Swimming in the Po River: inferences about biology, adaptation, and conservation of the Adriatic Common bottlenose dolphin (*Tursiops truncatus*)

VALERIO MANFRINI
Centro Studi Cetacei Onlus, Via M. Mantini, 15 - 65125 Pescara (PE), Italia, E-mail: valemanfro@gmail.com

VALERIA ANGELINI
Fondazione Cetacea Onlus, Via Torino, 7/A - 47838, Riccione (RN), Italia

MARCO AFFRONTE
Freelance Naturalist and scientific communicator, Rimini (RN), Italia

Abstract

A large number of marine cetaceans, both Mysticeti and Odontoceti, have been recorded in many places around the world, using rivers and even spending some time in shallow, freshwater habitats. One of these cases occurred in 2004 in which a Common bottlenose dolphin (*Tursiops truncatus*) was sighted in the Po, the longest river in Italy. The dolphin swam along the river up to 15 kilometers (8 miles) from the mouth and spent four days in these waters. This is the first recorded sighting of this species, more generally of a cetacean, in an Italian river. For this reason, it represents an important contribution to the body of knowledge surrounding the biology and adaptation characteristics of this species.

Keywords: Common bottlenose dolphin, river, mouth, shallow waters.

Riassunto

Nuotare nel fiume Po: implicazioni relative a biologia, adattamento e conservazione del tursiope (Tursiops truncatus) adriatico
Molte specie marine di cetacei, sia misticeti sia odontoceti, sono state osservate in molti luoghi nel mondo risalire fiumi e trascorrere del tempo in habitat di acqua dolce e in acque poco profonde. Rientra tra questi casi, un evento verificatosi nel 2004 in cui un tursiope (*Tursiops truncatus*) fu avvistato nel Po, il fiume più lungo d'Italia. L'esemplare nuotò nel fiume fino a 15 chilometri dalla foce e trascorse quattro giorni in queste acque. Si tratta del primo avvistamento registrato di questa specie, più in generale di un cetaceo, in un fiume italiano e per questo rappresenta un importante contributo alle conoscenze relative alle caratteristiche biologiche e alle capacità di adattamento di questa specie.

Parole chiave: tursiope, fiume, foce, acque poco profonde.

Introduction

In 2004, a Common bottlenose dolphin (*Tursiops truncatus*) was observed in the Po River for four days, and then disappeared (Fig. 1). The Po is the longest river in Italy. It descends from the Monte Monviso on the western Italian border and flows 652 kilometers (km) until it reaches the Adriatic Sea in the east. Its drainage basin covers 70,091 square km, forming the largest and most fertile plain in Italy. Its delta is among the most complex of any European river with at least 14 mouths arranged in six groups (from north to south): the Po of Levante, Po of Maestra, Po of Pila, Po of Tolle, Po of Goro, and Po of Gnocca (Fig. 2).

Common bottlenose dolphin (CBD) is the most common cetacean species globally, and the only cetacean species regularly observed in the Adriatic Sea (Notarbartolo di Sciara *et al.*, 1993; Bearzi & Notarbartolo di Sciara, 1995; Bearzi *et al.*, 2008; Cagnolaro *et al.*, 2015). Accounts of CBDs have been reported from many corners of the Adriatic basin, although reliable systematic data were limited to a few research studies (Fortuna *et al.*, 2011). In terms of distribution, this species prefers the neritic province (< 200 m) to the oceanic one with a higher prevalence for areas with depths < 100 m. The Adriatic CBD reveals a fine-scale genetic structure showing differentiation between north and central-south sub-basins (mtDNA), as well as between the western and eastern coasts

(nuclear DNA) (Gaspari *et al.*, 2013). It seems appropriate to address the conservation issues of the CBD in the Adriatic Sea at the 'sub-regional' if not the 'local' population level, rather than focusing on the entire basin. Potential threats should be evaluated accordingly.

Description

On April 21st, a CBD live-stranded in the shallow waters of the Goro lagoon near Gorino Port, within the borders of the Regional Park of the Po River Delta in the Northern Adriatic Sea (Fig. 2). Local fishermen called the Harbour-Office of Goro (FE) who, in turn, called the rescue team. The rescue team's observations on site were as follows: 1) the dolphin was approximately 2.7 meters long; 2) did not look underweight; 3) did not have any apparent major or minor injuries; 4) did not display any superficial scratches or abrasions. The conclusion was that the animal seemed stable and in good health. Identification information of the CBD was registered, and the ID 2004.04TtPG01 was assigned, where Tt is *Tursiops truncatus* and PG is Po of Goro.

CBDs are observed swimming in the Goro lagoon without problems, although its waters are not deep (0.5 m to 1.5 m). To avoid further stranding events and to set better monitoring conditions, the dolphin was moved into the deeper waters of a naval basin (3 m x 2 m x 2 m of depth) close to the stranding site. A naval basin is human-made structure designed to overcome the water level differences along the rivers or canals. In this case, the naval basin was between the Goro lagoon and Po River (4 m to 6 m of depth). In the basin, the CBD was able to swim and dive, however, the limited amount of space proved to be stressful. For this reason, the dolphin was let out in the river, where it was monitored from a boat without interfering with its natural behavior. Breathing rates (BRs) were taken in the first quarter of each hour from 11.00 AM to 5.00 PM, according to Mortola and Limoges (2006). The mean duration for each dive was about 50 seconds while the BRs were 11, over 6 hrs time. Unfortunately, the dolphin swam upstream far from the Adriatic Sea (Fig. 2, site 1). Thanks to the help of the Goro's Harbour personnel, the dolphin was conducted from a distance towards the Adriatic Sea using an additional boat, one on each side of the animal. The effort was successful because the dolphin left the river and was monitored for about 2 km swimming downstream.

On April 22nd, the same CBD swam up the Po River up to 15 km (8 miles) from the mouth. It was sighted near Cà Vendramin (RO) (Fig. 2, site 2) by the Naval Police of Porto Tolle (RO) and identified by the rescue team via photo-ID as 2004.04TtPG01, confirming it as the same CBD that had live-stranded and been released the previous day. The dolphin was monitored using binoculars from a small Police boat at a distance of 40 m. It was breathing normally and was alternating long dives (about 3 minutes) to shorter ones, probably correlated to hunting (Bearzi *et al.*, 1999; Mortola & Limoges, 2006; Serres & Delfour, 2019). Indeed, the dolphin was seen coming out with specimens of Wels catfish (*Silurus glanis*) between its teeth. The rescue team followed the dolphin from 1.00 to 6.00 PM and followed it downstream with two Police boats, one on each side of the animal. It was left approximately 100 m from the Adriatic Sea due to limited fuel.

The next morning, the rescue team sighted the same dolphin swimming up the Po River again. It was observed swimming upstream to a floating boat bridge (a singular bridge supported by small boats acting as bridge pillars that connect two shores of the river) about 9 km from the Adriatic Sea. The dolphin settled in the area surrounding the bridge until the evening. On the morning of April 24th, it was sighted for the last time close to the boat bridge (Fig. 2, site 3).

On the evening of May 3rd, the Harbour-Office of Goro received a call reporting the sighting of a floating dead dolphin near the above-mentioned bridge. The recovery of the carcass was scheduled for the following morning but was prevented by a flood tide that carried away the carcass overnight. Unfortunately, it was unable to confirm if it was the carcass of 2004.04TtPG01.

Discussion

There were no specific guidelines for handling this kind of event in the big rivers, and the rescue team involved had to follow reasonable, safe, and feasible procedures. However, CBD populations do inhabit the coasts by the Po delta, near the Goro location, and instances of dolphins swimming in Italian shallow waters have been previously described (Azzali, 1993; Bortolotto, 1996; Pari personal communication). This particular event represents a starting point to discuss what procedures should be taken in the future.

There are reports of *T. truncatus* sighted about 6 miles (approximately 11 km) upstream the lower Bojana/Buna River, along the east coast of the Adriatic Sea. However, this event is recognized as dolphin inshore habitat linked to the delta river characteristics. The observations were always of groups of dolphins (not a solo dolphin) and in summer periods, when the water level is particularly low, linked to the minor level of human disturbances in the specific location (Sackl *et al.*, 2014). There were no relevant natural events or unusual human activities occurring during or in the previous days of the first dolphin stranding in the Goro lagoon or during the period of its sightings in the Po, nor was the end of April of 2004 a noteworthy period for the Po waters (level or fish abundance). After this event in 2004, no other dolphin has ventured so far into the Po River. Whatever the reason that pushed the dolphin upriver, the dolphin was able to adjust to the river environment, but not to the point of making it a long-term stable home. CBD are noteworthy for their ability to cope with environmental changes. They can survive in the most chemically polluted waters, thanks to reservoir ability of their blubber (Yordy *et al.*, 2010; Ellisor *et al.*, 2013; Romanić *et al.*, 2014; Mancia *et al.*, 2014). They show great plasticity and survive changes in temperature and salinity (Yeates & Houser, 2008; Ridgway & Venn-Watson, 2010). But there is probably a limit to the way dolphins can cope with changes, and this limit is most

likely linked to their overall health. Infections, disease, stress, immunosuppression could push this limit.

The Po River collects the discharges of the most populated and industrialized area of Northern Italy and enters the Adriatic Sea and the Po delta waters suffer from pollution from heavy metals, organic micro-pollutants, and nutrient loads high enough to cause a severe marine eutrophication problem south of its delta. An analysis of samples from the top 10 cm of sediment along four stretches of the Po River, revealed the presence of a wide range of endocrine-disrupters, including flame retardants, and polybrominated diphenyl ether, personal care products, fragrances galaxolide, and tonalide, hormones (natural and synthetic estrogens), surfactants, a plastic components and legacy pollutants (DDT and PCBs) (Vigano' *et al.*, 2015). The level of most of the endocrine-disrupting chemicals in the river sediments and fish were so high that researchers have recommended that fish from some sections of the Po River should not be eaten (Vigano' *et al.*, 2015). Moreover, a study published in 2005, showed how both cocaine and its main metabolite benzoylecgonine, are present, and measurable, in surface waters of populated areas of the Po River (Zuccato *et al.*, 2005) and there is evidence that even low environmental concentrations of cocaine cause severe damage to the morphology and physiology of the skeletal muscle of the European eel (*Anguilla anguilla*) (Capaldo *et al.*, 2018), confirming the harmful impact of cocaine on the survival of the species inhabiting the Po River.

Common bottlenose dolphins do not venture up the Po River for many reasons, including shallow depths, turbidity, human activity, pollution and salinity. 2004.04TtPG01 did travel upriver, but did so after stranding, it could have been disoriented or its decision-making ability may have been impaired, or its echolocation ability could have been off for some reason. Or maybe this particular animal had a mutation in the CYP27C1 gene, a cytochrome p450 family member that in some vertebrate species have evolved to extend visual sensitivity to long-wavelength light, enabling them to live in murky, red-shifted, aquatic environments (Enright *et al.*, 2015), like the Po River.

We can only speculate at this point; it is impossible to understand the behavior of that one animal without a proper necropsy or any kind of tissue samples. But what we should learn from this event is that there are known variables characterizing specific estuarine environment that need to be taken into account. Better knowledge and insight on dolphin abilities to cope with a particular environment can shed some light on their ability to adapt to the changes that are occurring in the Po River, and will, in turn, impact the coastal resident populations near the Po delta.

Estuarine use is common with CBDs. Further, knowledge is critical to assess their capacity to adapt to a quickly changing environment as a result of anthropogenic activities such as development and industrialization along these estuarine habitats.

Acknowledgements

We want to thank the personnel of the Harbour-Office of Goro (FE) and Naval Police of Porto Tolle (RO), local fishermen, and volunteers for their help during the rescue procedures. We also thank Dr. Annalaura Mancia (University of Ferrara) for her critical revision of the manuscript and important suggestions, and Matthew Denny (Independent researcher, FL, USA) for his support and revision of the manuscript.

Fig. 1. The dolphin was identified as 2004.04TtPG01. The photo was taken on the Po of Goro, between Goro and Goro Ferrarese places. The background shows the typical environment that characterizes this area, where stretches of brackish water are interrupted by rises in the land or divided by embankments and ancient sandbars. Photo by Valerio Manfrini (Canon EOS 20D digital camera, fitted with a 300 mm f/5.6 Tamron lens).

Fig. 2. Map of the Po River Delta in the North of Italy. The Po of Goro, where occurred the event, is the light blue line, while the dark blue line shows the dolphin route upriver. Triangles mark the stranding (site 1. April 21st) and sightings (site 2. April 22nd; site 3. April 23rd) locations.

References

Azzali M., 1993 - Storie di delfini: Baby Garibaldi un messaggero da un altro mondo (Dolphin tales: Baby Garibaldi a messenger from another world). In: R. Varani (Editor). Cetacea Informa, II 4. Lithos Arti Grafiche, Villa Verrucchio, Italy, pp. 11-12.

Bearzi G., Azzellino A., Politi E., Costa M. & Bastianini M., 2008 - Influence of seasonal forcing on habitat use by bottlenose dolphins *Tursiops truncatus* in the northern Adriatic Sea. *Ocean Sci J.* 2008; 43(4): 175-182.

Bearzi G. & Notarbartolo di Sciara G., 1995 - A comparison of the present occurrence of bottlenose dolphins, *Tursiops truncatus*, and common dolphins, *Delphinus delphis*, in the Kvarneric (northern Adriatic Sea). *Ann Ser Hist Nat.* 1995; 7: 61-68.

Bearzi G., Politi E. & Notarbartolo di Sciara G., 1999 - Diurnal behavior of free-ranging bottlenose dolphins in the Kvarneric (Northern Adriatic Sea). *Mar Mam Sci.* 1999; 15(4): 1065-1097.

Bortolotto A., 1996 - Intervento di recupero su un esemplare di Tursiope, *Tursiops truncatus* (Montagu, 1821) (Rescue of Common bottlenose dolphin *Tursiops truncatus* (Montagu, 1821) specimen). In: R. Varani (Editor). Cetacea Informa, V 9. Lithos Arti Grafiche, Villa Verrucchio, Italy, pp. 36-37).

Cagnolaro L., Cozzi B., Notarbartolo di Sciara G. & Podestà M., 2015 - Fauna d'Italia, Mammalia IV Cetacea. Ed. Agricole di New Business Media S.r.l., 375 pp.

Capaldo A., Gay F. & Laforgia V., 2019 - Changes in the gills of the European eel (*Anguilla anguilla*) after chronic exposure to environmental cocaine concentration. *Ecotoxicol Environ Saf.* 2019 Mar; 169:112-119.

Ellisor D., McLellan W., Koopman H., Schwacke L., McFee W. & Kucklick J., 2013 - The distribution and stratification of persistent organic pollutants and fatty acids in bottlenose dolphin (*Tursiops truncatus*) blubber. *Sci Total Environ.* 2013 Oct 1; 463-464:581-8.

Enright J.M., Toomey M.B., Sato S.Y., et al., 2015 - Cyp27c1 Red-Shifts the Spectral Sensitivity of Photoreceptors by Converting Vitamin A1 into A2. *Curr Biol.* 2015; 25(23):3048-3057.

Fortuna C.M., Holcer D., Filidei Jr E., Donovan G.P. & Tunesi L., 2010 - The first cetacean aerial survey in the Adriatic Sea: summer 2010. In: 7th Meeting of the ACCOBAMS Scientific committee, 2011, p. 16.

Gaspari S., Holcer D., Mackelworth P., Fortuna C.M., Frantzis A., Genov T., Vighi M., Natali C., Rako N., Banchi E., Chelazzi G. & Ciofi C., 2015 - Population genetic structure of common bottlenose dolphins (*Tursiops truncatus*) in the Adriatic Sea and contiguous regions: Implications for international conservation. *Aquatic Conserv.* 2015; 25:212-222.

Mancia A., Ryan J.C., Van Dolah F.M., Kucklick J.R., Rowles T.K., Wells R.S., Rosel P.E., Hohn A.A. & Schwacke L.H., 2014 - Machine learning approaches to investigate the impact of PCBs on the transcriptome of the common bottlenose dolphin (*Tursiops truncatus*). *Mar Environ Res.* 2014 Sep; 100:57-67.

Mortola J.P. & Limoges M., 2006 - Resting breathing frequency in aquatic mammals: A comparative analysis with terrestrial species. *Resp Physiol Neurob.* 2006; 154: 500-514.

Notarbartolo di Sciara G., Venturino M.C., Zanardelli M., Bearzi G., Borsani F.J. & Cavalloni B., 1993 - Cetaceans in the Central Mediterranean Sea - distribution and sighting frequencies. *Bollettino di zoologia.* 1993; 60(1): 131-138.

Pari S., 2013 - Personal communication. Fondazione Cetacea Onlus, Riccione (RN), Italy.

Romanić S.H., Holcer D., Lazar B., Klinčić D., Mackelworth P. & Fortuna C.M., 2014 - Organochlorine contaminants in tissues of common bottlenose dolphins *Tursiops truncatus* from the northeastern part of the Adriatic Sea. *Environ Toxicol Pharmacol.* 2014 Sep; 38(2):469-79.

Ridgway S. & Venn-Watson S., 2010 - Effects of fresh and seawater ingestion on osmoregulation in Atlantic bottlenose dolphins (*Tursiops truncatus*). *J. Comp. Physiol. B.* 2010 Apr; 180(4):563-76.

Sackl P., Smole J., Saveljic D. & Stumberger B., 2014 - Inland observations of Common Bottlenose Dolphins *Tursiops truncatus* (Montagu, 1821) in the delta of the Bojana/Buna River, Albania and Montenegro. *Annales Ser hist nat.* 2014; 17. 191 - 194.

Viganò L., Mascolo G., & Roscioli C., 2015 - Emerging and priority contaminants with endocrine active potentials in sediments and fish from the River Po (Italy). *Environ Sci Pollut Res Int.* 2015 Sep; 22(18):14050-66.

Yeates L.C. & Houser D.S., 2008 - Thermal tolerance in bottlenose dolphins (*Tursiops truncatus*). *J. Exp. Biol.* 2008 Oct; 211(Pt 20):3249-57.

Yordy J.E., Pabst D.A., McLellan W.A., Wells R.S., Rowles T.K. & Kucklick J.R., 2010 - Tissue-specific distribution and whole-body burden estimates of persistent organic pollutants in the bottlenose dolphin (*Tursiops truncatus*). *Environ Toxicol Chem*. 2010 Jun; 29(6):1263-73.

Zuccato E., Chiabrando C., Castiglioni S., Calamari D., Bagnati R., Schiarea S. & Fanelli R., 2005 - Cocaine in surface waters: a new evidence-based tool to monitor community drug abuse. *Environ Health.* 2005 Aug 5; 4:14.