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The history and behaviour of a wild, sociable bottlenose dolphin (*Tursiops truncatus*) off the north coast of Cornwall

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Abstract

Field observations were made on an adult male, 4.1 m, solitary wild but sociable bottlenose dolphin, *Tursiops truncatus*, in the area between Portreath and St Ives, north Cornwall during 1984. Few permanent distinguishing body marks were seen, except for a white patch at the base of the leading edge of the dorsal fin, and deep scars on the mandible. The teeth were all present and only slightly worn. Tooth rake scars monitored throughout 1984 revealed regular but discontinous contact with conspecifics and larger cetaceans. Other scars revealed possible encounters with other animals in connection with feeding. The home range of the dolphin, in which he has been resident for about 4 years by the end of 1984, is coastal and about 77 km^2 in area. Diving and swimming patterns related to probable feeding activity were correlated with tide and specific topograhical locations which maximized tidal current. Dives up to 2.5 min. in duration with 2–3 blows between dives at intervals of ca 10–15 sec. were observed. Considerable interaction with people, boats, fishing buoys and equipment, and marine life was observed by and reported to us, and mostly constituted play. Specific behavioural patterns including those of aggression and sexual overture were directed towards swimmers at certain times. Close observations of investigative behaviour by the dolphin revealed that the lower jaw tip was often used as a sensor.

Introduction

The complete natural history of the dolphin, and its behaviour can only be fully appreciated by observation and long-term study in the wild. On a large scale, movements and behaviour of whole schools of dolphins and porpoises have been monitored around the Americas and South Africa, often using telemetry devices and/or individual body markings (Doak, 1981; Evans, 1971; 1974; Gaskin, Smith and Watson, 1975; Irvine, Wells and Scott, 1982; Leatherwood and Ljungblad, 1979; Perrin, Evans and Holts, 1977; Rice and Saayman, 1984; Saayman and Tayler, 1979; Saayman, Tayler and Bower, 1973; Wells, Irvine and Scott, 1979; Wursig, 1978; Wursig and Wursig, 1977; 1979; 1980).

There is a paucity of information on live Cetacea observed in British waters, although recently a number of sightings networks have been operating (D. McBrearty, R. J. Harrison and H. E. Dobbs—'Dolphin Watch'; J. Wharram—'Dolphin Link'; P. Evans—Cetacean sightings scheme) and have encouraged the public as well as coastguards and merchant seamen, to take an active interest in Cetacea around Britain and record their observations.

McBrearty has found that these surveys have revealed that despite the most common group size of dolphins being 2–5 individuals, the solitary dolphin is often the next most frequently occurring group, suggesting that singletons found in coastal areas are not necessarily aberrant, old or abandoned animals or unusual in any way. Resident dolphins first encountered in a solitary state are never sociable initially, but often become approachable by, even sociable with man. The approachability only comes gradually as a result of habitual and agreeable human encounters, negating any theories of active seeking of human company.

The few documented records of individual, wild, resident and often sociable bottlenose dolphins, *Tursiops truncatus,* have indicated that over the years, such occurrences appear to be relatively rare, yet offer unique opportunities to study in great detail many aspects of the dolphin's life history.

A number of wild sociable dolphins have been documented worldwide, nearly all *Tursiops truncatus*. These include accounts of 'Opo', a female bottlenose dolphin off New Zealand (Alpers, 1963), bottlenose dolphins, including 'Carolina Snowball', off Florida (Caldwell, 1955; Caldwell and Caldwell, 1972), 'Charlie', a female bottlenose dolphin off Northumberland, England (Gilchrist, 1967; Mundey, 1967), 'Jean-Louis', a female bottlenose dolphin off Brittany, France (Dobbs, 1984), 'Donald'/'Beaky', a male bottlenose dolphin off the west coast of England (Dobbs, 1977; 1981; 1984;

Lockyer, 1978; Lockyer, Flewellen, Madgwick and Morris, 1978; Saunders, 1975), 'Horace', a male bottlenose dolphin off New Zealand (Dobbs, 1981), 'Sandy', a male spinner dolphin off the Bahamas (Dobbs, 1981), 'Pelorus Jack', a male Risso's dolphin off New Zealand (Cowan, 1911; Alpers, 1963), 'Percy', a male bottlenose dolphin off Cornwall, England (Dobbs, 1984; Lockyer and Morris, 1985; in press; Morris, McCartney, Lockyer and Holborn, 1985), and 'Simo', a juvenile male bottlenose dolphin off Pembrokeshire, Wales (personal observation).

In this paper we have documented behavioural observations on the wild, single male *Tursiops truncatus*, known locally as 'Percy', one time resident of north Cornwall, between 1981 and 1984, and demonstrate that new information and data can be gained from observations on such a dolphin.

Observations

1. Species, sex and appearance

'Percy' was identified as a bottlenose dolphin, *Tursiops truncatus*, Montagu. The sex was established as male, initially from close inspection of the form and relative position of the genital slit, and subsequently on exposure of the creamy white penis which was first seen on 12 July 1984 by C. Lockyer. The body was greyish paling to white ventrally, especially in the abdominal, thoracic and lower jaw regions. A number of lateral throat creases were present ventrally, level with the eyes, and a lightly pigmented 'bib and brace' line was evident on the chest, running between throat and flippers.

The dolphin, when measured underwater from nose tip to tail notch in as straight a line possible, was about 4.1 m (13.5 ft) in length (Lockyer and Morris, in press). Girth in the abdominal region was not measured (although attempted) but was substantial relative to the length of the dolphin. The tail region, by comparison, appeared relatively lean and bore a line of discrete dark blotches along both sides.

The skin overall was punctuated with innumerable old and fresh scars, some so recent that skin was hanging loose around some nicks. Diffuse light pigmented patches approximately 2.5–5.0 cm in radius on the leading edge of the dorsal fin (see Fig. 1) appeared to be permanent (being seen many times throughout 1984) and could reasonably be used to aid subsequent indentification should the dolphin move into a different area. In addition there were several parallel tooth rake marks, some of ca 1.0–1.5 cm spacing, others of 2.5–4.0 cm spacing. Some appeared recent, others healed, and all were probably acquired during encounters with other cetaceans in the area. The beak and lower jaw were particularly scarred and pitted, rendering a battered appearance to the dolphin, suggesting old age. Harrison and Ridgway (1971) observed that battered jaws were associated with old age in dolphins from south Florida.

On occasions when the mouth was opened, the teeth were noted to be sound with no obvious losses or damage (see Fig. 2). The teeth tips however, were slightly rounded, suggesting wear characteristics of an older animal. The eyes and blowhole were in

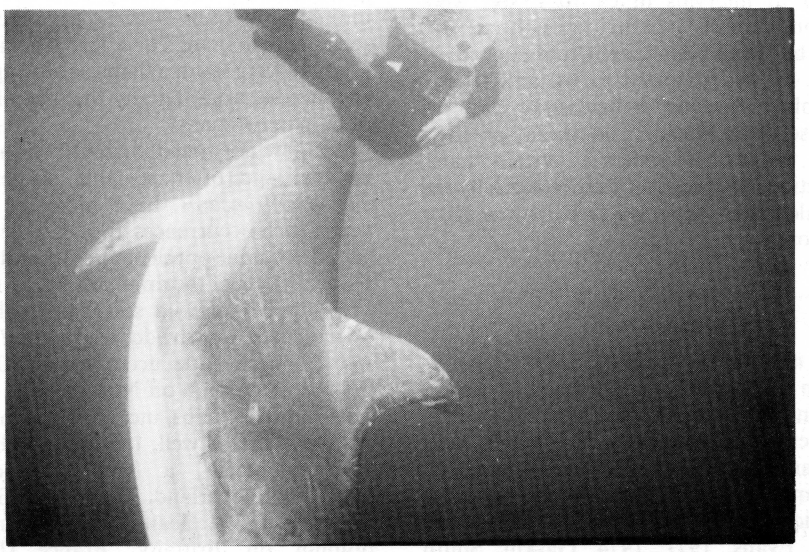

Figure 1. Photographs showing the white patch at the base of the anterior edge of the dorsal fin.

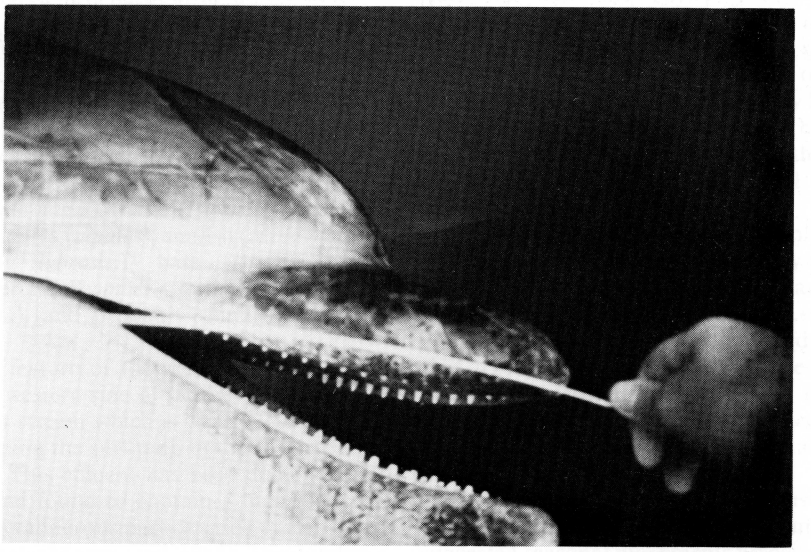

Figure 2. Photograph showing the teeth. Note that the mandibular teeth appear slightly more worn at the tips than the upper ones.

good condition, although small scars were present around the rear of the blowhole. In late August—early September 1983, the dolphin had been observed to have acquired a fish (bass) hook and attached net-line in the right eye (H. Dobbs, pers. comm.). At this time the dolphin was wary of diver contact. Fears of permanent eye damage seemed unfounded when R. Holborn (pers. comm.) observed that the hook and net-line had gone in March 1984, and that the dolphin approached him observing with the right eye. Close photographic inspection by us of both eyes in July 1984, revealed no abnormalities, although what appeared to be two large puncture scars were present over the right eye, so that we assume that any damage sustained was temporary. There were smooth outlines to the flippers, dorsal fin and tail flukes, with no nicks or notches.

From body size, colouration (extent of white around the jaw area), rounded teeth and generally battered appearance, we conclude that the dolphin was an old adult male.

2. Home range and movements

'Percy' was apparently first sighted underwater by local diver-fisherman, John Bishop, on a shipwreck situated between Horse Rock and St Agnes, north Cornwall during January 1981 (see Fig. 3). Between that time and autumn 1984, the dolphin has generally remained (to the best of our knowledge) within a small coastal range extending between north of St Agnes Head (Bawden Rocks) in approximately 50° 20′N, 5° 14′W, and St Ives in approximately 50° 14.5′N, 5° 25′W (Fig. 3). There have been a number of periods when he has not been sighted for periods of up to 7–8 days and during these times he may have undertaken excursions outside that of his normal area of residency. Over the three to four years the movement has been southward, in that the first sightings were off St Agnes, whilst during November 1984 the dolphin moved southward into a hitherto unused area off St Ives, although throughout the entire period, certain sites have been more favoured and have been continually revisited. These include primarily Godrevy Point, Godrevy Island and The Stones, Fishing Cove, Portreath Bay and Gull Rock (Fig. 3). The area around The Stones has been observed to be preferred in autumn and winter (R. Holborn, pers. comm.). The movements between areas such as Gull Rock, Godrevy and The Stones may well be related to feeding activities. Most of the year in 1983 and 1984, the dolphin has been found to return daily to the channel between Godrevy Point and Godrevy Island, at half-time between high and low waters, so that the appearance of the dolphin at mid-tide became fairly predictable daily throughout most of 1984 (R. Holborn, pers. comm.).

The water channel between Godrevy Point and the island is about 3.0–7.6 m (10–25 ft) in depth, dependent on the tide, with a kelp weed and rocky bottom. A 3.7 m (12 ft) high rock stands mid-way across this channel, slightly nearer to the Point. A favourite position for the dolphin is diving in a single spot just seaward of this rock, for periods of an hour or longer at half-tide, when the tidal current in this

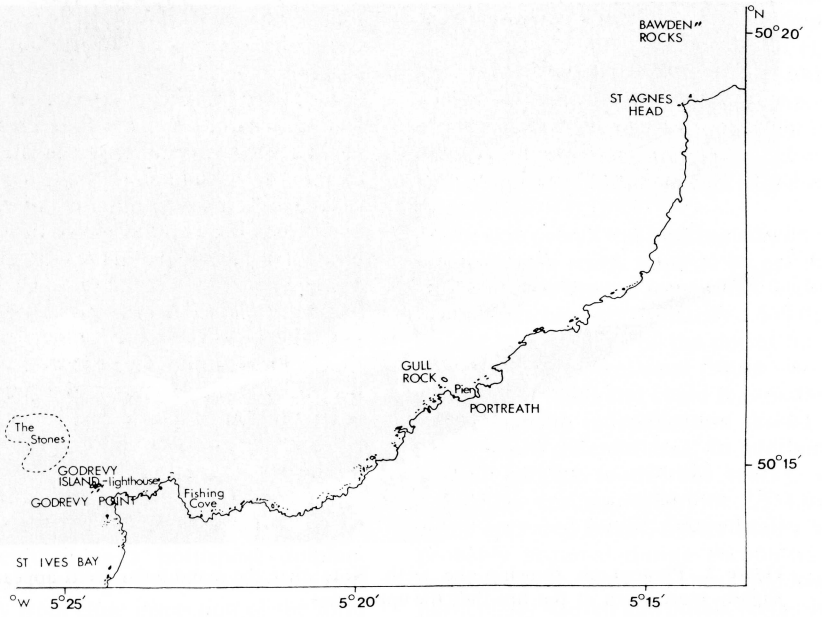

Figure 3. Map of the areas known to be frequented.

channel is strongest. Fishing Cove, east of Godrevy, is frequently sheltered in rough weather, and its attraction may also have been enhanced by the presence of numerous buoy lines to fish pots, which the dolphin frequently examined.

Portreath Bay became a major haunt during the summer of 1984, probably because of the aggregations of bathers, divers and surfers, as well as wind-surf craft present, which clearly were a source of great interest and potential interaction. Another factor may be the seasonal increase in sewage effluent which would attract certain types of fish, for example grey mullet (*Chelon labrosus*).

Gull Rock is a frequent attraction to the dolphin, perhaps partly due to the activities of local fishermen keeping buoyed keep-pots and fishing pots in this area. The dolphin has been known to accompany fishing boats here and frequently to entangle their buoy lines.

The entire stretch of the coast in Fig. 3, is about 24 km (15 ml) and because the dolphin has rarely been sighted beyond about 3–3.5 km (2 ml) distant from the shore, preferring close inshore waters, the actual home range of this resident dolphin is small, perhaps 77 km^2 (30 ml^2). This is remarkably similar to that reported for groups of bottlenose dolphins in the western North Atlantic (Irvine *et al*, 1979), of 85 km^2. Wells, Irvine and Scott (1980) reported a mean home range for adult male bottlenose dolphins as 20.84 km^2 ($\pm$10.53 km^2 S.D.) off Sarasota, Florida during 1975–6. They reported segregation by age and sex within a group of bottlenose dolphins in this area, and found that the size of the home range varied accordingly with the females and calves having the largest ranges. In their studies, male adults generally did not associate regularly with dolphins of different sexual status, and occurred in groups of 5.30 ($\pm$3.77 S.D.). Group size of bottlenose dolphins in the Florida area was calculated to average 2.87 with a range of 1–50 (Odell and Reynolds, 1977); Caldwell and Caldwell (1972) reported average group size off coastal Florida as 12. Clearly group size is very variable, and according to Wells *et al* (1980), may vary seasonally. We conclude therefore that the home range occupied by 'Percy' is typical in size, and that his solitary condition is not necessarily uncharacteristic of the species.

The nature of the coastline around 'Percy's' territory is steep, inaccessible rocky cliffs, with numerous rocky and craggy outcrops extending irregularly out from the shoreline. Most of the shores are steeply shelving or drop off, except notably in Portreath and St Ives Bays, where there is extensive sand. Most of the area is weather-exposed, with heavy swells and surf most of the year. The type of territory occupied by this dolphin has many similarities with the areas chosen by 'Beaky' (documented by Lockyer, 1978; Dobbs, 1977). The common factors appear to be rocky steep coastlines with frequent offshore islands forming channels between the mainland through which strong tidal currents flow.

Occasional sheltered bays harbouring buoys, mooring lines, boat traffic and people appear to be favoured for interactive play.

Other marine wildlife with which the dolphin may have interaction, and documented to occur locally in the area from our own and fishermen's observations, includes grey seals (*Halichoerus grypus*), pilot whales, bottlenose dolphins, sharks such as porbeagle (*Lamna nasus*), mako (*Isurus oxyrinchus*) and thresher (*Alopias vulpinas*), sunfish (*Mola mola*), mullett (*Chelon labrosus*), bass (*Dicentrarchus labrax*), mackerel (*Scomber scombrus*), wrasse (*Labrus bergylta*), and probably small squid and octopus.

One unusual feature of the area around St Ives Bay and at the western side of Godrevy Point, is a tin mine effluent stream which is clearly visible as a red current staining the surf pink in the eastern end of St Ives Bay. This effluent has been documented and analyzed and found to contain a high load of finely divided metalliferous particles rich in iron and other heavy metals (Morris *et al,* 1985). The dolphin has been observed never to dive in the red areas of water and to avoid them except to cross close to the surface *en route* elsewhere. Morris *et al* suggested that the echo-location and/or chemosensory system of the dolphin may be affected by this discharge.

The dolphin was last seen during the winter months of 1984–1985, at infrequent intervals, and finally disappeared from the area for certain by spring 1985. He has not been resighted elsewhere.

3. Basic behaviour

(a) Tidal behaviour

The predominantly tidal rhythmic behaviour of diving within a small area in the Godrevy Point—Island channel has been noted earlier. This activity which lasts for an hour or longer close to mid-water, we personally observed twice on an ebb tide (in May and July 1984) and once on the flood tide (in July 1984). The direction of diving was into the current on these occasions, so that the direction altered through 180° between ebb and flood.

Although no feeding has been observed by anyone during these periods, we would argue that feeding at these times might be productive because the tidal race is strongest and carrying potential food items through the channel. Presumably the dolphin could return to feed four times daily off Godrevy Point on this basis if the behaviour is directly associated with tide. Gaskin (1982) has reviewed data for several Cetacea, which show a strong diurnal component in feeding activities. We cannot make any statement on diurnal feeding behaviour in 'Percy', because there have been very few night-time observations. We observed the dolphin apparently feeding at around 21.00–22.00 hr on 12 July 1984, the period correlated with the half-tide state. Saayman and Tayler (1979), for example, found a strong tidal influence on the feeding activities of the humpback dolphin (*Sousa sp.*), and more especially found strong correlations of movements related to prey aggregations caused by local environmental conditions. They did find however, that feeding periods were longer during the earlier part of the day, suggesting both tidal and diurnal components in the feeding activities.

One possible explanation of the dolphin's preference for a specific spot in the Godrevy channel, close by the underwater rock mentioned earlier, is that if feeding is indeed taking place, this siting fits well with the observations of Norris and Dohl (1980) that—'Prey-capture seems more successful when the predatory cetacean forces the prey fish against a barrier of some kind, such as . . . underwater formations, producing, we suppose, predictable behaviour on the part of the prey'.

We have no information on items eaten. However, movements throughout the summer of 1984 suggested seasonal movements associated with local abundance of mackerel, mullett and bass, whose movements may have been partly related to local fluctuations in sewage outfall from the coast.

Egestion of fish bones, including intact lengths of several cm of fish vertebrae has been reported (R. Holborn, pers. comm.). However, neither these nor other items such as otoliths have been retained for subsequent analysis. A report of regurgitation has also been given in 'Dolphin Link' report of 1 July 1984 (Wharram *et al*).

There have been several reports of defaecation, in whitish (R. Holborn, pers. comm.) and yellowish brown plumes (H. Dobbs, pers. comm.), and one report (Mark and Monica Law, pers. comm.) of possible urination (this incident is discussed in detail later).

(b) Diving and blowing

From the cliffs overlooking Godrevy Island we observed the dolphin apparently feeding on two occasions, in May and July 1984, when a considerable part of his diving behaviour was recorded on video. Both occasions were mid-ebb tide, when the dolphin was seen to be in the position described earlier in the channel. From subsequent analyses of the recorded sequences we obtained logs of diving and blowing times.

Fig. 4 shows the dive/blow sequences recorded during these observation sessions. The duration of these sessions are similar, about half an hour on both occasions during an overall dive sequence of about one hour. However, one session was during a mid-day period, the other at night-fall. As explained earlier, these dive periods are thought to be associated with feeding, and the general features are dive periods of 1–2 min. followed by 2–3 blows at 11–15 sec. intervals. Whilst the average number of

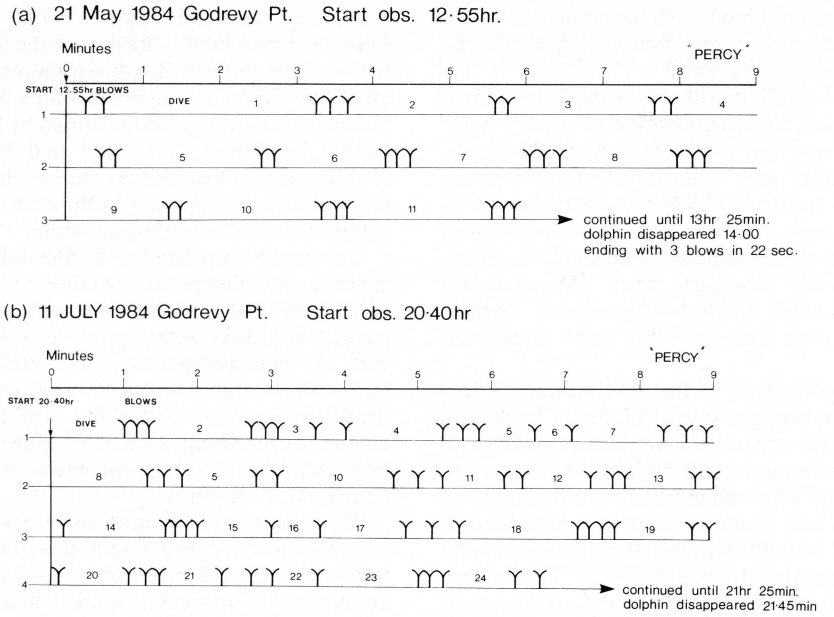

Figure 4. Respiratory and diving sequences observed at Godrevy Point:
(a) 21 May 1984, 12.55 hr;
(b) 11 July 1984, 20.40 hr.

Table 1. Respiratory and diving behaviour in bottlenose dolphin

Period	Dive time (min.) mean ± S.D.	Nos blows between dives mean ± S.D.	Watch period (min.)	Intervals between blows at surface (sec.) mean ± S.D.
1	1′52″ ± 21″	2.6 ± 0.5	24′	11″ ± 2″
2	1′ 1″ ± 18″	2.6 ± 1.0	34′	15″ ± 5″

Notes:
Period 1—see Fig. 5, date = 21 May 1984; daytime; mid-ebb tide; half-moon rising phase;
Period 2—see Fig. 5, date = 11 July 1984; dusk; mid-ebb tide; no-moon phase.

blows between dives remains constant (Table 1), the longer dives (May) are followed by 11 sec. shorter blow intervals, whilst the shorter dives (July) are followed by 15 sec. longer blow intervals. Parry (1978) observed a respiratory rate of 3.6 blows per minute in restrained captive dolphins, with a range from 6–12 sec. up to 39 sec. interval between blows. Parry's findings are similar to our findings, except that the dive periods observed for 'Percy' were considerably longer.

From a comparison of the two dive sequences in Fig. 4, the pattern of diving in July is more irregular. We can only speculate on the reason for this, but if feeding was taking place at these times, differences in the type of prey being hunted and its availability could have necessitated different hunting tactics. In addition in both diving sequences, the diving time in relation to surface time gradually got shorter. This may indicate some tiring on the part of the dolphin.

(c) Object investigation

Most 'foreign' material i.e. not of natural marine origin, or persons in the water were regarded with great inquisitiveness, and investigated at first visually, often by passing close by, or for stationary objects, by circling slowly, more usually clockwise. The initial investigation over, closer passes would be made. Finally the dolphin often would stop directly

in front of the object (ca 30–45 cm) and open his jaws—sometimes a little, sometimes quite wide and nod gently in the vertical plane. The lower jaw tip would then frequently be rested on the object under investigation. The dolphin would presumably gain visually different aspects by continually nodding whilst probably echo-scanning, by focusing alternatively above the rostrum across the front of the melon, and then below the mandible.

It is well known that highly accurate echo-location using a broad band of both low and high frequencies coupled with very sensitive directional hearing has given the odontocetes a sensory system unrivaled in the aquatic ecosystem (Morris, 1985). It is believed by some workers that items situated below the beak cannot be acoustically detected unless the head is moved (Norris, Prescott, Dorian and Perkins, 1961). If this is correct, it may be an explanation for the nodding movements of the dolphin's head.

During close range investigation with open jaws, the object was not touched with the tongue or teeth. Similar behaviour was reported for 'Beaky' by Dobbs (1977) and for the river dolphin, *Platanista indi,* (Purves and Pilleri, 1983). Our conclusion is that a very short range emission, presumably of high frequency, is being used to get detailed structural information, for example texture, internal density changes, anatomy. The far field of the normal echo-locating emission in *T. truncatus* is thought to occur at between 0.5 and 0.6 m (Au, Floyd and Haun, 1978), and Morris (1985) suggested that a close up sonar may well be necessary for target analysis at short range.

The dolphin's habit of resting the tip of the lower jaw on objects may be associated with the use of a close range acoustic system. There are no tactile hairs on this region of the lower jaw which might be used for sensing purposes. Indeed the lower jaw is often used as a weapon, as recorded from the damage inflicted on a marine turtle kept in Duisberg Zoo, Germany, which was attacked by a *T. truncatus* which charged the turtle and penetrated the dorsal carapace with its jaw making two deep circular holes. However, encapsulated nerve endings have been described in both the snout and lower jaw of a number of dolphin species (Jamison, Thurley and Harrison, 1972; Zhou Kaiya and Li Yuemin, 1981), and may have a role in pressure sensing.

The jaw tip and open jaws were used extensively by the dolphin to explore objects, such as floating buoys, and arms, legs and body parts of people, scuba diving equipment worn by swimmers such as knives, flippers and masks, cameras, particularly cine cameras which produce pulsed sound from the motor drive, and anchors, chains, ropes and mooring lines, and boat propellors. This behaviour must contribute to the battered and scarred state of the jaws, although Harrison and Fanning (1974) have suggested that extensive abrasion and induration of the dolphin snout may also be pathological. Below we specifically detail examples of the exploratory behaviour.

In July 1984, whilst close by our inflatable, moored by a blue cauline line, chain and folding fisherman-type anchor in Fishing Cove (Fig. 3), the dolphin stood head down vertically in about 7.5 m (25 ft) of water nosing the anchor, and having loosened its hold, twirled it around by its flukes on the seabed using his beak. Attempts on this occasion to get close to the dolphin by surface snorkel diving were repeatedly headed off by the dolphin turning upwards and rushing with the snout either pushing the swimmer firmly upwards to the sea surface or shooting past close and leaping clear of the water. The rope line was then taken into the angle of the jaw so that as the dolphin moved, the line was drawn across the teeth like oversize dental floss. The line was tugged and the boat dragged about eight times. Boat-towing behaviour was also reported for 'Beaky', the bottlenose dolphin off Cornwall in the late 1970's (Webb, 1978a).

In November 1984, the dolphin repeatedly picked up the anchor of our inflatable from the sea bed and, balancing the anchor stock and chain across his beak, carried the anchor to the surface and thence to the side of the boat. The anchor would then be dropped and the procedure repeated six or seven times.

Noises which appear to evoke a positive behavioural response in the dolphin include drumming on the hull pontoon of an inflatable boat nearby, jangling chains underwater and exhaust bubbles from divers' aqualungs (R. Holborn, pers. comm.). In fact all three attracted the dolphin, the aqualung bubbles over a distance of about two miles in one instance (R. Holborn, pers. comm.). Lockyer (1978) and Lockyer *et al* (1978) reported similar behaviour in 'Beaky', and one possible explanation for the attraction of clanking chains, in that the clanks were very close in sound to the 7 kHz echo-locating 'ping' of the dolphin, was given in Lockyer *et al* (1978). However, we note that initially chains did not attract 'Percy' (R. Holborn, pers. comm.), and it may be that habitual learned association of chain noise and boats is the real attraction for the dolphin. The purring of camera drives and the pulsed noise from engines also attract the dolphin.

However, one type of sound, that of large stones clashed repeatedly together in discrete claps on the water surface were observed to deter the dolphin. On 21 May 1984, R. Morris and R. Holborn stood on the shore at Godrevy Point and clashed stones loudly on the water's edge. The dolphin was diving/feeding in the channel at mid-ebb tide in a single spot about 300 m from the shore at this time. C. Lockyer who was on top of the cliffs overlooking the

area, observed the dolphin to suddenly leave his station and swim away to a position close to the south east corner of Godrevy Island. A few minutes after the stone clashing ceased, the dolphin returned to the former position in the channel, and continued as before. R. Holborn reported that this avoiding reaction to stone clashing was usual in the dolphin.

(d) Underwater vocalization

Up until July 1984 no underwater sounds whatsoever had been heard from the dolphin by any of the individuals who had swum with him. During two extended sessions in the water with him during the autumn one of us (Morris) noted numerous click trains of varying frequency (generally described as purring or creaking) and occasionally other noises (squeaks, mewing) similar to those heard from 'Beaky' (Lockyer *et al*). At no stage however, was the single frequency ping reported for 'Beaky' (Lockyer *et al*) heard from this animal. The sudden use of audible acoustic emissions in mid-summer on the part of the dolphin when in the company of swimmers coincided with a definite change in the animal's behaviour. This latter point will be discussed later.

4. Solitary behaviour—play

Apart from the tidal diving/feeding behaviour off Godrevy Point detailed earlier, many observations have been made both by us personally regarding specific behavioural incidents, and also by others.

On the 21 May 1984, after apparently voluntarily leaving the Godrevy channel area at about 14.00 hr, the dolphin swam eastwards around into Fishing Cove (Fig. 3), whilst observed from the clifftops overlooking the coast. The dolphin spent about one hour in the cove, diving around and beneath a number of yellow surface marker buoys attached to fish lines under the north end of the west cliffs. The buoys were nosed and the lines tugged downwards repeatedly. Occasionally, the dolphin leapt clear over the buoys, and on one occasion back-flipped over them. After a period circling and swimming between the buoys, the dolphin swam eastwards across the cove skimming over surface rocks in the surf (ebb tide), then swam northwards to further rocks and then turned back to the buoys (to complete a triangle). At about 15.00 hr, the dolphin swam out of the cove and returned to the Godrevy area, whence he swam on the seaward side of the island rather than into the channel, and out of view.

We have observed leaping clear (breaching) and skimming over rocks, especially in the surf, sometimes to a height of 2.4 m (8 ft). On the 12 July 1984, after spending about one and a half hours in the water with the dolphin in Fishing Cove, we saw the dolphin leaping clear several times close to our 4.3 m (14 ft) inflatable as we motored (outboard) back to Portreath. On this occasion, the dolphin accompanied us for the entire trip, right into Portreath Bay, a distance of ca 8 km, much of the time either bowriding or slipstreaming alongside or astern. The boat's average speed throughout the trip was approximately 14 km.hr^{-1} (8.6 m.p.h.). When the inflatable cut across inlets, the dolphin left the boat and sped inshore making detours to investigate the area, and to leap in the surf near rocks, clearly preferring the inshore area. As the boat passed close to rock promontories, the dolphin would rejoin us, usually leaping clear just ahead.

Such surfing and breaching just described, is very characteristic of bottlenose dolphins (Leatherwood *et al*, 1982) which appear to favour inshore surf zones.

This leaping behaviour recently (August to September 1984) became a menance to surfers and windsurfers in Portreath and St Ives Bays, because the dolphin would follow, rise beneath and then frequently leap across the leading part of the board, on one occasion hitting and breaking off the front end when re-entering the sea (R. Holborn, pers. comm.). In St Ives Bay, one solitary windsurfer was molested in such a way, and had to be rescued by the RNLI, making national news (BBC radio, 4 November 1984).

Many other incidents involving buoys and fish lines have been reported, and the dolphin appears to associate buoys with particular boats, and we ourselves (and others) have observed the dolphin accompanying certain fishing boats collecting up lines, and moving ahead of the boat to the next float as if in anticipation. In these incidents, the buoys have been red.

One particular incident reported (R. Holborn, pers. comm.), which involved constructive interaction with a person, concerned a number of fish keep pots on the seabed (depth 15 m–ca 50 ft) off Gull Rock. Apparently, the dolphin had wound up the buoy lines to the pots so that the ropes were tangled horizontally about 2.4 m (8 ft) off the seabed. Unable to raise or disentangle the lines, the fisherman concerned sought R. Holborn's assistance as a scuba diver to clear them. Initially, the task looked hopeless without cutting some lines, but the dolphin indicated individual lines in turn with his jaws, which apparently coincided with the reverse order in which the lines had initially been tangled up, so that the lines easily became disentangled without needing to sever any. This incident we consider to demonstrate a high degree of discrimination relating to reverse sequence. Certainly the probability of selecting the correct sequence for disentanglement by chance would be remote. Herman (1980) discusses the relative successes of memory, learning and conceptual processes in dolphins, and notes that of the captive animals (bottlenose dolphins) tested, these were

comparable with those of many terrestrial mammals and some birds. However, the powers of discrimination using visual cues were predictably not as great as those where echo-location was also possible. Despite an interesting review of this subject presented by Herman, containing many parallels with performance in this dolphin, we feel that we cannot draw direct comparisons because in Herman's experimental situation in captivity the options were both limited and controlled largely by a reward system. In the situation we report here, the dolphin helped voluntarily to solve a problem of his own making, which clearly involved memory and visual, perhaps echo-locatory cues, and conceptual processes.

One report (R. Holborn, pers. comm.) was of a surface buoyed fishing net, set across the channel between Godrevy Point and the island at its eastern end. The dolphin, apparently deprived of access to his favourite spot at mid-tide, systematically and successfully set about biting and tearing at the net and eventually managed to separate one of the buoys from the net thus clearing the net from the passage.

Another form of play which almost parallels 'russian roulette' and which has probably resulted in some of the head scars, is the dolphin's tendency to poke his snout up into the stern space around propellors (mobile and stationary) on both inboard and outboard engines (Law, pers. comm). This behaviour has been well documented for 'Beaky' (Dobbs, 1977; Lockyer, 1978; Lockyer *et al*, 1978) who received severe head wounding on one occasion. Body contact with objects became more frequent during 1984, and in the summer period, the dolphin would frequently rub his body along boat hulls, often belly up, also with the head and flanks.

5. Interactive behaviour

(a) Specific interaction with people in boats, divers and swimmers

The dolphin, on his initial appearance in 1981, was somewhat aloof, and apart from curiosity in tasks being performed underwater by divers, did not come close. The intimate approach to people and especially those in the water came later, and whilst the dolphin appeared progressively to associate more readily with boats and people during the first two years, close contact was not made until 1983. By spring 1984, the dolphin was actively seeking bodily contact with people, even those with whom he was unfamiliar. On the first occasion we swam with the dolphin in July 1984, despite an initial period of 10 min. when it appeared that he would come within 0.5 m yet manage to remain just a few cm beyond reaching range, he allowed the whole body to be touched and stroked, while he remained very placid and still. At this time we were able to make close inspection of body marks and scars, and examine the teeth as well as measure the body length.

The pushing up of swimmers and snorkellers to the surface with the snout is widely reported, and has been experienced by ourselves. This is a behavioural characteristic of many cetaceans (Defran and Pryor, 1980; Pryor, 1975). It was also noted for 'Beaky' (Lockyer, 1978). This behaviour seems a variation on the habit of pushing foreign material and objects as well as other dolphins to the sea surface. However, in common with 'Beaky', this dolphin would also pin divers and push swimmers underwater with his beak. This behaviour too is widely reported for this and other species in captivity, where it is interpreted as aggressive (Herman and Tavolga, 1980; Norris, 1967).

The snout was used as a kind of battering ram towards swimmers increasingly during the summer of 1984, reaching a peak in August–September, when what can only be described as aggressive or warning-off behaviour was commonplace. The trigger for such behaviour is unknown, but we give three examples to show its diversity and possible motive.

The first example concerns the instance described earlier, on 12 July 1984 when C. Lockyer (wetsuit-clad and with snorkel gear) experienced being gently but firmly pushed upwards and away by means of the dolphin's beak, from the area where the dolphin was playing with an anchor and chain on the seabed of Fishing Cove. This was interpreted as 'keep away from my toy/play area/territory'.

The second instance took place in August 1984, when R. Holborn motored in his inflatable and outboard engine of Fishing Cove with a new visitor to the area. This person, an older man, although wetsuit-clad, was not a strong swimmer, and was unfamiliar with dolphins. R. Holborn, also wetsuit-clad, spent some time swimming intimately with the dolphin, and then invited the visitor to enter the water. As soon as this happened, the dolphin turned and left R. Holborn, and rushed at the older man with his beak and bit him hard. This kind of attack is well described for captive dolphins (Pryor, 1975; Defran and Pryor, 1980). The motive may have been one of possession—the stranger perhaps being regarded as an intruder, threatening to disrupt play or even remove the playmate.

The third incident, in August 1984, is the most difficult to interpret. Here again, two wetsuit-clad swimmers, R. Holborn and Sue Jago, were involved. The incident took place in Portreath Bay, but in this instance, both swimmers were in the water simultaneously with the dolphin, both were local residents and very familiar with the dolphin, and both were excellent swimmers. After about an hour with the dolphin, the swimmers decided to return inshore, when suddenly the dolphin turned and rushed at Sue, butting first her arm and shoulder, then her

thigh and then her chest with such force that she became winded and subsequently bruised. She succeeded in continuing to the beach, whilst R. Holborn maintained his position and stayed with the dolphin, managing to distract the dolphin's attention away from Sue. This ultimately proved potentially disastrous, in that the dolphin repeatedly tried to push R. Holborn out to sea with his beak, until their position was well outside the bay and beyond the reach of normal swimmers. R. Holborn eventually succeeded in returning inshore after an hour, through guile, by encouraging the dolphin to push him in play, but in an inshore direction. Apparent abduction of swimmers has been reported for 'Beaky', another adult male bottlenose dolphin which was resident off Cornwall in the late 1970's (Webb, 1978b).

We cannot ascertain why one rather than the other swimmer should have been the subject of such forceful aggression—the purpose clearly being to prevent both swimmers from leaving the area. One swimmer was able to escape simply because the dolphin could not stay with both simultaneously if they split up. Perhaps the dolphin was attempting to dominate the group as leader, and in order to maintain this role, attacked the apparently smaller/weaker individual first. Such dominant and aggressive behaviour has widely been reported for both captive and wild dolphins (Herman and Tavolga, 1980; Norris, 1967). Since this incident, many other reports of the dolphin pushing swimmers out to sea have been received.

Other acts of apparent aggression include one occasion during summer 1984, when R. Holborn entered the water from his inflatable and swam over to the dolphin in the Godrevy area. The dolphin circled him clockwise and then forcibly pushed him back to the side of the boat, took his hand in his jaws, bit and drew blood. The dolphin, on this occasion, would not permit R. Holborn to move from the side of the boat. R. Holborn's interpretation was that the dolphin clearly did not want him in the water at this time. The reason is pure speculation, but sharks had been seen in the area shortly before.

A frequent trigger to aggressive butting by the dolphin is over-excitement caused by many swimmers in the water around him. On these occasions, the dolphin appears to rush from one person to another, occasionally lingering with one more than others and subsequently turning aggressive to the others. We personally observed this behaviour in 'Beaky' on several occasions. Such aggression under these circumstances may be fear of intrusion into and over-running of the dolphin's territory, or again may be attempts at domination of the group.

We cannot rule out several interacting factors effecting this behavioural response, and recognize the possibility of complex motives. There have been occasions of completely unsolicited attack (R. Holborn, pers. comm.) when solitary swimmers who were unaware of the dolphin's proximity have been butted for no apparent reason.

One curious incident, which occurred in early October 1984, was reported by Mark and Monica Law who were aboard their boat outside Portreath Bay. Three people in the boat were looking over the side, whilst the fourth (Mark) stood in the stern at the tiller. The dolphin zoomed off about 12 m distance and rushed the boat, turning onto his back, belly up, and when close to the boat, the penis was extruded and directed in such a way that to arch a stream of fluid up and over into the stern of the boat. The observers believe, from the quantity of fluid discharged, that the animal was urinating. We have not seen or heard of such a similar incident anywhere previously. The only comparable incident was observed by C. Lockyer with 'Beaky' in Martin's Haven, Pembrokeshire in 1975. On this occasion, 'Beaky' lay belly up, astern of an inflatable with the head pointing away from the boat. The dolphin lay at the surface with the penis extruded and erect and appeared to ejaculate several feet into the air. This too may have been urination, although the previous activity, unlike the Laws' incident, had been primarily of a sexual nature, rubbing and thrusting the belly and penis on the underside of the inflatable. Should these incidents represent urination, they are of a most unusual form (Klinowska, pers. comm.).

During 1984, the attitude of the dolphin became more inquisitive and friendly than ever before, until July through October, the character of the dolphin progressively and dramatically altered, aggressive butting and biting occurring frequently, and more active exposure of the penis. Initially, the penis appeared to be used directionally for tactile contact, but very rapidly the purpose became explicitly sexual, the erections being accompanied by thrusting movements directed at swimmers. We believe that the penis was certainly used in a sensory tactile manner on some occasions, and histological studies of surface innervation of the genital area (Greenwood, Harrison and Whitting, 1974) suggest this facility. During mating, the use of the penis for tactile sensing is however likely to be a necessary operation prior to penetration, since dolphins mate belly to belly with no other sensory capacity available to the male for locating the female's genital area. The triggering of the combination of sexual and aggressive behaviours in the dolphin is unclear. By early November however, when one of us (Morris) spent several hours in the water with him on two consecutive days, the dolphin showed the placid, gentle behaviour which had been so characteristic of him in the spring and early summer.

The wild bottlenose dolphin is known to have a

peak of sexual activity in spring and fall (Leatherwood *et al*, 1982) and M. Klinowska (pers. comm.) has observed a peak in spring and a secondary peak in fall in captive bottlenose dolphins. Harrison and Ridgway (1971) observed peak testosterone levels in the blood plasma of captive *T. truncatus* in spring and fall.

Because 'Percy' appears solitary, possible female triggering stimuli are absent. Careful questioning revealed that no swimmers or divers bore pale or white-fronted suits, which could be broadly interpreted as the preliminary sexual invitation (Caldwell and Caldwell, 1972; 1977).

Several factors however, independent of hormonal influence, may have contributed to the sudden sexual confrontations which by the end of summer were almost continuous, to the extent of assault on anyone entering the water with the dolphin.

First, during the period end of July through September 1984, the coastal area became daily more crowded by holidaymakers, newspaper reporters and film crews, all actively seeking the dolphin whose presence had by now been widely broadcast. A situation where the dolphin was almost constantly surrounded by people may have caused the animal to become highly unstable temperamentally. By the end of this period the dolphin had abandoned the regular mid-tidal diving/feeding periods off Godrevy, and his diurnal movements became geared to the distribution of people in the area.

Second, the dolphin experienced several persistent encounters, throughout 30 June to 13 August 1984, with various persons aboard sailing crafts (J. Wharram *et al*, 1984). From 18 July onwards, certain of the crew members (sometimes wetsuit-clad, sometimes naked) behaved freely during encounters with the dolphin, displaying various levels of human sexual intimacy. At these times, the dolphin attempted to intervene, and subsequently demonstrated sexual arousal with erect penis, pelvic thrusting and belly to belly contact with swimmers of both sex (Wharram *et al*, 1984; R. Holborn, pers. comm.). Especial interest was shown in the female swimmers' genital area which was nosed frequently ('Dolphin Link' report, 19 July).

Third, the dolphin can clearly distinguish visually between male and female swimmers when naked, and apparently also when wetsuit-clad, from the apparent preference for investigating the female groin area. Obviously such discrimination is easily possible by use of his acoustic sensory faculty whether swimmers are naked or otherwise but it is possible that certain chemosensory cues may assist this discrimination, and that body exudates may even act as stimuli. Such possibilities are reviewed by Herman and Tavolga (1980), and although chemosensory and gustatory powers are still poorly evaluated, certain structural characteristics of the tongue in *T. truncatus* have revealed that buds are present on the floor of small cavities in the root of the tongue, and that the structure and position of these buds resemble those of the taste buds of other mammals (Suchowskaja, 1972). Kuznetsov (1978), quoted in Bullock and Gurevich (1979), found responses to certain genital exudates. The most obvious exudates would be associated with the female's reproductive cycle—menstruation and ovulation. However, we are perplexed as to the apparent sudden interest in the sex of swimmers which the dolphin seemed to display during the summer. Clearly he was more than capable of discriminating between the sexes from his first contacts, but perhaps no significance was attached to the sex differences on the dolphin's part until he witnessed human sexual displays.

It is clear that during this period of time, the dolphin was exposed to new stimuli of many kinds in relation to people, and as a being with a learning capacity at least equivalent to that of many terrestrial mammals (Defran and Pryor, 1980), we may assume that some learning processes have been activated. However, despite interesting coincidental timing of these three factors and the apparent character change in the dolphin, we cannot conclude that any one or all are necessarily correlated.

We would comment that such apparently indiscriminate sexual behaviour, frequently accompanied by aggressiveness is quite normal in captive bottlenose dolphins and other cetaceans (Pryor, 1975; Defran and Pryor, 1980; Caldwell and Caldwell, 1977), and were commonplace for 'Beaky' (Lockyer, 1978). The indiscriminate nature of this dolphin's sexual behaviour during the summer may be best demonstrated by the following incident which was viewed by the entire crew of a fishing vessel from St Ives. He is reported to have attempted to insert his erect penis into a 5 cm diameter hosepipe which was hanging over the side of the vessel—no water was flowing through the pipe at the time. At least five separate approaches were made with this apparent intent (W. Benney, pers. commn).

(b) Interactions with other animals

Direct observations

Few actual observations of interactions with other creatures have been made. On four separate occasions in early August 1984, several sunfish were seen in the waters around the Portreath–Godrevy area. On the first occasion, R. Holborn was motoring in his inflatable past Godrevy heading for Portreath. He saw a sunfish at the sea surface and turned his boat back to examine the fish. When he attempted to lift it out, it swam down out of sight. The dolphin also turned and dove, following the fish, and seconds later reappeared pushing the sunfish (about

75–90 cm in body depth) out of the water balanced momentarily on his beak before it toppled off. This was repeated several times. On another three occasions, the dolphin did a repeat performance, but with bigger fish, although R. Holborn was not looking for sunfish at the time. This behaviour seems to be an elaboration of the 'pushing up out of the water' behaviour so well documented for bottlenose dolphins (Caldwell and Caldwell, 1972), and in these instances may have been a form of play.

Indirect observations

Neither we nor others have seen any interaction between 'Percy' and either seals or cetaceans. The assumption has always been that this dolphin is entirely solitary, and for this reason might be considered to be aberrant, eccentric, or an old animal which has been rejected by his group.

However, close visual inspection, assisted by photography, of the body marks and scars on the dolphin over a period between July and November 1984 revealed a number of apparent tooth rake marks (Lockyer and Morris, 1985). Teeth rakes of five broadly spaced lines, about 2.5–4.0 cm apart, and too widely spaced for *Tursiops sp.*, we concluded may have resulted from an encounter with a larger odontocete species such as pilot whales (known to be in the area—reports from M. Law and Wharram *et al.* pers. comm.), or killer whales (*Orcinus orca*), judging from the rake spacing (Lockyer, 1979). Other tooth rake marks, at spacings of about 1.0–1.5 cm, are most likely to have been made by a conspecific which have not infrequently been sighted in groups of up to three in the area (R. Holborn, pers. comm.).

Photographs examined in September 1984 showed clearly that the broad tooth rake marks were barely visible. Photographs taken in November 1984 revealed that all the marks discussed above could barely be discerned if at all. Harrison and Thurley (1984) and Brown, Geraci, Hicks and St Aubin (1983) demonstrated that the basal germinative cells of the bottlenosed dolphin dermis proliferated very rapidly at a rate several times that of terrestrial mammals, giving rise to a thick epidermis. The fact that melanocytes in the basal layer of dermis give rise to columns of pigmented cells immediately above (Harrison and Thurley, 1974) explains the discrete pale scars which frequently appear from old deep wounds. Bruce-Allen and Geraci (1985) reported that in wounds where the melanocytes were not actually damaged, the healed skin was less pigmented than normal, although they considered that most minor scars would recover their pigmentation with time. The eventual disappearance or near disappearance of many tooth rakes on the skin probably reflects the frequently superficial damage inflicted by tooth rakes. Rake scars which persist may represent the product of aggressive biting, where deep rakes were inflicted.

Fresh *Tursiops*—like tooth rake scars were found on the dorsal flank, running parallel to the long body axis, in photographs taken by us in November 1984, indicating further recent contact with other dolphins. These scars appeared after a 10-day absence from the usual haunts in late October-early November. At the end of the period, the dolphin reappeared in St Ives Bay, an area known to have been visited only once previously.

We are certain that these scars are evidence of cetacean tooth rakings (Lockyer and Morris, 1985) and that their presence indicates recurrent social encounters with other dolphins in the area, so that 'Percy' cannot be regarded as truly solitary. Indications of contact with other animals, possibly in a feeding context, from skin marks, have been discussed in detail by Lockyer and Morris (1985), and include possible encounters with otters, and feeding on deep-sea squid.

Conclusions

Much of the data relating to dolphins and other small whales has largely come from work in restricted environments such as artificial tanks or enclosures in shallow sea inlets. Very much less work on wild dolphins has been carried out for obvious practical reasons. In this present paper we have attempted to show that a careful study of a resident, wild dolphin can produce new information on behaviour and habits.

In particular, we have been able to demonstrate a home range of size comparable with that observed for bottlenose dolphins in waters around Florida. The area of occupancy which appears constant over a long period of years, is relatively small, but this fact, and the nature of the coastal topography may yield information which could be useful for maintaining and improving holding areas for *Tursiops truncatus* in captivity. The diving habits, swimming patterns and local movements appear to be influenced by tide and season, probably indirectly, because these factors affect prey distribution.

The dive duration can be extended to over 2.5 min., a period not often reported in captivity, with little effect on blow rate. The body scars, monitored regularly, seem to us to be a potential source of information on movements and contact with other animals.

In addition, by a careful record keeping by local observers, annecdotal information given by reliable people and regular watches kept by ourselves, we are able to build up a fairly complete record of the dolphin's daily, seasonal and yearly habits.

We make the final point that it is clear that interactions with any wild dolphin (or any wild animal)

are potentially hazardous and unpredictable in outcome, and that persons seeking contact with wild animals should responsibly argue their motives for such contacts, keeping the animal's ultimate welfare a priority. Unfavourable incidents arising from such encounters cannot subsequently be blamed on the animal.

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