NEW RESULTS ON A BOTTLENOSE DOLPHIN (*TURSIOPS TRUNCATUS*) COMMUNITY AT RANGIROA ISLAND (FRENCH POLYNESIA)

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INTRODUCTION By studying and comparing dolphin populations living in different habitats, we will be able to isolate the environmental factors shaping the range of behaviors this polymorphic species has developed. At Rangiroa Island (Tuamutu – French Polynesia), a population of bottlenose dolphins is described by the locals to be visiting the Tiputa pass almost every day, all year-round. A first study was conducted during four weeks from mid October to mid November 2001 in order to better understand the residency pattern, population size, habitat use, and social structure of this community.

MATERIALS AND METHODS

Study area The atoll of Rangiroa has two passes. Out-flowing and in-flowing currents strongly influence the sea state in passes by making the waves respectively appear and disappear for periods of nearly 6 hours.. One of the passes, the Tiputa pass, covers an area of roughly 0.2km^2. Its depth ranges from 15 to 60 m. For the purpose of this study, the pass was divided into two zones (zone I and zone II) based on their characteristics. Zone I is from 25 to 60 m deep, coral covers the bottom, and the waves, if present, are stronger than in zone II. This second zone is less deep, and its bottom is sandy. A third zone, called "zone III", is the edge of the pass at the ocean side. Deeper than the two other zones, no current is observed. The waves, if present, are wind-induced and not a result of in and out-going currents.

Shore-based surveys

Day long surveys Five complete days of 11 hours and 40 minutes each were spent on the pass shore to record every 15 minutes dolphin absence/presence, their relative activity, the direction of the current, the force of the waves, the meteorological parameters and the absence/presence of boats.

4pm to 5pm surveys During 11 days, a one hour period from 4pm to 5pm was spent on the pass shore to record every 5 minutes dolphin absence/presence, their behavioral sequences, the direction of the current, the force of the waves, the meteorological parameters, and the absence/presence of boats.

Boat-based surveys Thanks to the Rangiroa dolphin watch tour, 14 boat trips were conducted. Whenever a group of dolphins was detected, the boat would tend to approach the group. The dolphins appeared to be used to the dolphin watch boat and were easily approached. The data collection included date, hour, position, environmental data, a visual estimate of the group size, the name of the individuals we could recognize, and the behavior of the group related to the boat (avoidance, indifference, interest, interaction). In each sighting cruise, lasting about 1 hour, photo identification was conducted.

Underwater videos Three scuba-diving schools of Rangiroa provided us with about 7 hours of high quality underwater video footage. All of the video sequences were filmed in the zone III of the pass. Each footage was viewed in order to identify the individuals, determinate their sex, and study their social behavior. The number of dolphins per sub-group was defined and any kind of interaction was counted, describing the number of individuals implicated in the physical contact.

RESULTS

Population size and residency pattern

Boat-based surveys During the 14 boat trips, a total of 133 dolphins were observed. School sizes ranged from 4 to 15 individuals with a most frequent group size of 12 dolphins, and a mean size of 9.5 individuals per sighting. Thirteen individuals have been catalogued from a population locally estimated at 20-30 individuals. Four individuals of the 13 identified are juveniles (30.8%). 56.4% of the dolphins sighted belonged to the "identified" category and were frequently re-sighted.
Groups of spinner dolphins (*Stenella longirostris*) were sighted twice. On the first occasion, two catalogued bottlenose dolphins shared the bow wave with the spinner without any apparent aggressiveness.
Underwater video A total of 598 dolphins were sighted during the 7 hours of underwater videos recorded from 1996 to 2001. From the total, 31.6% belonged to the "identified" category. The high level of re-sightings for Titti (29.6%) and the "adopted" spinner dolphin (18.0%) can be due to the fact that conspicuous natural markings made them easily identifiable.

Habitat use

The influence of tidal rhythm From a total of 233 samples of "day long" surveys, dolphins were present in the pass 48.1% of the time. In the absence of waves (in-flowing current), the dolphins were present at a low frequency (16.2%). In this case, there were quiet for 82.4% of the time. In the presence of waves (out-flowing current), the dolphins were present at a higher frequency (74.2%) and they spent 65.3% of their time jumping and surfing. Hence, the dolphin presence (χ^2=19.2, $p<0.01$) (Fig.1) and the dolphin behavior (χ^2=13.4, $p<0.01$) seemed to be linked to the tidal rhythm.
From a total of 131 samples of "4 to 5pm" surveys, dolphins were observed in the pass 63.4% of the time. In absence of waves (in-flowing current) the dolphins were present at a low frequency (13.0%). In this case, the number of calm behaviors represent 70.7% of the 133 behaviors observed. In the presence of waves (out-flowing current), the dolphins were present at a higher frequency (90.6%) and the jumps and surfs represent 80.0% of the 2941 behaviors observed. Here again, dolphin presence (χ^2=65.9, $p<0.01$) (Fig.1) and dolphin behavior (χ^2=377.7, $p<0.01$) were linked to the tidal rhythm.
The influence of the zone Of the 8 different behaviors observed in the pass during "4-5pm" sighting surveys (131 samples), surfing and simple leaps represent the majority of the behaviors. Zone I was most frequently used (83.6%) than zone II (Table1). The leaps were parallel to the shore for 91,7% and in the same direction as the current for 54,7%. When dolphins swim from the lagoon to the ocean, it is not linked to the flow direction (χ^2=0,3, $p<0.01$). When dolphins swim from the ocean to the lagoon, it is current-dependant (χ^2=76,9, $p<0.01$): in 80,3% of the case they move against the out-flowing current.
The influence of powerboats The presence of powerboats has been observed in 55.8% of "day long" shore based sighting sessions (233 samples). The absence/presence of small powerboats passing or crossing the pass doesn't affect the absence/presence and the behaviors of the dolphins (χ^2= 0.4, $p<0.01$). Once or twice a week, a cargo boat comes to Rangiroa to supply the island. No matter the direction of the current, dolphins escort frequently the cargo boats ahead and through the pass.

Social structure Dolphins were categorized into adult, juvenile or calf classes on the basis of body size. The three classes were observed in the three zones.
The total number of tactile behaviors (contact with pectoral fins, flukes, dorsal fins, or rostrum, and assisted swimming) between individuals were counted using the underwater video footage. Among the 73 interactions between *Tursiops*, 21 were between juvenile(s) or a calf and an adult, including 4 between a male and a juv/calf (from 7 cases with a sexed adult), and 52 were between adults (71.2%).

From the 73 intra-specific interactions, 61.6% concerned 2 adults, 17.8% an adult and a juvenile, 9.6% a calf and an adult, 9.6% three adults, and 1.4% two juveniles and an adult. Of the 73 interactions, 89% were between two individuals and 11% between three individuals. No interaction involving more than 3 bottlenose dolphins was observed (Fig.2).

Large groups of spinner dolphins and melon headed whales (*Peponocephala electra*) are frequently seen off Tiputa pass. Inter-specific relations have been recorded with both species: video footage shows a neonatal spinner dolphin swimming in echelon position with the catalogued male bottlenose dolphin Blanche Neige (estimated year 1996-1997). Still more footage shows a neonatal melon headed whale swimming in echelon position with an adult bottlenose dolphin of undetermined sex (estimated year 1997-1998). Both calves showed the fetal folds along their sides. No aggressive behavior from the adults *Tursiops* towards the calves was observed. The only behavior observed was the typical assisted swim behavior. Both neonates actively swam to maintain the echelon position, and none of the two adults seemed to force the neonate to stay with them.

An adult female spinner dolphin was known to be part of the social community of the bottlenose dolphins group from 1996 to September 1998. This "adopted" spinner dolphin is present in 11.4% of the underwater footage. The majority of the time, she was accompanied by 2 (17.6%) to 3 (52.9%) bottlenose dolphins. She was hardly ever seen with 4 (8.8%) or 5 individuals (2.9%) and she was never observed alone or with more than 5 bottlenose dolphins. She had interactions with one or several *Tursiops* in 32.4% of the cases. If we look at the 12 interactions between this adult "adopted" spinner dolphin and the bottlenose dolphins, 42% were between the spinner and 1 bottlenose dolphin (2 individuals), 33% were between the spinner and 2 bottlenose dolphins (3 individuals) and 25% with the spinner and 3 bottlenose dolphins (4 individuals) (Fig.2).

DISCUSSION

Group size and residency pattern Group size of dolphins communities seems to depend on two factors: the predation on dolphins (small group size revealing low predation pressure - Norris and Dohl, 1980), and the distance to the coast (small group size from 2 to 14 individuals is founded near the coast – Weigle, 1990). Despite the presence of different species of sharks (Tiger shark *Galeocerdo cuvier*, gray shark *Carcharinus amblyrhinchos*, hammerhead shark *Sphyrna zygaena*, white tip shark *Carcharinus albimarginatus*) in high density at Rangiroa island, the dolphin school size stays small. Except cookie sharks (*Isitius brasiliensis*) bites, no injuries caused by sharks were reported. This low predation pressure may be explained by the fact that these waters are extremely rich in fishes, probably an easier prey for the sharks than the dolphins.

Habitat use The tidal rhythm influences the absence/presence and the behavior of the dolphins in the pass. When the current is in-flowing, there is a good chance of finding the dolphins swimming calmly in small sub-groups from 2 to 4 individuals et the "angle" of the pass. On an out-flowing current, the dolphins jump and surf in the waves of the pass.

No feeding activities were observed, unless we consider breaching as indicative of foraging behavior (Lewis and Evans, 1993) since we saw much of this in the pass. Moreover, Ingram and Rogan (1998) assert that areas of strong current in the entrance to rivers are important foraging habitats for bottlenose dolphins. Hence, contrary to local belief, the Tiputa pass might be also a feeding zone instead of being an area for social contact and play time.

Social structure

Male/juvenile or calf interactions In this study, the exceptional opportunity to easily determine sex with underwater videos helped us to discover these few reported male/juvenile or calf interactions in a community where the sex ratio is oriented to male prevalence. Tizzi *et al*. (1998) explain the function of the male-juvenile interaction as beneficial for the mother by releasing her for more efficient foraging. Bojanowski (1998) refers to male-juvenile interaction as a social tool. This type of interaction would help the males to have access to females by playing the role of agonistic buffer or protector.

Inter-specific interactions Inter-specific interaction with a lone cetacean neonate is rarely described in literature (Baird, 1998; Herzing and Johnson, 1997). Referring to Baird (1998), we would classify the interaction of this community with the two neonates (*Peponocephala electra* and *Stenella longirostris)* as displaced epimeletic behavior. However, the short length of footage and reduced time of observation *in situ* by the divers don't allow us from drawing conclusions.
In the case of the "adopted" spinner dolphin, the number of interactions with bottlenose dolphins shows that she was well integrated to the group. Her contacts with bottlenose dolphins implicate more dolphins than is observed for sub-groups formed by bottlenose dolphins only. It is the first time that a long term inter-specific interaction like this is reported. Usually, intergeneric associations implicate numerous animals of two or more different species. Usually, inter-specific associations implicate numerous individuals of different species (Gannier, 2000; Laran and Gannier, 2001).

CONCLUSIONS In spite of being observed by many scuba-divers and professionally filmed on several occasions, this population of bottlenose dolphins had never been studied before. Its fearless behavior in presence of humans and boats shows the respectful behavior that the locals developed in regard to this resident population.
Some results like the small group size or the influence of the tidal rhythm on habitat use confirm results from other surveys world wide. Other results like baby-sitting males, inter-specific epimeletic behavior, and long term inter-specific associations are rarely mentioned in literature and make from this group of dolphins a unique community.
This one month study just provided an insight on the ecological and behavioral parameters for *T.truncatus* inhabiting a so particular ecosystem. Further investigations need to be undertaken.

ACKNOWLEDGEMENTS This research was partially funded by the "Groupe de Recherche sur les Cétacés". We wish to thank the "dolphin watch activity", "The 6 passengers", "Raie Manta Club" and "Dream dive" for providing us the essential tools to achieve this study. We are grateful to Christiane and Gérald Lefèvre for the logistical support.

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Table 1. Percentage of the 8 behaviors observed in function of the zone of the pass

	Surfing	Simple leap	Stationary	Side breach	Swim from lagon to ocean	Swim from ocean to lagon	Belly breach	Upside down leap	Total
Zone I	35,5	25,2	9,7	5,4	3,8	3,0	0,7	0,4	**83,6**
Zone II	1,7	8,3	2,3	0,6	1,2	2,3	0,1	0,0	**16,4**
Total	**37,2**	**33,5**	**11,9**	**5,9**	**4,9**	**5,3**	**0,8**	**0,4**	**100,0**

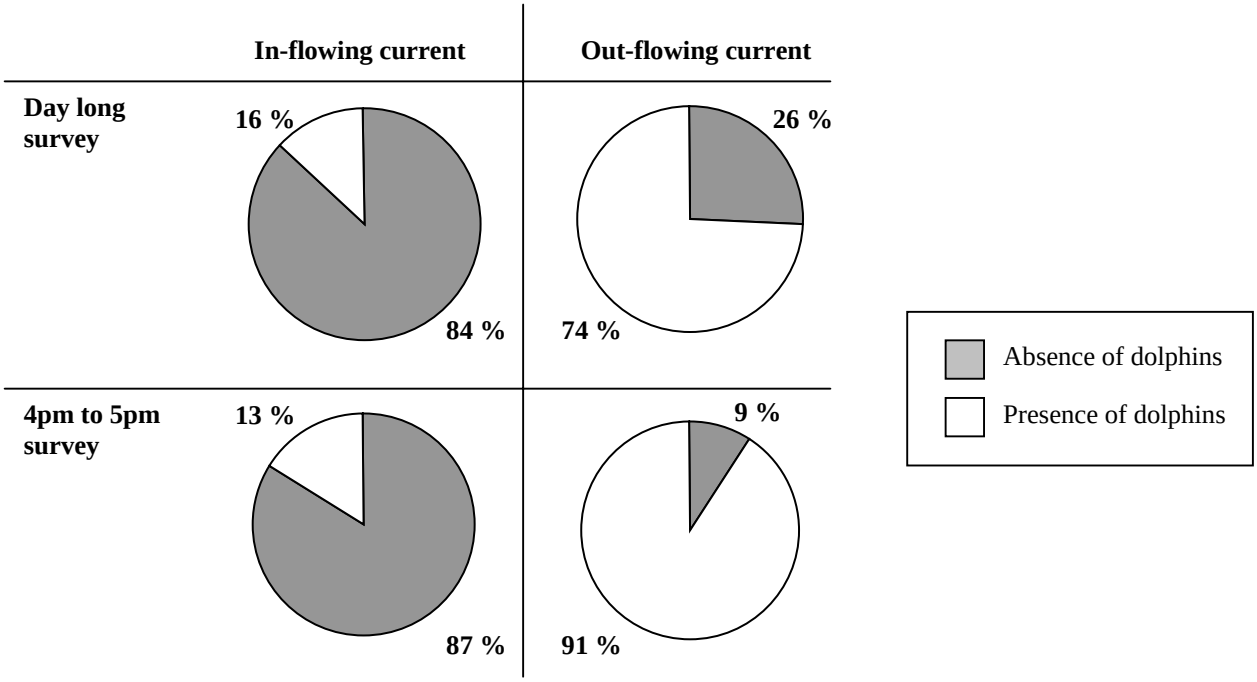

Fig. 1. Absence/presence of dolphins in function of in and out-going currents

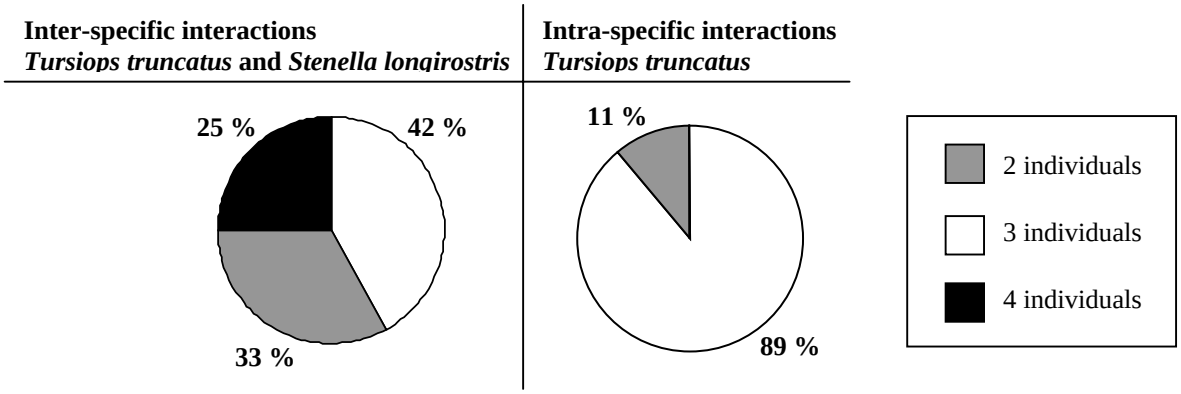

Fig. 2. Number of individuals implicated in intra and inter-specific interactions