Indeterminate status of West African populations of inshore common bottlenose dolphins *Tursiops truncatus* cautions against opportunistic live-capture schemes

KOEN VAN WAEREBEEK[1,2], IDRISSA L. BAMY [3], AZZA MINT JIDDOU [4], MARINA SEQUEIRA [5], MIKA DIOP [6], P.K. OFORI-DANSON [7], SÉVÉRIN TCHIBOZO [8] AND PIERRE CAMPREDON[9]

[1] Conservation & Research of West African Aquatic Mammals, COREWAM-Sénégal, Musée de la Mer-Gorée, Institut Fondamental d'Afrique Noire (IFAN), Université CAD, BP 206, Dakar, Senegal
corewam.senegal@yahoo.co.nz
[2] Scientific Counsellor, Federal Public Service Public Health, Food Chain Security and Environment, Multilateral and Strategic Affairs, Eurostation building (DG5), Place Victor Horta 40, box 10, Room 02C368, B-1060 Brussels, Belgium
[3] Centre National des Sciences Halieutiques de Boussoura (CNSHB), BP-3738 Boussoura, Conakry, Guinea
[4] Coordinatrice, Cellule Etude et Suivi des Mammifères Marins, Directeur adjoint, Institut Mauritanien de Recherche Océanographique et de Pêches (IMROP), BP 22, Nouadhibou, Mauritania
[5] Instituto da Conservação da Natureza e da Biodiversidade, Rua de Santa Marta, 55, 1150-294 Lisboa, Portugal
[6] Secrétariat Permanent de la Commission Sous-Régionale des Pêches (CSRP), SICAP, AMITIE 3. Villa 4430, BP 25 485, Dakar, Senegal
[7] Coordinator, Environmental Science Programme, University of Ghana, P.O. Box LG 71, Legon, Ghana
[8] Centre de Recherche pour la Gestion de la Biodiversité et du Terroir (CERGET), 04 B.p. 0385 Cotonou, Benin
[9] União Internacional para a Conservação da Natureza (UICN), CP 23, Bissau, Guinea-Bissau

Abstract
The limited information available on the status of inshore common bottlenose dolphins *Tursiops truncatus* along the coasts of West Africa is reviewed. Although reported from at least ten countries, it is unclear whether their distribution is continuous. Population structure and genetics have not been studied, however cranial morphology suggests that the West African dolphins differ from North Sea bottlenose dolphins. Mean group sizes are small (3.19 – 12.91 individuals/group) and are smallest in Guinea-Bissau. There are no estimates of abundance but by analogy with a well-studied population in Sarasota, Gulf of Mexico, the Guinea-Bissau population may number only in the hundreds. It is essential that scientific estimates be obtained through dedicated surveys. In some areas of Guinea-Bissau with a high density of fishing activities, bottlenose dolphins are now less frequently encountered than they were in the recent past. Key parameters besides abundance, including population identity, bycatch levels and other anthropogenic threats need to be documented and quantified before any deliberate exploitation is considered. A small-scale, botched live-capture operation in Senegal in 2003, in which all dolphins died, serves as warning against such opportunistic schemes. In management terms, live-capture operations are equivalent to hunting and multi-year, large-scale removals of bottlenose dolphins in Guinea-Bissau would have the potential to effectively extirpate the wild population from its waters.

Resumo
A pouca informação disponível sobre o estatuto de conservação dos roazes *Tursiops truncatus* costeiros ao longo da costa Ocidental de África é revista. Apesar de estar presente em pelo menos dez países, a continuidade geográfica da sua distribuição não é clara. A estrutura populacional é desconhecida, e a genética da espécie não foi estudada; no entanto, a morfologia do crânio sugere a existência de diferenças relativamente aos roazes do Mar do Norte. O tamanho médio dos grupos é reduzido (3.19 – 12.91 indivíduos / grupo) sendo ainda mais baixo na Guiné-Bissau. Não existem estimativas de abundância, mas por analogia com uma população bem estudada em Sarasota, Golfo do México, a população da Guiné-Bissau pode contar com apenas poucas centenas de animais. É no entanto fundamental que se obtenham estimativas populacionais credíveis, através da realização de censos. Em algumas áreas da Guiné-Bissau onde se registam elevadas densidades de actividades pesqueiras, os roazes são avistados com frequências cada vez mais reduzidas. Para além da abundância, identidade populacional, índices de capturas acidentais e outras ameaças antropogénicas, é necessário igualmente determinar e quantificar outros parâmetros-chave desta população, antes de se poder considerar qualquer tipo de exploração. Uma operação de captura de roazes em pequena escala, mal organizada, levada a cabo no Senegal em 2003 e na qual morreram todos os animais, constitui um sério aviso contra as capturas oportunísticas. Em termos de gestão de populações, as operações de captura de animais vivos são equivalentes à caça, e uma operação em larga escala com uma duração de vários anos na Guiné-Bissau poderá, potencialmente, erradicar a população selvagem de roazes das suas águas.

Résumé
L'information disponible sur le statut des grands dauphins côtiers *Tursiops truncatus* le long des côtes de l'Afrique de l'Ouest est passé en revue. Bien que signalés dans au moins dix pays, il n'est pas claire si leur distribution est continue. La structure des populations et leur génétique n'ont pas été étudiées. Leur morphologie crânienne semble présenter des différences par rapport à celle des grands dauphins de la mer du Nord. La taille moyenne de chaque groupe est petite (3,19 - 12,91 individus/ groupe) et la plus basse est enregistrée en Guinée-Bissau. Leur abondance est inconnue, mais par analogie avec la population bien étudiée de Sarasota, Golfe du Mexique, la population de la Guinée-Bissau peut se situer dans des centaines. Il est essentiel que des estimations scientifiques soient obtenues par le biais de prospections. Dans certaines régions de la Guinée-Bissau où la densité des activités de pêche est élevée, les grands dauphins sont désormais moins fréquemment rencontrés qu'avant. Il faudrait documenter et quantifier les principaux paramètres, outre l'abondance, y compris l'identité des populations, les niveaux de prises accessoires et autres menaces d'origine humaine, avant qu'aucune exploitation dirigée ne soit envisagée. Une opération à petite échelle mais très néfaste qui a eu lieu au Sénégal en 2003 et où tous les dauphins sont morts, devrait servir de mise en garde contre les captures opportunistes. En termes de gestion, les opérations de captures d'animaux vivants sont équivalent à la chasse. L'exploitation de plusieures années et à grande échelle des grands dauphins côtiers en Guinée-Bissau a le potentiel d'éliminer pratiquement la population sauvage de ses eaux.

Introduction

A large, growing and increasingly opportunistic trade in dolphins and small toothed whales has shifted its centres of supplies away from North America, Japan, and Iceland to the Russian Federation and developing nations in Latin America, the Caribbean, West Africa, and Southeast Asia. Rigorous assessment of source populations is often lacking, and in some instances live captures are adding to the pressure on stocks already at risk from hunting, fishery bycatch, habitat degradation, and other factors (*e.g.* Reeves and Mead, 1999; Fisher and Reeves, 2005; Reeves *et al.*, 2003; Van Waerebeek *et al*., 2003, 2006).

In December 2007, the IUCN Bissau office informed about two trader companies, one foreign and another domestic, that had requested permission from government agencies of the Republic of Guinea-Bissau to exploit (live-capture) common bottlenose dolphins *Tursiops truncatus* in national waters. Reportedly, the trader companies are seeking a catch quota of 30-40 animals *per annum* for up to 15 years (i.e. 450-600 animals), which if carried out could severely deplete, if not extirpate, the inshore bottlenose dolphin population in Guinea-Bissau's waters. The alleged aims are to include captive breeding, tourism, and export. However, in view of important challenges related to breeding programmes of small cetaceans (see below) and Guinea-Bissau's incipient tourism industry[1] the only realistic purpose may be the export of wild-caught dolphins. At any rate the issue merits international attention, the more so because exploitation may at least partly occur in the Bijagós Biosphere Reserve[2] designated in 1996 by UNESCO. The permit applicants reportedly have expressed interest in captures also of other, unspecified, aquatic mammals, but probably including the (vulnerable) West African manatee *Trichechus senegalensis*.

Unregulated live-capture fisheries for small cetaceans can contribute to the depletion of wild populations (Fisher and Reeves, 2005; Reeves *et al.*, 2003) and considerable management-oriented research is required prior to exploitation to assure sustainability (Scott, 1990). Sustainability constitutes a key parameter in several international biological resource agreements to which Guinea-Bissau is Party.

Here we briefly review the conservation status of inshore bottlenose dolphins in West Africa and why it would be incautious to permit their direct exploitation without substantial assessment work beforehand.

Methods

Coastal West Africa is here defined as the shallow, neritic waters (200m or less) above the continental shelf, plus the continental slope area adjacent to the shelf break, stretching from the Strait of Gibraltar southeast to eastern Nigeria (the UN-defined eastern boundary of West Africa). Our rationale is that in the study area these waters are the only habitat of the inshore form of the common bottlenose dolphin *Tursiops truncatus* (Montagu, 1821), further referred to as 'bottlenose dolphins'.

Animal welfare issues, although certainly relevant in cetacean live-capture contexts, are considered here only in management terms, *i.e*. to the extent that the quality of husbandry has an impact on survivorship. Significant differences in survivorship exist between facilities that exhibit live cetaceans (DeMaster and Drevenak, 1988; Reeves and Mead, 1999) which may largely translate as variance in approach to animal welfare.

Distribution

One of the earliest reports of *T. truncatus* in West Africa goes back to bycatches and strandings on Senegal's central coast (Cadenat, 1947, 1949). Although bottlenose dolphins are widely distributed in the study area, it is unknown whether their distribution is continuous and they do not seem to be abundant anywhere. In the Strait of Gibraltar, an indeterminate

[1] The main attractions for foreign ecotourists to Guinea-Bissau are its varied free-ranging wildlife, as opposed to captive animals.
[2] http://www.unesco.org/mabdb/br/brdir/directory

ecotype is reported to prefer continental slope waters of between 250-500m deep (Hashmi, 1990)[3]. *T. truncatus* is the cetacean most often encountered in Morocco, although group size is rarely greater than 10 individuals (Dollfus, 1968; Bayed and Beaubrun, 1987). Notarbartolo-di-Sciara (1998) reported 21 photo-identified individuals from Dakhla Bay, Western Sahara. In Mauritania *T. truncatus* is perhaps best known from a symbiotic association with Imraguen fishermen on the Banc d'Arguin (Busnel, 1973; Robineau, 1995) and their presence is relatively well-documented (Altenburg *et al.*, 1982; Maigret, 1980, 1981; Robineau and Vély, 1998; Van Waerebeek and Jiddou, 2006). Authenticated records are available for most of Senegal's coast (*e.g.* Cadenat, 1947, 1959; Dupuy and Maigret, 1976, 1980; Robineau and Vély, 1997; Van Waerebeek *et al.*, 2000, 2003). Resident or semi-resident communities occupy the Gambia River estuary and the lower Casamance Delta, mainly around Ile de Carabane, thanks to a strong tidal salt-water influx. In the Gambia River, bottlenose dolphins move upstream as high as Mansa Konko (Van Waerebeek *et al.*, 2000; Jallow *et al.*, 2005).

In Guinea-Bissau the species was reported mainly from the Canal do Gêba and less from more shallow areas of the Bijagós Archipelago (Spaans, 1990; Van Waerebeek *et al*., 2000). More recently, both *T. truncatus* and *S. teuszii* have been sighted in at least five of the eight rias (estuaries) and in the main channels of the Bijagós Islands. *T. truncatus* tends to concentrate at the mouth of the rias (P. Campredon, pers. observations) where water depth is greater. The species is further documented from Guinea (Bamy *et al.*, 2006), Ivory Coast (Cadenat and Lassarat, 1959), Benin (Van Waerebeek, 2003; Tchibozo and Van Waerebeek, 2007 [4]) and Ghana (Ofori-Danson and Odei, 1997; Van Waerebeek and Ofori-Danson, 1999; Debrah, 2000; Ofori-Danson *et al.*, 2003).

Stock identification

In the temperate North Atlantic, distinct inshore (also named 'coastal') and offshore forms of common bottlenose dolphin exist, often referred to as ecotypes or morphotypes, each with diagnostic morphological, genetic and ecological characteristics. The inshore ecotype is now thought to be so genetically and morphologically distinct from the offshore form as to deserve specific status, although species names have not yet been assigned. The two forms are characterized by important reproductive isolation despite a parapatric distribution (*e.g.* Mead and Potter, 1995; LeDuc and Curry, 1997; Hoelzel *et al.*, 1998; Reeves *et al.*, 2003; Natoli *et al.*, 2004; Sanino *et al.*, 2005; Charlton *et al.*, 2006). Irrespective of the ultimate assignation of taxon level, consensus exists that inshore and offshore forms require separate management strategies.

Fig. 1. Population structure of *T. truncatus* remains largely unstudied in West Africa. Inshore bottlenose dolphins in Mauritania, as shown here (Banc d'Arguin, 10 November 2006), have a noticeably longer rostrum than these from some European waters, which is measurable also in skulls (Photo K. Van Waerebeek).

Except for a preliminary craniometric study (Robineau and Vély, 1997), population structure of *T. truncatus* in West African waters has not been investigated, nor is anything known about genetic variation. Robineau and Vély (1997) suggested a longer rostrum and a narrower neurocranium in skulls from Senegal and Mauritania than in those from the southern North Sea. The long rostrum in Mauritanian individuals is evident even from free-ranging animals (Figure 1). Body size, up to 360cm (Robineau and Vély, 1997), is also large, especially compared with bottlenose dolphins from the western tropical Atlantic (see Hersh *et al.*, 1990).

Reported sightings in West Africa combine neritic habitat with small group sizes (<40 animals), pointing to inshore stocks (Van Waerebeek *et al.*, 2000, 2003). Five bottlenose dolphins were captured 10-16 nautical miles south of Vridi (05°14.5'N, 04°02.3'W), Ivory Coast, in 1957-1958. Cadenat and Lassarat (1959) add that the species has only been seen a certain distance from shore (10-20 nmiles) in small groups. From a nautical chart, these positions are still on the continental shelf. Jefferson *et al.* (1997) suggested that *T. truncatus* may occur in some oceanic waters off West Africa, but it's not clear what the evidence is. Skulls from Senegal have large, wide teeth, which are indicative for inshore populations in some other areas (*e.g.* Van Waerebeek *et al*., 1990), but a detailed morphological study is awaited.

Inshore common bottlenose dolphins are notable in forming small, highly discrete reproductive groups with fine scale population structure and little genetic exchange among them, although distribution along coastlines often may seem continuous (*e.g.* Reeves *et al*., 2003; Natoli *et al.*, 2004; Sanino *et al.*, 2005; Charlton *et al.*, 2006).

Abundance and status

J. Cadenat affirmed in 1949 that *T. truncatus* is the most common cetacean species in Senegal, 'at least it is the most frequently observed'. No scientific abundance estimates are available for any part of West Africa (see Van Waerebeek *et al.*, 2000, 2003), only a few estimates of minimum numbers in some known home ranges. In Dakhla Bay, Western Sahara, 6 of 21 identified individuals were seen in two different sightings 'suggesting that the Dakhla Bay bottlenose dolphin

[3] Hashmi, D.K. 1990. Habitat selection of cetaceans in the Strait of Gibraltar. *In*: P.G.H. Evans, A. Aguilar, C. Smeenk (eds.). *European Research on Cetaceans* 4: 40 (Abstract).

[4] Tchibozo, S. and Van Waerebeek, K. 2007. La baleine à bosse et le lamantin d'Afrique, des potentielles ressources de tourisme de la nature au Bénin. Poster presented to UNEP/CMS WATCH, Western African Talks on Cetaceans and their habitats. Adeje, Tenerife, 16-20 October 2007.

community is rather small' (Notarbartolo di Sciara *et al.*, 1998). A dolphin-watch operator who kept daily notes for several years on 'the five identifiable groups in the Gambia River' recognized individuals from scars and behaviour and suggested a total of about 120 animals (Van Waerebeek *et al.*, 2000). A resident or semi-resident community, probably of a few dozen dolphins, inhabits the lower Casamance river, Senegal (Van Waerebeek *et al.*, 2000). Indications are that the bottlenose dolphin community in the marine protected area of the Banc d'Arguin, Mauritania, is one of the best conserved in West Africa. Eleven groups for a total of 142 animals, of which many photo-identified, were encountered during a three-day coastal survey of the shallow waters of the Banc d'Arguin, in November 2006 (Van Waerebeek and Jiddou, 2006).

A wildlife trading company based in Guinea-Bissau which for years has been advertising via the internet on-request captures of bottlenose dolphin, for export, claims [5] an absurdly high and unsupported number of 'about 10,000 in Guinea-Bissau'. To provide a rough, but more realistic, idea at what order of magnitude abundance may be expected, a comparison can be made with the well-studied Sarasota Bay community of inshore bottlenose dolphins in western Florida (Scott *et al.*, 1990). The Sarasota home range of *ca.* 100 bottlenose dolphins encompasses a 40-km stretch of coastline including a system of bays, protected by a series of barrier islands, and the waters of the Gulf of Mexico up to about 1km offshore of the islands (Scott *et al.*, 1990). For Guinea-Bissau's 240km coastline of comparable topography, six times the Sarasota home range, a predictable total population might range in the hundreds, not thousands. However, a scientific estimate should be obtained through dedicated boat surveys and 'mark-recapture' photo-identification techniques (Eberhardt *et al.*, 1979; Hammond *et al.*, 1990; Wells and Scott, 1990). Ominously, in some areas of Guinea-Bissau where they used to be common in the recent past, bottlenose dolphins are now less frequently encountered, notably in areas with high densities of fish nets (P. Campredon, pers. observations).

West African populations have not been evaluated by the Convention on the Conservation of Migratory Species of Wild Animals (CMS), largely for lack of data. The 1994 IUCN Red List of Threatened Species listed *T. truncatus* as 'Data Deficient'. In the European Union, the species earned special protected status under Annex II of the EU Habitats Directive. CITES placed *T. truncatus* on its Appendix II, recognizing that the species may be threatened by trade [6]. Although opinions vary, non-detriment findings should logically apply only to the exploited population or Evolutionary Significant Unit (Ryder, 1986). Because if an ESU, indicative of past restriction of gene flow and far-reaching reproductive isolation, is extirpated, it likely means in practice the permanent loss of a species in a country or a region.

Guinea-Bissau acceded to the CITES convention on 16 May 1990, ratified it on 14 August 1990 and became a CMS Party in September 1995. An electronic query (d.d. 24 Dec 2007) with the CITES Trade Database held by the UNEP World Conservation Monitoring Centre[7] returned no entries for exports of *T. truncatus* from Guinea-Bissau to any CITES member nation since 1975. However, an unknown number may have been captured and exported irregularly and remained unreported.

Fig. 2. Two common bottlenose dolphins captured in a semi-industrial purse-seine net and landed in Jamestown, Ghana, in 1994, to be utilised for food. This form of exploitation, although illegal in many countries, is widespread in West Africa but rarely monitored. Mortality is thought to be significant in several areas (Photo P.K. Ofori-Danson).

Incidental and directed takes

Cadenat (1947) first reported frequent freshly caught bottlenose dolphins and skulls in fishermen's huts from Senegal's Petite Côte. Bycatches in shark gillnets and seine nets have been documented with some frequency, for many decades, in Senegal and The Gambia (Cadenat, 1947, 1959; Cadenat *et al.*, 1959; Dupuy and Maigret, 1978; Murphy *et al.*, 1997; Van Waerebeek *et al.*, 2000, 2003). During the CMS/WAFCET-2 project, remains of 6-8 bottlenose dolphins were found near fisheries communities in the Saloum and Casamance Deltas and Djinack Island (Van Waerebeek *et al.*, 2003). Most were known, or suspected, to have died in fisheries interactions.

Dolphins from bycatches, direct catches or strandings are locally consumed as 'marine bushmeat' (Clapham and Van Waerebeek, 2007) in many coastal areas of West Africa. The practice ranges from occasional to frequent, although a few ethnic groups reject it. Multiple or single documented cases exist for Mauritania (P. Campredon, unpublished data), Senegal, The Gambia (reviewed in Van Waerebeek *et al.*, 2000, 2003), Guinea (Bamy *et al.*, 2006), Ivory Coast (Cadenat and Lassarat, 1959), Ghana (Van Waerebeek and Ofori-Danson, 1999; Debrah, 2000; Ofori-Danson *et al.*, 2003), Gabon (Van Waerebeek and De Smet, 1996) and Cape Verde (Van Waerebeek *et al.*, 2008) but no national or region-wide statistics are published. In Ghana, *T. truncatus* was the third most frequently landed cetacean in 1998-2000 and constituted 15.5% of

[5] River Zoo Farm (see www.riverzoofarm.com/dolphins.htm)

[6] CITES Article IV: "An export permit shall only be granted when, in addition to other conditions, a Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species".

[7] http://www.unep-wcmc.org/citestrade/index.cfm

cetacean bycatches (Figure 2), all destined for local consumption (Ofori-Danson *et al*., 2003). No documented information is available for Guinea-Bissau, however considering similar artisanal fisheries, bycatch levels are expected to be comparable to these in neighbouring countries, and some limited hunting may also occur.

Reported live-captures

In 1951, an indeterminate number of bottlenose dolphins were captured alive 3-4 miles off the coast at Gunjur (13°11'N, 16°46'W), The Gambia, for unknown purposes. All died within a short period and the complete skeletons of six specimens are curated in the US National Museum of Natural History (Murphy *et al.*, 1997).

Another live-capture operation occurred in Senegal in May 2003, reportedly with a permit issued by the Ministry of Fisheries (J. Goepp and B. Melis, pers. communications to KVW). Five inshore bottlenose dolphins were taken off Casamance by Spanish nationals and were transported by road in a freezer truck to rudimentary facilities in the Parc National du Siné-Saloum (Van Waerebeek *et al.*, 2002; this paper). The five dolphins were kept in a small, naked concrete swimming pool (Figure 3). Four animals died within a short period, while the fifth, a male calf, was released into a creek of the Saloum after the foreigners were arrested for not counting with any permit to operate in the Siné-Saloum National Park. Reportedly the calf was found dead later. Dolphins that died were hastily buried, effectively eliminating evidence (Figure 4). Locally contracted fishermen claimed that a fairly large group of dolphins had been captured initially and while most were released, they said that several dolphins died during the botched capture operation (J. Goepp and B. Melis, pers. communications to KVW).

A few years ago, a large commercial captive facilities scheme was proposed in The Gambia that would have taken bottlenose dolphins from the Gambia River estuary. The Gambian authorities denied permission, partly thanks to sound negative advice from the Gambia's Department of Parks and Wildlife Management.

Fig. 3. Small, concrete swimming pool in which live-captured bottlenose dolphins were held in Senegal's Saloum region, in May 2003. Four of five animals died while housed in this pool (Photo by Jean Goepp).

Unknown numbers may have been exported from Guinea-Bissau in the past. An international wildlife trader operating from Guinea-Bissau, has advertised capture expeditions for bottlenose dolphins for years, claiming that 'Guinea-Bissau has an annual export quote [sic] of 20 *Tursiops truncatus* only, however we also work with other export countries too' [6]. In 2004 the intention for the capture and export of a large number of bottlenose dolphins from Guinea-Bissau was revealed (Fisher and Reeves, 2005; KVW, unpublished data) but the outcome was unclear.

Group size

In Morocco, group size rarely exceeds 10 individuals (Bayed and Beaubrun, 1987). In the Marine Protected Area of the Banc d'Arguin, Mauritania, groups ranged 2-36 individuals (mean, 12.91 individuals/group) (Van Waerebeek and Jiddou, 2006), similar as in The Gambia (means, 10.1 and 12.41 ind./group). Spaans (1990) documented sightings of bottlenose dolphins in neritic waters of Guinea-Bissau and found groups of 1-25 animals, with however a low mean of 4.07 ind./group in 1986-87. Later surveys confirmed small group sizes in Guinea-Bissau, in 1992 (mean, 3.19 ind./group) and 1995-98 (mean, 4.60 ind./group), the lowest reported values for West Africa. Group size parameters and sources are summarized in Table 1.

In the eastern tropical Pacific (ETP), one difference between coastal and offshore groups is that the latter are sometimes composed of hundreds or thousands of individuals, despite similar median group sizes, i.e. 10-12 animals (Scott and Chivers, 1990). However, a coastal definition of 'within the 1,000m isobath', being ecologically broad, may besides inshore-forms include also some offshore-form groups. The authors are unaware of any published information on offshore bottlenose dolphins off West Africa.

Movements and seasonality

The Gambia River estuary is characterized by a strong tidal regime, and the movements of bottlenose dolphins are tidally synchronized. In the Saloum delta, during the rainy season (July-September), when high salinity drops and shrimps are abundant, *T. truncatus* is reported as far inland as the salt creeks near Foundiougne (Van Waerebeek *et al.*, 2000). Maigret (1980) reports also Atlantic humpback dolphins *Sousa teuszii* from Foundiougne (14°08'N, 16°28'W). Authenticated records will be needed to clarify whether both or a single dolphin species occur. Seasonality in the Saloum Delta seems opposite of that in the upper Gambia River where bottlenose dolphins are reported to penetrate farther upstream in the dry season, possibly in pursuit of marine fishes present due to stronger sea water intrusion However, at the estuary bottlenose dolphins are present year-round.

In international border areas, home ranges of inshore bottlenose dolphin communities may straddle neighbouring nations which would make them 'migratory' under the CMS Convention. For example, Senegal (Saloum Delta) and The Gambia may share the Gambia Estuary community and Senegal and Guinea-Bissau may share the Casamance Delta community.

Survivorship

Schemes for live-captures and captive display should discuss survivorship projections in some detail, as mortality may occur at several stages. For instance, during net-capture expeditions, dolphins may asphyxiate following accidental entanglement underwater; internal or external traumatic injuries may be inflicted and calves can become permanently separated from lactating mothers. A percentage of dolphins refuse to learn to feed on dead fish or generally fail to acclimatize in captivity, and should be released. Sustained stress from capture, unfamiliar surroundings and ruptured social structures may negatively impact ability to cope and lead to increased morbidity. After acclimatization, while long-term annual survival rates (ASR) for *T. truncatus* in oceanariums with high-quality husbandry may parallel these found in the wild (*e.g*. 0.93 in US oceanariums, DeMaster and Drevenak, 1988, *versus* 0.96 in Sarasota Bay, Wells and Scott, 1990), in many lesser-equipped facilities or those with inexperienced personnel, ASR may be unacceptably low.

Fig. 4. Bottlenose dolphins that died following a failed live-capture operation in Casamance, Senegal, in May 2003, were buried. Pictured here is a large male. (Photo by Jean Goepp).

Although there have been many improvements (see Duffield *et al*., 2000), there still exist major challenges to captive breeding of small cetaceans. For instnace, a large-scale breeding programme causes the ASR to decrease because of stillbirths or calves that die from birth-related complications (DeMaster and Drevenak, 1988). Small and DeMaster (1995a) excluded perinatal mortality during an 'acclimation period', arbitrarily set at three days and later extended to a 60day period (Small and DeMaster, 1995b), but recognizing this as a period of high mortality. However, if high perinatal mortality is at least partially the consequence of a substandard captive environment, it would be appropriate to account for it in ASR estimation. It seems essential that if ASR is used as a performance estimator of a captive breeding scheme, it should evaluate both perinatal mortality and non-calf mortality, and if these are high, the rationale for the facility's operation should be reviewed.

As Odell and Robeck (2002) indicate, successful captive breeding of any marine mammal requires more than just holding the animals in a pool. Besides sexually mature males and females, adequate housing and nutrition, it requires also consideration of the animals' social needs. Dolphins show strong social ties within a group and these bonds can be maintained for life. Therefore it seems prudent not to change the social structure by either removing or introducing more conspecifics (Odell and Robeck, 2002). In other words, a temporary pre-export holding pool of recently captured animals would not fit the requirements of a successful breeding scheme.

While advanced reproductive technologies have been tested for some time in bottlenose dolphins (*e.g.* Robeck *et al.*, 1994; Odell and Robeck, 2002), with the help of detailed information on endocrinological events related to ovulation, artificial insemination was successfully developed only in the past few years (Robeck *et al*., 2005). It should be emphasized that it requires highly sophisticated equipment and analysis capabilities, and top-level expertise.

Conclusions

Already in 1984, the International Whaling Commission in a review of live-capture operations concluded that certain stocks of five cetacean species, including bottlenose dolphin, were of particular concern (IWC, 1984). Since inshore bottlenose dolphins are easily accessible for capture expeditions with seine-nets, the live-capture industry typically exploits such populations. For the same reason, inshore stocks are also more vulnerable to hunting, bycatch and habitat degradation than offshore stocks, while total abundances are significantly lower (Curry and Smith, 1997; Fisher and Reeves, 2005; Van Waerebeek *et al.*, 2006). With improved understanding of global *Tursiops* phylogenetics, more and unexpected stock structure is found in inshore waters, which adds to the argument for greater caution.

As demonstrated, published information on the biology and conservation status of inshore *T. truncatus* in West Africa is very limited. However, all indications are of low numbers in several areas and unassessed levels of fisheries-related mortality. In Guinea-Bissau, the low mean group size compared to other areas in West Africa, as well as indications of a reduction in encounter rates in some heavily fished areas, require further study.

Fisher and Reeves (2005) pointed out that non-detriment findings must be based on reliable, recent (and ideally peer-reviewed) survey data, and take into account biological factors, the life history stage, and reproductive potential of the specimens to be traded, the level of domestic use for subsistence and commercial purposes, the extent of illegal trade, and the effects of other known or likely threats. None of this has been met in Guinea-Bissau. Also, there is a risk that the actually implemented husbandry and captive-breeding infrastructure will not live up to the standards of original proposals and claims. As in the Solomon Islands (Ross *et al.* 2003), temporary holding areas (*e.g.* sea pens) may become semi-permanent and projected tourist facilities may never be built, if the only genuine role of facilities consists of acclimatization to captivity and short-term holding of dolphins between capture and air-lifting to overseas export markets.

Boat survey design will require experienced observers and 'closing mode' operation for species

confirmation. Inshore bottlenose dolphins and Atlantic humpback dolphins have repeatedly been confused, apparently due to great similarities in body size, indistinct colouration, group size and sympatric occurrence (Van Waerebeek *et al.*, 2003). Aerial surveys would be unreliable (or at least problematic, requiring substantial training and experience on the part of observers) because the dorsal perspective would make the main distinctive feature, the dorsal hump in *S. teuszii*, difficult to ascertain, especially from the altitude required for safe flight.

High rates of inter-populational if not interspecific captive cross-breeding, infections with alien pathogens (*e.g.* morbillivirus, poxvirus) and vast costs associated with re-introduction efforts demystify the oft-cited claim that dolphinaria are important repositories for conservation purposes (see also Reeves and Mead, 1999). No re-introductions of cetaceans have ever supported a conservation strategy, and none are likely to do so in the foreseeable future.

As a general principle, wild cetaceans should not be captured until their specific population has been assessed and it has been determined that proposed removals will not reduce the population's long-term viability or compromise its role in the ecosystem. Importantly, delineation of stock boundaries and assessment of abundance, reproductive potential, mortality and trends cannot be achieved quickly or inexpensively, and the results should be reviewed by an independent group of scientists before any captures are made (Reeves *et al.*, 2003; Fisher and Reeves, 2005). In biological terms, live-captures are equivalent to lethal removals, with captured individuals no longer available for recruitment. Live-capture schemes must be dealt with as strictly as hunting, as the net result for the wild population is the same.

ACKNOWLEDGEMENTS

Mr. J. Goepp (Océanium) and Mrs. B. Melis (IUCN) are thanked for sharing unpublished data and photographs documenting the May 2003 dolphin captures in Senegal. Dr. R.L. Brownell Jr. and Dr. Randy Reeves are thanked for critical comments on an earlier drafts and for providing papers. Dr. M-F Van Bressem edited the French résumé. Dr. Van Waerebeek gratefully acknowledges support from the Fondation Internationale du Banc d'Arguin for the preparation of this document. The authors thank also the Secrétariat Permanent de la Commission Sous-Régionale des Pêches (CSRP), Dakar, for hosting two related meetings.

REFERENCES

Altenburg, W., Engelmoer, M., Mes, R. and Piersma, T. 1982. Wintering waders on the Banc d'Arguin, Mauritania. Report of the Netherlands Ornithological Mauritanian Expedition 1980. Communication No. 6 of the Wadden Sea Working Group (unpublished).

Bamy, I.L., Van Waerebeek, K., Bah, S.S., Dia, M., Kaba, B., Keita, N., Konate, S. and Tall, H. 2006. The cetaceans of Guinea, a first check-list of documented species. SC/58/O15, 58th Annual Meeting of International Whaling Commission, St Kitts, May-June 2006. 7pp.

Bayed, A. and Beaubrun, P.C. 1987. Les mammifères marins du Maroc: inventaire préliminaire. *Mammalia* 54: 162-164.

Busnel, R.G. 1973. Symbiotic relationship between man and dolphins. *Trans. New York Academy of Science*, Sér. 11, 35(2): 112-131.

Cadenat, J. 1947. Observations de Cétacés au Sénégal. *Notes Africaines* 34: 20-34.

Cadenat, J. 1949. Notes sur les Cétacés observés sur les côtes du Sénégal de 1941 à 1948. *Bulletin de l'IFAN* 11: 1-15.

Cadenat, J. 1959. Notes sur les Delphinidés ouest-africains IV. Le gros dauphin gris (*Tursiops truncatus*) est-il capable de faire des plongées profondes? *Bulletin de l' IFAN* 21A (3): 1137-1141.

Cadenat, J. and Lassarat, A. 1959. Note complémentaire. *Bulletin de l'IFAN* 21 (A1): 416-417.

Cadenat, J., Doutré, M. et Paraiso, F. 1959. Notes sur les Delphinidés ouest-Africains. III. *Tursiops truncatus* (Montagu). *Bulletin de l'IFAN* 21 (A1): 410-415.

Charlton, K., Taylor, A.C. and McKechnie, S.W. 2006. A note on divergent mtDNA lineages of bottlenose dolphins from coastal waters of southern Australia. *Journal of Cetacean Research and Management* 8(2) : 173-179.

Clapham, P. and Van Waerebeek, K. 2007. Bushmeat, the sum of the parts. *Molecular Ecology* 16: 2607-2609.

Debrah, J.S. 2000. Taxonomy, exploitation and conservation of dolphins in the marine waters of Ghana. Master of Philosophy thesis, Department of Oceanography and Fisheries, University of Ghana. 86pp. (unpublished).

DeMaster, D.P. and Drevenak, J.K. 1988. Survivorship patterns in three species of captive cetaceans. *Marine Mammal Science* 4: 297-311.

Dollfus, R.P. 1968. Nématodes de cétacés odontocètes (*Globicéphalus* et *Tursiops*) récolté au large de la côte méditerranéenne du Maroc par Henry Aloncle. *Bulletin de l'Institut des Pêches Maritimes du Maroc* 16 : 35-54.

Duffield, D.A., Shell, E.D. and Dudley, M. 2000. Demographic analysis of breeding bottlenose dolphins in North American zoological facilities: 1976-1998. Pp. 139-155 *in* (eds.) D. Duffield and T.R. Robeck. The Bottlenose Dolphin Breeding Workshop. Silver Springs, MD, USA: AZA Marine Mammal Taxon Advisory Group.

Dupuy, A.R. and J. Maigret. 1976. Les Mammifères marins des côtes du Sénégal. 1. Bilan des observations signalés entre 1960 et 1976. *Bulletin de l'IFAN* 38A (4): 921-928.

Dupuy, A.R. and Maigret, J. 1978. Les Mammifères marins des côtes du Sénégal. 2. Observations signalés en 1977. *Bulletin de l'IFAN* 40A (2): 457-465.

Dupuy, A.R. and Maigret, J. 1980. Les Mammifères marins des côtes du Sénégal. 4. Observations signalés en 1979. *Bulletin de l'IFAN* 41A (2): 401-409.

Eberhardt, L.L., Chapman, D.G. and Gilbert, J.R. 1979. A review of marine mammal census methods. *Wildlife Monographs* 63. 46pp.

Fisher, S.J. and Reeves, R.R. 2005. The global trade in live cetaceans – Implications for conservation. *Journal of International Wildlife Law and Policy* 8**:**315-340.

Hammond, P.S., Mizroch, S.A. and Donovan, G.P. (Eds). Individual recognition of cetaceans: use of photo-identification and other techniques to estimate population parameters. Reports of the International Whaling Commission (Special Issue No. 12). 440pp.

Hersh, S.L., Odell, D.K., and Asper, E.D. 1990. Sexual dimosphism in bottlenose dolphins from the east coast of Florida. *Marine Mammal Science* 6: 305-315.

Hoelzel, A.R., Potter, C.W. and Best, P. 1998. Genetic differentiation between parapatric 'nearshore' and 'offshore' subpopulations of the bottlenose dolphin. *Proceedings of the Royal Society of London B* 265:1–7.

IWC, 1984. Report of the Scientific Committee. *Reports of the International Whaling Commission* 34: 35-181.

Jallow, A., Cham, A.M., Barnett, L. and Van Waerebeek, K. 2005. Conservation of cetaceans in The Gambia: whale and

dolphin field research. pp. 37-54. *In:* (Ed. L. Barnett) Proceedings from the First Biodiversity Research Symposium The Gambia, Makasufu Wildlife Trust, Darwin Initiative Project, The Gambia. [unpublished].

Jefferson T.A., Curry, B.E., Leatherwood S., and Powell, J.A. 1997. Dolphins and porpoises of West Africa: a review of records (Cetacea: Delphinidae, Phocoenidae). *Mammalia* 61: 87-108.

Leduc, R.G. and Curry, B.E. 1997. Mitochondrial DNA sequence analysis indicates need for revision of the genus *Tursiops*. *Report of the International Whaling Commission* 47:393.

Maigret, J. 1980. Les mammifères marins des côtes de Mauritanie. Etat des observations en 1980. *Bulletin du Centre National de Recherches Océanographiques et des Pêches, Nouadhibou* 9(1): 130-152.

Maigret, J. 1981. Les mammifères marins des côtes de Mauritanie. 2. Rapport annuel des observations signalées en 1981. *Bulletin du Centre National de Recherches Océanographiques et des Pêches, Nouadhibou* 10(1) : 81-85.

Mead, J.G. and Potter, C.W. 1995. Recognizing two populations of the bottlenose dolphin (*Tursiops truncatus*) off the Atlantic coast of North America: morphologic and ecologic considerations. *IBI Reports (International Marine Biological Research Institute, Kamogawa, Japan)* 5:31–44.

Murphy, P.F., Van Waerebeek, K. and Jallow, A. 1997. Cetaceans in Gambian coastal waters. Document SC/49/SM11 presented to IWC Scientific Committee, Bournemouth, UK. 8pp.

Natoli, A., Peddemors, V.M. and Hoelzel, A.R. 2004. Population structure and speciation in the genus *Tursiops* based on microsatellite and mitochondrial DNA analyses. *Journal of Evolutionary Biology* 17: 363-375.

Odell, D.K. and Robeck, T.R. 2002. Captive breeding. Pp. 188-192 in *Encyclopedia of Marine Mammals*.

Ofori-Danson, P.K., Van Waerebeek, K. and Debrah, S. 2003. A survey for the conservation of dolphins in Ghanaian coastal waters. *Journal of the Ghana Science Association* 5(2): 45-54.

Ofori-Danson, P. K. and M. A. Odei. 1997. Preliminary observations of the common dolphin, *Delphinus delphis*, (order Cetacea; fam. Delphinidae) in the Ghanaian coastal waters. IWC Scientific Committee document SC/49/SM3.

Notarbartolo di Sciara, N., Politi, E., Bayed, A., Beaubrun, P.C. and Knowlton, A. 1998. A winter cetacean survey off southern Morocco, with a special emphasis on right whales. *Report of the International Whaling Commission* 48: 547-550.

Reeves, R.R. and Mead, J.G. 1999. Marine Mammals in captivity. Pp. 412-436 *in* (eds. J.R. Twiss Jr. and R.R.Reeves) *Conservation and Management of Marine Mammals*. Smithsonian Institution Press, Washington and London.

Reeves, R. R., Smith, B.D., Crespo, E.A. and Notarbartolo di Sciara, G. (compilers). 2003. *Dolphins, Whales and Porpoises. 2002-2010 Conservation Action Plan for the World's Cetaceans.* IUCN/SSC Cetacean Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. 139pp.

Robeck, T., Curry, B.E., McBain, J.F., and Kraemer, D.C. 1994. Reproductive biology of the bottlenose dolphin (T.t) and the potential application of advanced reproductive technologies. *J. Zoo. Wild. Med.* 25: 321-336.

Robineau, D. 1995. A propos de la prétendue symbiose entre les pêcheurs Imragen de Mauritanie et les dauphins. *Mammalia* 59(3): 460-463.

Robineau, D. and M. Vély. 1997. Données préliminaires (taille corporelle, craniométrie) sur le grand dauphin (*Tursiops truncatus*) des côtes d'Afrique du nord-ouest (Mauritanie, Sénégal). *Mammalia* 61:443-448.

Robineau, D. and Vély, M. 1998. Les cétacés des côtes de Mauritanie (Afrique du Nord-Est). Particularités et variations spatio-temporelles de répartition: rôle des facteurs océanographiques. *Rev. Ecol. (Terre Vie)* 53: 123-152.

Ross, G., Gales, N, Brownell, R., Reeves, R, Gulland, F. 2003. Live-capture and trade of bottlenose dolphins, Solomon Islands. *Species* (Newsletter of the Species Survival Commission IUCN-The World Conservation Union) 40:4-5.

Ryder, O.A. 1986. Species conservation and systematics: the dilemma of subspecies. *Trends in Ecology and Evolution* 1: 9-10.

Scott, G.P. 1990. Management-oriented research on bottlenose dolphins by the Southeast Fisheries Center. Pp. 623-639. *In* : (eds.) S. Leatherwood and R.R. Reeves. *The Bottlenose Dolphin.* Academic Press, San Diego.

Scott, G.P. and Chivers, S.J. 1990. Distribution and herd structure of bottlenose dolphins in the Eastern Tropical Pacific Ocean. Pp. 387-402. *In* : (eds.) S. Leatherwood and R.R. Reeves. *The Bottlenose Dolphin.* Academic Press, San Diego.

Scott, G.P., Wells, R.S., Irvine, A.B. 1990. A long-term study of bottlenose dolphins on the West Coast of Florida. Pp. 235-244. *In*: (eds.) S. Leatherwood and R.R. Reeves. *The Bottlenose Dolphin.* Academic Press, San Diego.

Small, R.J. and DeMaster, D.P. 1995a. Survival of five species of captive marine mammals. *Marine Mammal Science* 11: 209-226.

Small, R.J. and DeMaster, D.P. 1995b Acclimation to captivity a quantitative estimate based on survival of bottlenose dolphins and California sea lions. *Marine Mammal Science* 11: 510-519.

Spaans, B. 1990. Dolphins in the coastal area of Guinea Bissau. *Lutra* 33: 126-133.

Van Waerebeek, K. 2003. A newly discovered stock of humpback whales in the northern Gulf of Guinea. *CMS Bulletin* 18: 6-7.

Van Waerebeek, K. and De Smet, W.M.A. 1996. A second record of the false killer whale *Pseudorca crassidens* (Owen, 1846) (Cetacea, Delphinidae) from West Africa. *Mammalia* 60(2): 319-322.

Van Waerebeek, K., Ndiaye, E., Djiba, A., Diallo, M., Murphy, P., Jallow, A., Camara, A., Ndiaye, P. and Tous, P. 2000. A survey of the conservation status of cetaceans in Senegal, The Gambia and Guinea-Bissau. UNEP/CMS Secretariat, Bonn, Germany. 80pp.

Van Waerebeek, K., Barnett, L., Camara, A., Cham, A., Diallo, M., Djiba, A., Jallow, A.O., Ndiaye, E., Samba Ould Bilal, A.O. & Bamy, I. L. 2003. Conservation of Cetaceans in The Gambia and Senegal 1999-2001, and Status of the Atlantic humpback dolphin. WAFCET-2 Report. UNEP/CMS, Bonn, Germany. 55 pp.

Van Waerebeek, K. and Jiddou, A. 2006. Deuxième formation sur l'identification des mammifères aquatiques de l'Afrique de l'Ouest et campagne de prospection des Cétacés dans les eaux du Cap Blanc et du PNBA. Rapport à la Fondation Internationale du Banc d'Arguin. 13pp. (unpublished). [in French].

Van Waerebeek, K. and Ofori-Danson, P.K. 1999. A first checklist of cetaceans of Ghana, Gulf of Guinea, and a shore-based survey of interactions with coastal fisheries. Paper SC/51/SM35 presented to the IWC Scientific Committee, May 1999, Grenada. 9pp.

Van Waerebeek**,** K., Sequeira, M., Williamson, C., Sanino, G.P., Gallego, P. and Carmo, P. 2006. Live-captures of common bottlenose dolphins *Tursiops truncatus* and unassessed bycatch in Cuban waters: evidence of sustainability found wanting. *Latin American Journal of Aquatic Mammals* 5(1): 39-48.

Van Waerebeek, K., Hazevoet, C.J., López-Suárez, P., Simão Delgado Rodrigues, M. and Gatt, G. 2008. Preliminary findings on the mass strandings of melon-headed whale

Peponocephala electra on Boavista Island in November 2007, with notes on other cetaceans from the Cape Verde Islands. Technical Report to the Fondation Internationale du Banc d'Arguin (FIBA). 9pp. [unpublished, obtainable from www.lafiba.org].

Wells, R.S. and Scott, M.D. 1990. Estimating bottlenose dolphin population parameters from individual identification and capture-release techniques. *Reports of the International Whaling Commission* (special issue 12): 407-415.

Wolff, W.J. (ed.) 1998. The end of the East-Atlantic fly-way. Waders in Guinea-Bissau. Report on a cooperative research project in the estuaries of Guinea-Bissau. October 1992- May 1993. WIWO Report No. 39. Foundation Working Group for International Waterbird and Wetland Research, Zeist. 94pp.

Robeck, T. R., Steinman, K.J., Yoshioka, M., Jensen, E., O'Brien, J.K., Katsumata, E., Gili, C., McBain, J.F., Sweeney, J. and Monfort, S.L. 2005. Estrous cycle characterisation and artificial insemination using frozen-thawed spermatozoa in the bottlenose dolphin (*Tursiops truncatus*). *Reproduction* 129 (5): 659-674.

Area	Range	Median	Mean	SD	N	Source
Dahkla Bay, Western Sahara			6.8	4.7	6	Notarbartolo di Sciara *et al.* (1988)
Banc d'Arguin, Mauritania	2-36	15	12.91	10.76	11	Van Waerebeek and Jiddou (2006)
Gambia River estuary	2-40		12.1	9.13	52	Van Waerebeek *et al.* (2000)
Gambia River, Kiang West National Park (upriver)	3-23		10.41	4.95	32	Van Waerebeek *et al.* (2000)
Guinea-Bissau (1986-1987)	1-25	2	4.07	6.47	13	Spaans (1990)
Guinea-Bissau (1992)	1-10		3.19		32	Wolff (1993)
Guinea-Bissau (1995-1998)	1-10		4.60		5	Van Waerebeek *et al.* (2000)

Table 1. Group sizes for four inshore populations of common bottlenose dolphins *Tursiops truncatus* in West African waters. The sample by Wolff (1993) includes several estimates deemed minimum ("number+").