

OBSERVATIONS ON THE CAPTIVE BEHAVIOUR OF *SOTALIA FLUVIATILIS GUIANENSIS*.

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Summary

The first, informal observations on the captive behaviour of the coastal Tucuxi, *Sotalia fluviatilis guianensis*, are presented. Even with a limited study group, conspecific behavioural patterns seem apparent, including similarities in temperament, social bonding, sexual expression, and aggression. There is also a wide range of individual expression in these and other forms of communicative behaviour. Although timid by nature and wary of novelty or changes in their environment, these *Sotalia* have demonstrated a reliable trainability. Contrary to earlier reports, the *Sotalia* in the present study adapted well to captivity and have been vigorous and healthy since their arrival six years ago.

Introduction

Sotalia fluviatilis is a small South American dolphin whose range extends from the fresh-water systems of the Amazon River and Orinoco estuary (up to Ciudad Bolivar) to the marine coastal waters of Columbia in the north, and as far south as Santos, Brazil. These small delphinid cetaceans pose provocative questions for cetologists. The taxonomy of the genus has been in a state of flux over the last two decades. Due to their wide range of habitats, and large population variations in size, colour and number of teeth (WATSON, 1980), an accurate assessment of the exact number of species and/or subspecies within the genus has not been determined. The ultimate cause of this state of confusion, recognized by several recent authors (ELLIS, 1982; WATSON, 1980) is the severe lack of hard data on *Sotalia*. Adding to the informational confusion associated with the genus is the use of several arbitrarily assigned common names. These include the Tucuxi (ELLIS, 1982), the Guiana Dolphin (BOSSENECKER, 1978) and the Estuarine Dolphin (WATSON, 1980). The use of Tucuxi, an Amazon Indian name for the riverine population, *Sotalia fluviatilis fluviatilis* (Gervais, 1852) in Brazil, can be especially misleading when applied to the marine populations found along the coasts of Colombia, Venezuela, Guiana and Surinam. Considering the present deficit of information on *Sotalia*, the distinction between the various geographic populations within the genus is an important one. Following precedents set by previous authors (MAGNUSSON *et al.*, 1980; WATSON, 1980), the present study assumes one species within the genus with the designation offered by VAN BREE (1983) of *Sotalia fluviatilis guianensis* (P.J. van Beneden, 1864) for the subspecies observed. Until more definitive speciation studies are available, this seems a reasonable interim solution to distinguish the population of *Sotalia* observed in the present study.

The presence of any form of *Sotalia* in captivity has been rare until recently, and behavioural observations in these few instances have been severely limited. Exceptions include two specimens at Marineland of Florida (CALDWELL and CALDWELL, 1970) and one specimen at the Niagara Falls Aquarium (SPOTTE, 1967). In both cases, the observations made were over brief periods and on specimens from the Amazon River, apparently *Sotalia fl. fluviatilis*. Although a few studies exist on morphological aspects of *Sotalia fl. guianensis*,

to the best of the author's knowledge observations on their captive behaviour have not been reported.

In 1977, twenty-four *Sotalia fl. guianensis* were collected from a shallow bay on the coast of Columbia and transported to various sites in Europe (BOSSENECKER, 1978). Of the original group, eight are presently alive in captivity. Three of those *Sotalia*, two males and one female, are at the Antwerp Zoo in Belgium. Training of these dolphins for sonar discrimination experiments began in December of 1982. Although similar studies have been completed for *Tursiops truncatus* (HOL and KAMMINGA, 1979), this work is the first of its kind on *Sotalia*. Due to the scarcity of information on the species, and considering possible behavioural influences on experimental design, concurrent behavioural observations began on these three dolphins.

Observational environment and subjects

The dolphinarium at the Antwerp Zoo has one large performing tank (approximately 27 m by 7 m) and several holding tanks (5 m by 5 m on the average) connected by channels. All tanks are 3 m deep. The water is maintained at an average salinity of 3.0‰ and a minimum temperature of 20°C. The *Sotalia* share the facilities with four female and two male *Tursiops truncatus*, although the two groups are normally separated from one another by gate barriers. During normal daily activities, they spend time at various locations within the facilities. Glass windows along one side of the main tank aid in observations and allow video-taping of behaviour. Observations were conducted and recorded biweekly on an informal basis from November 1982 through June 1983. The duration of observations varied from thirty to ninety minutes.

The three *Sotalia* matured since their arrival at the dolphinarium in the Fall of 1977. Each gained approximately 20 cm in length and almost doubled in weight during the first three years in captivity. Their present physical attributes (see Table 1) are in general agreement with other reports (ELLIS, 1982; WATSON, 1980) with the notable exception of a much higher maximum body weight. Based upon the onset of maturity, signaled by changes in sexual behaviour and scarring on their skin, the present age of these dolphins is estimated to be between 8 and 10 years.

Temperament

Sotalia are timid and rather nervous by nature, socially dependent on one another, and tend to react adversely to novelty. They are easily frightened by changes in their environment. Fear is typically demonstrated by rapid swimming, increased breathing rates, bunching, and, occasionally, aerial displays. Even with their timid nature, and contrary to other reports (ELLIS, 1982; HERALD, 1967), the dolphins at Antwerp are vigorous in captivity. Their health, on the whole, has been better than that of *Tursiops* in the same captive environment.

The close social bonding displayed by these dolphins has been maintained since their arrival in captivity. Several months of patience by the staff was needed after the dolphins arrival before the three individual *Sotalia* could be separated for training purposes (DE BLOCK, 1982). At the present time, they still move rapidly and in tight formation through the channels between tanks, and bunch quickly when frightened. Aggression is also usually expressed by the three dolphins as a social unit, especially when directed towards the *Tursiops*. Even though they are easily agitated, since their arrival at Antwerp, the *Sotalia* have never threatened or attacked humans.

Table 1:

Physical attributes of *Sotalia fluviatilis guianensis* in Antwerp

Name	Sex	Length*	Weight	Avg. Daily Food Intake
Evita	Female	180.5 cm	105 kg.	3.0 kg.
Eros	Male	184.0 cm	72 kg	2.5 kg.
Eddie	Male	181.5 cm	86 kg.	2.5 kg.

*measured from the tip of the rostrum to the notch in the flukes.

Ages: Between 8 and 10 years

Number of teeth: Approximately 120 total - varies by no more than one tooth from individual to individual.

Dental formula = upper 32 x 2 lower 28 x 2

Coloration: Even light grey over the back fading to pale grey on the sides and a white-cream underside with a slight pinkish flush from the chin to past the genital slit area. Top and bottom of the pectoral fins are the same color as the back; the top of the flukes are also the same as the back, but the undersides are a pale grey to white-cream. No sharp lines of color demarcation are apparent. There are no white splotches on the dorsal or tip of the rostrum reported by LAYNE (1958) for *Sotalia fl. fluviatilis*.

Skin: Extensive white scarring on the back and sides of each individual. The two males each have a large, prominent semi-circular scar on the side (left and right respectively) of their body; the wounds, inflicted in the wild, were well-healed upon arrival in captivity.

The daily activities of these small cetaceans demonstrate a distinct lack of curiosity or innovative behaviour with objects in their environment. Even though trained to retrieve objects for show purposes (balls, rings, and propellers), their normal behaviour is virtually devoid of manipulative activities. On only two occasions, over a period of eight months, were individual *Sotalia* observed to manipulate an object on their own initiative. Both instances involved a ball, often present in their tank; once the ball was pushed against the tank wall, and once it was tossed into the air. In each case the action was performed only once. Occasionally an individual *Sotalia*, usually the female, will sky-hop (rise out of the water to investigate visually). This behaviour, almost always performed when humans are in the immediate vicinity, seems less motivated by curiosity than by the prospect for food.

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General behaviour

Throughout the course of their normal activities the *Sotalia* exhibit a stereotyped pattern of constant motion, commonly swimming in counter-clockwise circular patterns one to two metres below the water surface. Unless prospecting for food or attracted by familiar humans, they spend little time at the surface of the water. During calm moments their swimming speed is rather slow, with one or more power strokes and a long glide pattern. When not under stress, they will commonly cover 25 metres in 20 seconds and breathe approximately every 25-30 seconds (although the breathing rate easily varies between 15 and 50 seconds). During calm periods it is not unusual for the *Sotalia* to remain submerged for several minutes. When agitated or during chases, however, they are capable of surprisingly rapid bursts of speed, typically braking off suddenly into long glides. When motivated they can easily cross 27 metres in 3 to 4 seconds (approximately 8 metres/second), often startling onlookers in the process. Their breathing is normally quiet, in the form of a low "puff". Even when agitated, they rarely exhibit the loud "chuff" noticed in other captive dolphin species (DE FRAN and PRYOR, 1980).

The close social bonding characteristic of these *Sotalia* figures prominently in their daily swimming formation. The three individuals normally maintain a tight grouping with the males slightly behind the female (Fig. 1). Breathing is not usually in unison, even though the three maintain a close swimming pattern. This social grouping is broken only on occasions when *Tursiops* are present (but separated by net gates) or when recognized humans are in the vicinity. Interestingly, the two males form an even closer social subunit. The female ventures away on her own from time to time, but the males rarely leave one another's side (Fig. 2). Although the female is easily isolated for training, the males react to separation with agitation. Once an isolated male was observed to sink to the tank bottom beside a net gate separating him from the other two. A steady stream of bubbles came from his blowhole as he issued a series of whistles usually indicative of stress.

Aerial displays are not uncommon by the *Sotalia* in Antwerp. Trained to leap over a rope (more or less in unison), the female, in addition, leaps through a hoop and to a target two metres above the water. Leaps on their own initiative are usually associated with agitation or used as a form of avoidance during chases, especially with *Tursiops*. The observed aerial displays include both porpoising (with a smooth arching reentry) and breaching (landing flat on the side). WATSON (1980) listed only breaching as the common aerial display in the riverine population, but porpoising seems just as frequent in these *Sotalia*. When these displays occur, they can be graceful and quite spectacular in form and repetition.

Communicative behaviour

Most captive dolphin species maintain a large repertoire of displays associated with communication (PRYOR, 1973). *Sotalia* also demonstrate a wide range of communicative behaviour, including body postures, visual and acoustic signals, and tactile displays. The Antwerp dolphins emit both whistles and clicks in the course of acoustic communication. The whistles, commonly emitted when agitated, are short, pure tone, and rise sharply in

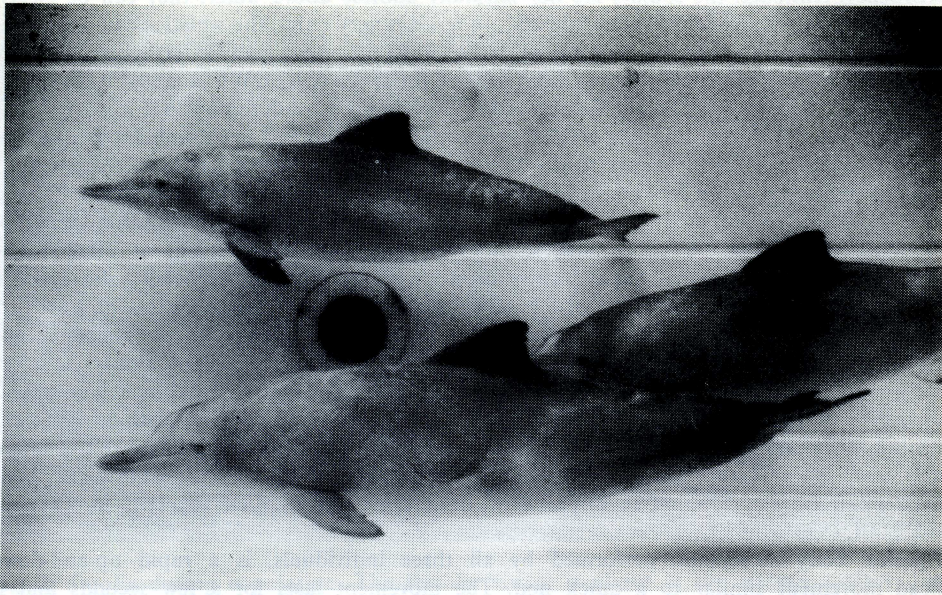


Fig. 1: All three *Sotalia* in a typically close social grouping. The two males (background and foreground) partially hide the female in the middle.

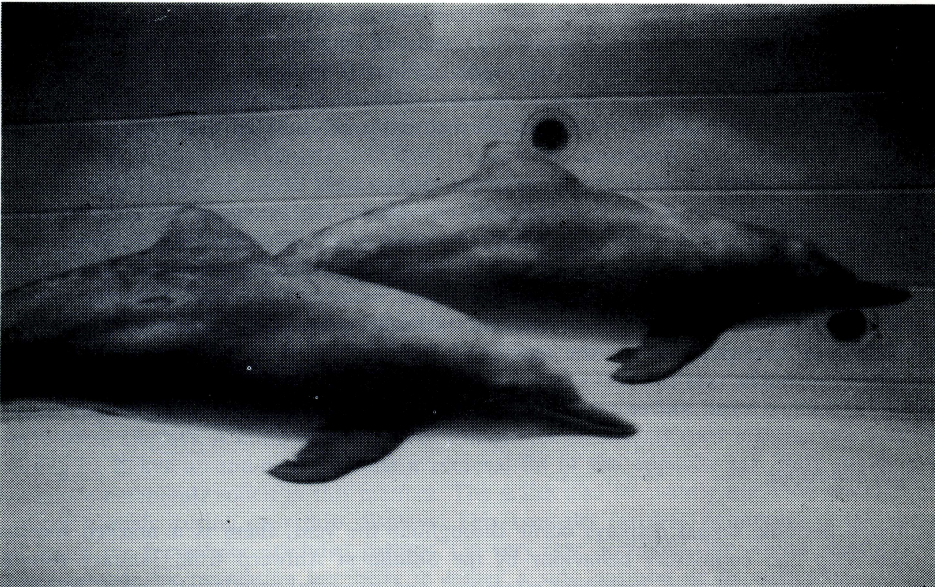


Fig. 2: The two male *Sotalia* maintaining a tight social subunit. Note the large curving scar, present when captured, on the right side of the male in the background.

frequency. Although the sounds are not normally audible above water, they can be clearly heard with a hydrophone as short "wheets". When it is very quiet, the whistles can sometimes be heard without aid at the viewing windows along the main pool. In structure, they are very similar to the whistles recorded for *Sotalia f. fluviatilis* (CALDWELL and CALDWELL, 1970). The ultrasonic, sonar signals of *Sotalia fl. guianensis*, analyzed by WIERSMA (1982), are two-component in nature and consist of simultaneous high and low dominant frequencies at 95 kHz and 30 kHz respectively. The adaptive use of such a sonar signal in the dolphin's natural habitat is cause for interesting speculation. The extent to which the whistle is used as a "signature" sound among individuals in *Sotalia* is not yet clear. Although these dolphins are trained to "sing" in performances, they rarely vocalize above water at other times. PILLERI (1982) suggested that the sense of vision in this species, especially above water, is much more limited than that of *Tursiops*. Vision does seem to play less of a role in communication between individual *Sotalia* than in other dolphin species. Responses during training to a range of visual signals, however, indicate some degree of ability to adapt their visual attention to a captive environment. Certain body gestures and head movements further indicate that visual cues have value in intraspecific communication, especially during sexual behaviour. One of the males typically glides in a distinctive inverted U-shape, and, when sexually excited, will flex his body back-and-forth in this U-posture. This body orientation is very different in appearance from the S-shape often reported in *Tursiops* (PRYOR, 1973).

Another body movement, performed by all three individuals, is a rapid up-and-down head movement similar to a quick nod. The movement lasts for a few seconds and is usually repeated at intervals while swimming in formation. It is typically initiated by one of the males and frequently elicits the same movement from one of the other two (often, but not always, the female). It is not currently known if any sound is emitted during this behaviour, but it is frequently performed when visual contact between the individuals is possible. Further, the nodding is often accompanied by a series of "flipper chops", where both pectoral fins move sharply to the body and away again. This may indicate a state of emotion, but whether it functions in a social or sexual context is difficult to tell. Tactile displays, although occasionally serving apparent social functions, usually are indicative of sexual behaviour and will be discussed in that context.

In spite of close social bonding, the *Sotalia* also show a wide range of individual expression in their behavioural repertoire. For instance, one of the males characteristically leads in copulatory behaviour far more often than the other male. The two males spend much more time in their daily routine involved in aggressive interchanges with the isolated *Tursiops* than does the female. The female, however, assumes the initiative during training and is more apt to attempt new or difficult tasks. In general the *Sotalia* seldom solicit stroking from humans, but it is the female who normally does so when it occurs. On the infrequent occasions that she seeks tactile contact, she seems to genuinely enjoy having her tail pulled, body stroked, and chin rubbed.

Sexual behaviour

Although periodic sexual displays occur throughout the year, there is a marked increase in courtship and copulatory behaviour by the *Sotalia* at Antwerp from January through May. Peak sexual activities, including attempted and successful copulations, occur in March and April, although this fluctuates slightly from year to year. The extent to which the timing of this activity corresponds to their natural breeding cycle is unknown.



Fig. 3: *Sotalia* during copulation. The female (Evita) is above at the water's surface, the male (Eros) is upside down and below. Glare from the underwater observation window partially obstructs view of the male's body.

As with other dolphin species, tactile stimulation plays a major role in the sexual behaviour of *Sotalia*. Masturbatory behaviour is common during the seasonal sexual activities and includes the use of the tip of the dorsal fin, the edges of the flukes, and, more rarely, the pectoral fins insertion into the genital slit of male or female. These forms of masturbation occur reciprocally between a male and the female, or, less frequently, between the two males. Masturbation at times may be an end in itself or used during courtship displays for stimulation. On rare occasions, a form of beak (male) - genital slit (female) propulsion has been observed. BATESON (PRYOR, 1973) noted similar behaviour in *Stenella* sp. and suggested that it may function in maintaining a social dominance hierarchy. When observed in *Sotalia*, however, this behaviour preceded and followed sexual activity. It was not observed to occur between the males.

Tactile displays also serve as a dominant form of courtship behaviour. Insertion of a fluke edge into the genital slit of the opposite sex is the most commonly used form of stimulation during solicitation. Other parts of the body, such as the dorsal fin or flipper, are used to a lesser degree. Body rubbing also occurs on rare occasions, but it plays a relatively small role in these displays. A more subtle form of stimulation commonly used involves one dolphin rubbing its flukes up-and-down against a pectoral fin of the opposite sex. Both males and the female commonly solicit in this manner. The males also frequently use body orientations as visual signals during courtship displays. This typically involves swimming upside-down and below the female for extended periods. On very rare occasions, the female uses similar body language by presenting her belly in either a side position or by swimming upside-down and in front of a male.

Copulation is accomplished in *Sotalia* in the belly-to-belly (anterior-posterior) body orientation, with the male swimming upside-down and approaching the female from below (Fig. 3)



Fig. 4: head region of male *Sotalia* (Eddie) during medical check. Note extensive scarring due to tooth-rakes from other *Sotalia*. The injury on the rostrum tip was inflicted by a male *Tursiops* while in captivity.

Numerous courtship displays over variable time periods usually precede copulatory attempts. At other times, however, it occurs with little fanfare. Although frequent attempts and numerous (and sometimes prolonged) erections are seen during the mating season, successful intromissions in these dolphins have been rare. Ejaculations often occur outside of the female's body, either in the vicinity of the genital slit, against the side of the body, or, in one instance, against the flukes. To date there have been no pregnancies.

There may be a combination of factors working against successful reproductive attempts in these particular dolphins. First, all three *Sotalia* matured in captivity without access to the variety and range of sexual contact common in larger cetacean social groups. Second, the female, who represents the only sexual partner for the males, has been to date rather passive to their advances and, in general, has shown less interest in copulatory behaviour than the males. Third, the penis in *Sotalia* is longer and more narrow in proportion than in *Tursiops*, with a pronounced curve at the tip, perhaps necessitating a longer period of learning experience in sexual behaviour (preferably with a greater number and variety of partners). Finally, in mature dolphins success at copulation and fertility often continues to increase with age. DUDOK VAN HEEL (1983) suggests that since successful breeding does not begin in *Tursiops* males until the age of 12-14 years and in females until the age of 6-8 years, the *Sotalia* males at Antwerp (and the female) may yet be simply too young to breed.

Aggression

Upon arrival in captivity, the skin of all three *Sotalia* was smooth, with an even, medium grey tone (DE BLOCK, 1982). At present their skin shows extensive, white scarring, especially on the backs (Fig. 4), from the melon to the peduncle (although much less so in the female).

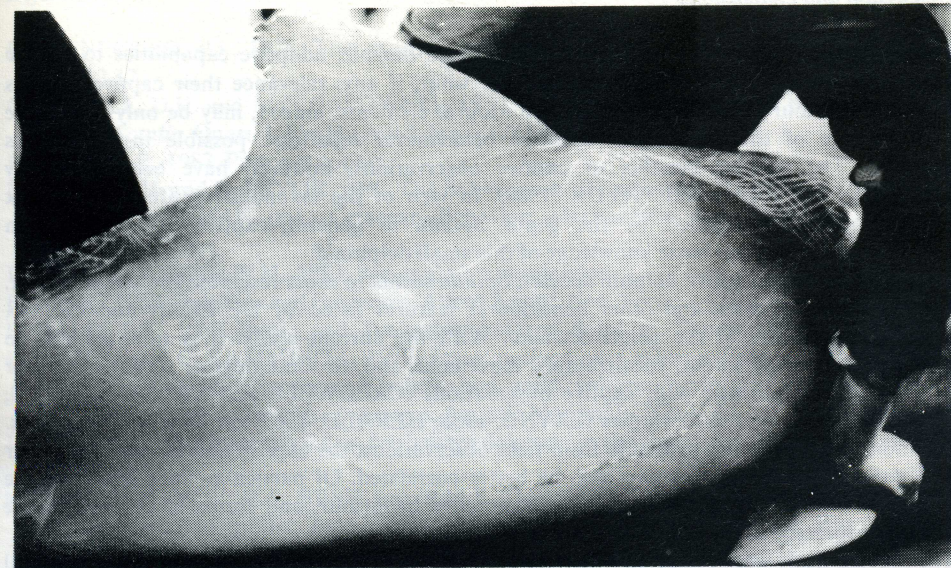


Fig. 5: Lateral view of male *Sotalia* (Eddie) during a medical check. Scarring of the body due to tooth-raking is evident along the back and anterior of the dorsal fin. Note ragged edges of the dorsal fin and flipper. The large curved scare was present when the dolphin was captured.

In addition, the posterior edge of the dorsal fin and pectoral fins, as well as the trailing edge of the flukes in the males, are ragged with numerous gaps (Fig. 5). Fresh cuts around the head and wounds along the flukes are noted from time to time. The scarring of the skin appears now to be a permanent condition.

These physical indicators suggest the type of socially and sexually aggressive behaviour observed in other mature cetaceans (NORRIS, 1967). The⁴ skin scarring and condition of the dorsal fins and flukes appeared since maturation in captivity. Chases occur among the *Sotalia*, frequently during the sexual season, and the males occasionally are observed to leap out of the water and collide, back to back, in mid-air (DE BLOCK, 1982). These incidents are usually short-lived.

It is not entirely clear to what extent aggressive interactions in *Sotalia* serve reproductive and/or social functions. Certainly, the toothraking, chasing and nipping of flukes noted during courtship behaviour appears to be sexually motivated. The size of the present study group, however, precludes conclusions concerning the role of aggressive behaviour in the formation of a dominance hierarchy. Although the *Sotalia* have demonstrated no aggressive behaviour toward humans at Antwerp, they show an impressive array of aggressive displays toward the *Tursiops* in the same facilities. These include coordinated physical attacks by the males (and sometimes all three *Sotalia*) directed toward individual *Tursiops*. Complete observations of this behaviour will be discussed in a future study.

Many species of odontocete cetaceans demonstrate flexible, adaptive capabilities to captive environments. It is often difficult to conclude what, if any, relevance their captive displays have to behaviour in the wild. Certain behavioural elements, indeed, may be only a measure of the range of the redundant, adaptive behavioural repertoire possible in the species observed. The positive benefits of captive observations, however, have been previously outlined by DE FRAN and PRYOR (1980). In view of the taxonomic confusion and lack of information exemplified by the genus *Sotalia* in general, captive observations can only serve to further our basic knowledge of this small delphinid.

Compared to other captive dolphin species, *Sotalia* seems to most resemble the temperament, training characteristics, and other behavioural features listed by DE FRAN and PRYOR (1980) for members of the genus *Stenella*. With the current study, it is now possible to compare the temperament, vocalizations, movement, and, to some degree, sexual behaviour of *Sotalia fl. guianensis* with captive observations (CALDWELL and CALDWELL, 1970; SPOTTE, 1967), and field studies (LAYNE, 1958; HERALD, 1967) on *Sotalia fl. fluviatilis*. As information becomes available from field observations, the captive and natural behaviour of *Sotalia fl. guianensis* can now also be better correlated. Of particular interest will be the variety and functions of aerial displays, aggressive behaviour, and forms of communicative displays expressed in the dolphin's natural environments.

The present study was conducted with several limiting factors. There is always an observational bias associated with an informal study format made by a single observer. Attempts to offset this bias to some degree included the discussion of observations with dolphinarium staff members and the viewing at a later date of videotapes made during the course of the study. The limitations of the study group size were recognized. It cannot be entirely clear whether behavioural elements reported are indicative in every case of the species as a whole, or whether they may be (1) expressions of adaptation to a captive environment, (2) individual behavioural variations within the species, or (3) a combination of the previous two considerations.

These limitations can only be overcome by quality field observations of *Sotalia fl. guianensis*. In the mean time, these diminutive dolphins continue to present intriguing possibilities for future studies. A better understanding of their adaptation to a range of marine and freshwater habitats, and the nature of their relationship to the platanistid river dolphins and delphinid pelagic dolphins could provide important new insights into cetacean ecology and evolution.

Further Study

The observations which formed the basis of this study are still in progress. Future study will concentrate on the intergeneric behaviour of *Sotalia fluviatilis guianensis* and *Tursiops truncatus* in the same captive environment. It is hoped that the present observations lead to more quantitative behavioural studies on the captive behaviour of *Sotalia*.

In addition, the training of these dolphins for the radiated sonar beam pattern and sonar discrimination experiments, the first of their kind on this species, is in progress. A separate study on the learning behaviour and training characteristics of captive *Sotalia*, including *Sotalia fl. guianensis* at other locations in Europe, is planned for the near future.

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