner dolphins have been studied off the Big Island of Hawaii (Norris *et al.*, 1994) and off the Waianae coast (leeward western edge) of Oahu (Marten & Psarakos, 1999), there has been no previous description of mixed-species interaction in these areas. In Hawaii, spotted dolphins and spinner dolphins occasionally share habitat in the shallow, sandy resting bays off Oahu. This paper presents an overview of shore observations and detailed underwater observations of interactions between these two species between 1996 and 1998.

## Materials and Methods

Since 1995, regular shore and underwater observations have been made of a group of spinner

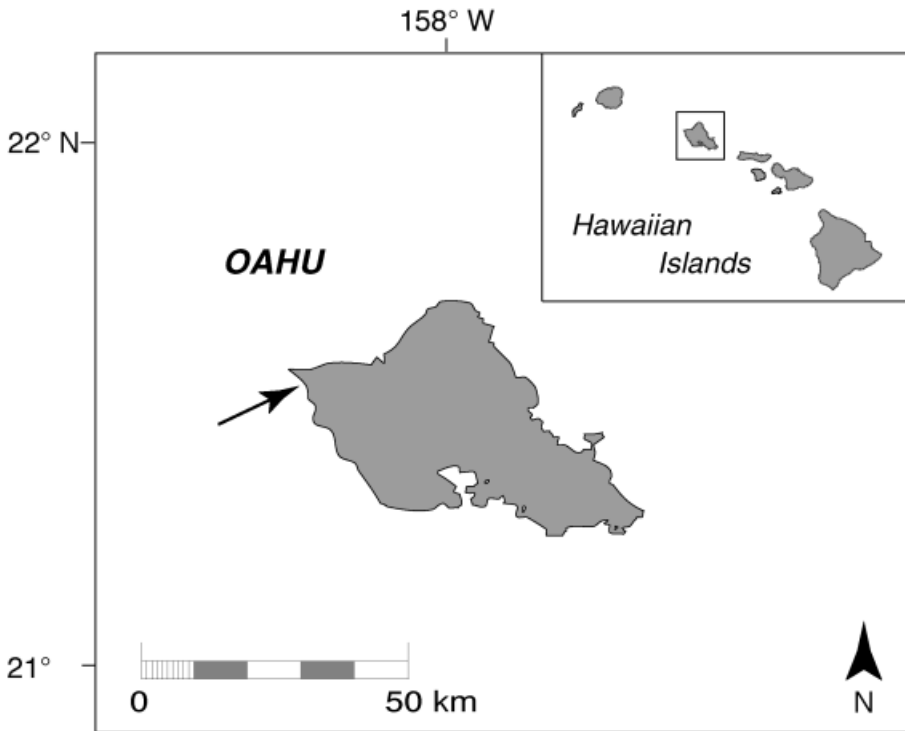


Figure 1. The study site off Waianae, the western coast of Oahu, Hawaii.

dolphins off the Waianae coast of Oahu. The study site is a large, protected, near-shore, shallow, sandy-bottom bay (Fig. 1). The site was first visited in 1990; periodic, informal visits to the beach were carried out from 1991 to 1994; systematic observations began in 1995. Shore observations were made during daylight hours between 0600 and 1800 h. When dolphins were sighted, an initial count of total group size was made from shore, and, if possible, species were identified. An observer then entered the water to attempt underwater observation, photo identification, or video logging. An experienced observer made underwater observations in 1996, 1997, and 1998. By that time, over 125 individuals had been photo identified, sexed, and observed on a regular basis (Marten & Psarakos, 1999). Opportunistic video/sound recordings were also made to document and verify behavioural interaction.

### Results

The spotted dolphins seen at the study site were always in the presence of spinner dolphins. In 1996, spotted dolphins were seen on 6 out of 55 days that spinner dolphins were observed underwater; in 1997 on 9 out of 53 days; and in 1998 on 4 out of 55 days.

Although the two species often swam within 3–10 m of each other, they tended to stay within their own conspecific groups.

Over a 3-year period, spotted dolphins were sighted 12% of the time when spinner dolphins were present. Spinner dolphins typically outnumbered spotted dolphins in ratios ranging from 1.5: 1 up to 75: 1. (Table 1). A majority of sightings occurred during morning hours, although time of field sighting effort varied on a daily basis. Interactive behaviours observed included travel, avoidance, aggression, and interspecific copulation (Fig. 2). Although most actual in-water observations were brief, due to the nature of travelling schools, detailed observations of the five interactions involving aggression and copulation are described below.

#### *Interspecific observations—aggressive activity*

(1) On 6 September 1996, between 0700 and 1000 h, a group of approximately 100 moderately active spinner dolphins were observed, with an unknown number of spotted dolphins nearby. Three spotted dolphins were seen on the periphery of a subgroup of 15–20 spinner dolphins, rapidly approaching them from the side; the movement of the spotted dolphins' rostra indicated they were closely following the spinner dolphins' activity. The spinner

**Table 1.** Sighting dates, times, ratio of species, and observed behaviour for interspecific interactions between spinner dolphins and pantropical spotted dolphins off Oahu, Hawaii, 1996–1998.

Year	Total observation days	No. of days dolphins sighted	No. of days mixed species sightings	Mixed species sightings	Date	Time-frame	No. of spinner dolphins	No. of spotted dolphins	No. of spinners to spotted dolphin (ratio)	Behaviour
1996	63	55	6	11%	8 July	0630–0900	75–100	8	11:1	travel
					10 July	0700	75+	present	?	travel
					19 July	0600–0630	75	present	?	travel
					24 July	morning	60–75	present	?	travel
					12 August	1145	25–50	13	3.2:1	travel
					6 September	0700	100+	3	33:1	aggression; travel
1997	64	53	9	17%	13 May	0900–1230	75	1	75:1	aggression; travel
					27 May	0830	15	10	1.5:1	travel
					29 May	0700–0800	15	18	0.83:1	avoidance; travel
					2 June	0730–0930	20	20–30	0.80:1	travel
					10 July	morning	<25	present	?	travel
					3 August	morning	35–40	present	?	unknown aggression;
					5 August	0645–0945	40–50	25–30	1.6:1	travel
					4 September	0700–1000	35–45	25–35	1.3:1	travel
					11 September	0900	20–30	25–35	0.86:1	travel copulation; aggression;
1998	67	55	4	7%	1 July	0730–0900	60–70	40–50	1.4:1	travel
					19 July	morning	90+	present	?	unknown
					21 July	0630–0800	50–60	40	1.4:1	travel
					26 July	0700–0930	50–60	30–35	1.7:1	aggression; travel
					Total	194	163	19	12%	

Travel=seen underwater moving along together, or traversing the same area.

Avoidance=both species in area but actively avoiding each other.

Aggression=jaw clap, head jerk, biting, bubble blow.

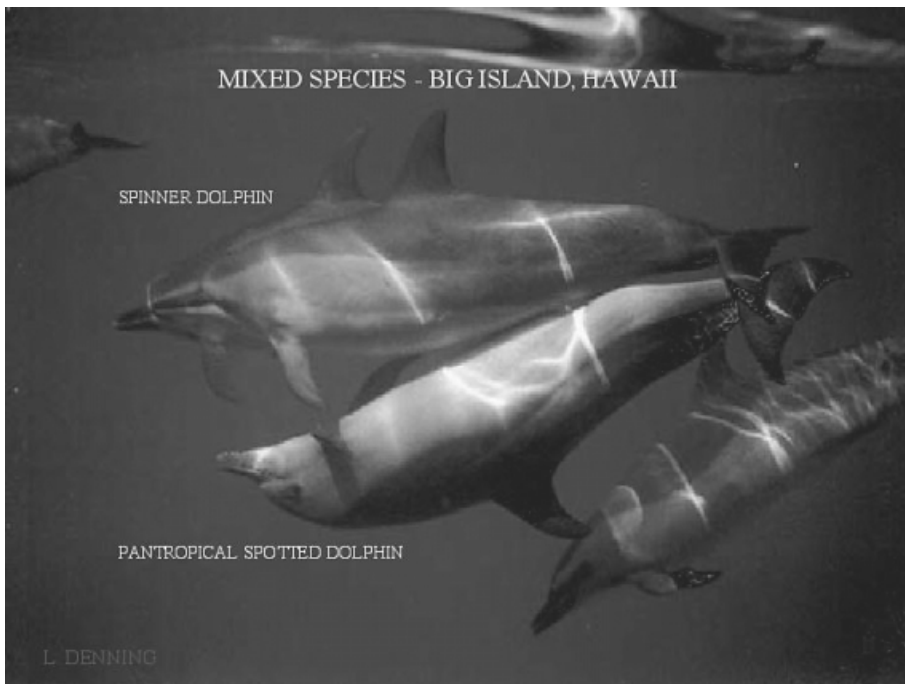
Copulation=erectations and intromission observed between species.

Unknown=observed in area together but no underwater observation of behaviour.

dolphins appeared jumpy and agitated: swimming was asynchronous, uncoordinated, and punctuated by brief, aggressive inter-group bouts. When the spotted dolphins were within 5 m, a spinner dolphin on the edge of the subgroup jerked its rostrum sharply toward the spotted dolphins. The spotted dolphins did not visibly react, and continued to approach, whereupon the spinner dolphin audibly clapped its jaws, then opened its mouth and jerked his head towards one of the spotted dolphins, raking its body. There was an exchange of vocalizations and some physical tousling, after which the spotted dolphins departed the area.

(2) On 13 May 1997, between 0900 and 1230 h, a single male spotted dolphin was observed on and off with a group of 75 resting spinner dolphins who

were traversing the shallow bay. This dolphin had a lumpy, seaweed-like growth around his mouth, but otherwise appeared to be able and in good health. He was visibly shorter in length than the adult spinner dolphins nearby. Although the spotted dolphin swam alone the entire time, he was always seen within 5 m of a subgroup of 25 mixed age-class spinner dolphins. His swimming was jerky and erratic, in stark contrast to the slow, rhythmic movement of the resting spinner dolphins. During this travel/resting behaviour one adult male spinner dolphin on the periphery of the subgroup made an aggressive mouth gesture. The same male spotted dolphin was re-sighted with spinner dolphins twice during the next month, swimming alone but with other spotted dolphins present in the area.



**Figure 2.** Interspecific copulation between a pantropical spotted dolphin, *Stenella attenuata*, (bottom) and a spinner dolphin, *Stenella longirostris*, (top) off the island of Hawaii. Photo credit: L. Denning.

(3) On 5 August 1997, between 0645 and 0945 h, a group of 40–50 spinner dolphins and 25–30 spotted dolphins were observed. The spinner dolphins were spread out in small subgroups, but the spotted dolphins were in a single loose, but contained, group. A subgroup of nine adult spinner dolphins and one spinner dolphin calf was 5 m from the spotted dolphins. The calf was swimming in a close triad with her mother and another adult female. This female was observed leaving the mother/calf pair, swimming up to a spotted dolphin, tussling with and biting the spotted dolphin, then returning to the mother/calf. The interaction was not overly long or aggressive. No other spinner dolphins were seen engaged in interactions with the spotted dolphins.

(4) On 1 July 1998, between 0800 and 0900 h, a mixed-species group of 40–50 spotted dolphins and 60–70 spinner dolphins was observed. The dolphins swam in widely spread single-species subgroups of five to 20 individuals. Spotted dolphins were predominantly adults and large juveniles; spinner dolphins included small calves, pregnant females, and mature males. During this interaction, a dolphin (unknown species) was seen from a distance expelling a large bubble burst, possibly of the type Herzing (1996) has seen in intraspecific

male aggressive encounters in Atlantic spotted dolphins and pantropical spotted dolphins (Pryor & Kang-Shallenberger, 1991). The display originated from an intermixed subgroup of 3–4 spotted dolphins and 2–3 spinner dolphins. The spinners were older juveniles or young adults; based on their lack of mature spotting patterns, the spotted dolphins were of similar age class. A close-knit, aggressive interaction ensued; one spinner dolphin was seen chasing after and nipping a spotted dolphin while whistling. The energetic and vocal activity of this subgroup continued for 1–2 min, with spinner dolphins visibly chasing spotted dolphins. A large group of 30 spinner dolphins, 7 m away from them, appeared to ignore the fighting. A spotted dolphin from the mixed subgroup was seen inverting underneath a spinner dolphin for approximately 5 s, and copulation, complete with intromission, was observed (Fig. 2). The event was repeated a total of five or six times over the next minute, with a male spotted dolphin underneath a spinner dolphin each time. There were at least two different spotted dolphins and two different spinner dolphins involved in these multiple copulations. The spotted dolphin penises were directly observed, but gender of the spinner dolphins is unknown. Although the copulations were interspersed with brief chasing

episodes, the acts appeared cooperative. This subgroup was followed for about 3 min, after which they moved out of the area. They were observed together again 15 min later still highly energetic and interactive, but not copulating.

(5) On 26 July 1998, between 0700 and 0930 h, 50–60 spinner dolphins and 30–35 spotted dolphins were observed traveling together. A subgroup of 30 spinner dolphins was swimming with five spotted dolphins close by. The spinner dolphins alternated between quiet, synchronized, linear swimming, and bouts of frenzied, bunched up, fast swimming, with much squawking and wrestling. Several times the spotted dolphins were included in the tousing. One spinner dolphin approached the spotted dolphins and squawked and jerked its rostrum sharply. There were several instances of aggressive open-mouth postures, made predominantly by the spotted dolphins.

### Discussion

In the interspecific aggressive instances described, spinner dolphins appeared to attempt to chase away spotted dolphins in the area. Although interspecific copulation (between adult male spotted dolphins and unsexed spinner dolphins) was observed and appeared cooperative, the pre- and post-aggressive behaviour of the spinner dolphins suggests that it was, perhaps, unwanted/unsolicited attention. In the Bahamas, interspecific copulation between males is often observed following aggressive and violent dominance behaviour directed to the young male spotted dolphins by larger and aroused male bottlenose dolphins (Herzing & Johnson, 1997). High ratios of spinner to spotted dolphins were also similar to other reports of interspecific interactions in the Bahamas, especially aggression. It may be that although outwardly appearing to 'cooperate', a subordinate species may be avoiding physical confrontations with an aggressive individual or species as described for primate species (Strier, 2003).

Spinner and spotted dolphins travel and rest together near-shore in the ETP open ocean waters and likely display a range of shared behaviours (Perrin *et al.*, 1973). Shared aggressive behaviours across delphinid species including open-mouth threats, jaw claps, body charges, and head-to-head posturing have been described for bottlenose dolphins (*Tursiops truncatus*—Caldwell & Caldwell, 1967; Overstrom, 1983; Herzing, 1988; Ostman, 1991) Atlantic spotted dolphins (*Stenella frontalis*—Wood 1953; Herzing, 1996) and pantropical spotted dolphins (*Stenella attenuata* in tuna purse-seine nets—Pryor & Kang-Shallenberger, 1991). Given these similar repertoires within species it is not surprising that such displays have also been

observed across sympatric species (Wood, 1953; Herzing & Johnson, 1997).

It is likely that delphinid species would utilize and potentially understand *interspecific* signals that have evolved for a similar function *intraspecifically*. The streamlined, hydrodynamically efficient form of dolphins limits their range of gestural signals relative to other mammals (Johnson & Norris, 1986). Such limitations converge across delphinid species, increasing the likelihood of a shared gestural repertoire. Interspecific activity is possibly more common than we have observed to date in these open-ocean and often-elusive marine mammals.

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### Literature Cited

- Baird, R. W., Ligon, A. D., Hooker, S. A. & Gorgone, A. M. (2001) Subsurface and nighttime behaviour of pantropical spotted dolphins in Hawaii. *Canadian Journal of Zoology* **79**, 988–996.
- Baraff, L. S. & Asmus-Silvia, R. A. (1998) Long-term association of an individual long-finned pilot whale and Atlantic white-sided dolphins. *Marine Mammal Science* **14**, 155–161.
- Bearzi, G. (1996) A 'remnant' common dolphin observed in association with bottlenose dolphins in the Kvarneric (Northern Adriatic Sea). Presented at the *10th Annual Conference of the European Cetacean Society*, Lisbon, 11–13 March 1996.
- Caldwell, M. C. & Caldwell, D. K. (1967) Intraspecific transfer of information via the pulsed sound in captive Odontocete Cetaceans. In: R. G. Busnel (ed.) *Animal Sonar Systems, Biology & Bionics*, pp. 879–936. Laboratoire de Physiologie Acoustique, Jovy-en-Josas, France.
- Caldwell, M. C., Hall, N. R. & Caldwell, D. K. (1971) Ability of an Atlantic bottlenose dolphin to discriminate between, and potentially identify to individual, the whistles of another species, the spotted dolphin. *Cetology* **6**, 1–6.
- Corkeron, P. J. (1990) Aspects of the behavioral ecology of inshore dolphins *Tursiops truncatus* and *Sousa chinensis* in Moreton Bay, Australia. In: S. Leatherwood & R. R. Reeves (eds.) *The Bottlenose Dolphin*, pp. 285–294. Academic Press, New York.

- Frantzis, A. & Herzing, D. L. (2002) Mixed-species associations of striped dolphin (*Stenella coeruleoalba*), short-beaked common dolphin (*Delphinus delphis*) and Risso's dolphin (*Grampus griseus*) in the Gulf of Corinth (Greece, Mediterranean Sea). *Aquatic Mammals* **28**, 188–197.
- Herzing, D. L. (1988) A quantitative description and behavioral associations of a burst-pulsed sound, the squawk, in captive bottlenose dolphins, *Tursiops truncatus*, 87 pp. Masters Thesis. San Francisco State University.
- Herzing, D. L. (1996) Vocalizations and associated underwater behavior of free-ranging Atlantic spotted dolphins, *Stenella frontalis*, and bottlenose dolphins, *Tursiops truncatus*. *Aquatic Mammals* **22**, 61–79.
- Herzing, D. L. & Johnson, C. M. (1997) Interspecific interactions between Atlantic spotted dolphins (*Stenella frontalis*) and bottlenose dolphins (*Tursiops truncatus*) in the Bahamas, 1985–1995. *Aquatic Mammals* **23**, 85–99.
- Jefferson, T. A., Stacey, P. J. & Baird, R. W. (1991) A review of killer whale interactions with other marine mammals: predation to co-existence. *Mammal Review* **21**, 151–180.
- Johnson, C. M. & Norris, K. S. (1986) Delphinid social organization and social behavior. In: R. Schusterman, J. A. Thomas & F. G. Wood (eds.) *Dolphin Cognition and Behavior*, pp. 335–346. Lawrence Erlbaum Associates, Hillsdale, N.J.
- Lockyer, C. (1990) Review of incidents involving wild, sociable dolphin, worldwide. In: S. Leatherwood & R. R. Reeves (eds.) *The Bottlenose Dolphin*, pp. 337–354. Academic Press, San Diego.
- Marten, K. & Psarakos, S. (1999) Long-term site fidelity and possible long-term associations of wild spinner dolphins (*Stenella longirostris*) seen off Oahu, Hawaii. *Marine Mammal Science* **15**, 1329–1336.
- Norris, K. S. & Prescott, J. H. (1961) Observations on Pacific cetaceans of California and Mexican waters. *University of California Publications in Zoology* **63**, 291–402.
- Norris, K. S., Würsig, B., Wells, R. S. & Würsig, M. (1994) *The Hawaiian Spinner Dolphin*, 408 pp. University of California Press, Berkeley.
- Orr, J. R. & Harwood, L. A. (1998) Possible aggressive behavior between a narwhal (*Monodon monoceros*) and a beluga (*Delphinapterus leucas*). *Marine Mammal Science* **14**, 182–185.
- Ostman, J. (1991) Changes in aggressive and sexual behavior between two male bottlenose dolphins (*Tursiops truncatus*) in a captive colony. In: K. Pryor & K. S. Norris (eds.) *Dolphin Societies*, pp. 305–318. University of California Press, Berkeley.
- Overstrom, N. A. (1983) Association between burst-pulse sounds and aggressive behavior in captive Atlantic bottlenose dolphins (*Tursiops truncatus*). *Zoo Biology* **2**, 93–103.
- Perrin, W. F., Warner, R. R., Fiscus, C. H. & Holts, D. B. (1973) Stomach contents of porpoise, *Stenella* spp. and yellowfin tuna, *Thunnus albacores*, in mixed species aggregations. *Fishery Bulletin U.S.* **71**, 1077–1092.
- Pryor, K. & Kang-Shallenberger, I. (1991) Social structure in spotted dolphins (*Stenella attenuata*) in the tuna purse seine fishery in the eastern Tropical Pacific. In: K. Pryor & K. S. Norris (eds.) *Dolphin Societies*, pp. 161–196. University of California Press, Berkeley.
- Ross, H. M. & Wilson, B. (1996) Violent interactions between bottlenose dolphins and harbour porpoises. *Proceedings of the Royal Society of London, B* **263**, 283–286.
- Saayman, G. S. & Tayler, C. K. (1973) Social organization of inshore dolphins (*Tursiops aduncus* and *Sousa* sp.) in the Indian Ocean. *Journal of Mammalogy* **54**, 993–996.
- Shane, S. H. (1995) Relationship between pilot whales and Risso's dolphins at Santa Catalina Island, California, USA. *Marine Ecology Progress Series* **123**, 5–11.
- Shelden, K. E. W., Baldrige, A. A. & Withrow D. E. (1995) Observations of Risso's dolphins, *Grampus griseus* with gray whales, *Eschrichtius robustus*. *Marine Mammal Science* **11**, 231–240.
- Strier K. B. (2003) *Primate Behavioral Ecology*, 2nd edn. Allyn & Bacon, Boston, MA.
- Sylvestre, J. P. & Tasaka, S. (1985) On the intergeneric hybrids in cetaceans. *Aquatic Mammals* **11**, 101–108.
- Terry, R. P. (1984) Intergeneric behavior between *Sotalia fluviatilis guianensis* and *Tursiops truncatus* in captivity. *Zeitschrift für Säugetierkunde* **49**, 290–299.
- Weller, D. W., Würsig, B., Whitehead, H., Norris, J. C., Lynn, S. K., Davis, R. W., Clauss, N. & Brown, P. (1996) Observations of an interaction between sperm whales and short-finned pilot whales in the Gulf of Mexico. *Marine Mammal Science* **12**, 588–594.
- Wood, F. G. (1953) Underwater sound production and concurrent behavior of captive porpoises, *Tursiops truncatus* and *Stenella plagiodon*. *Bulletin of Marine Science of the Gulf and Caribbean* **3**, 120–133.
- Würsig B. & Würsig, M. (1980) Behavior and ecology of dusky porpoises, *Lagenorhynchus obscurus*, in the South Atlantic. *Fishery Bulletin* **77**, 871–890.