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Bottlenose dolphins in South Australia: biology and threats

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INTRODUCTION

Bottlenose dolphins have been the subject of many studies around Australia. Their taxonomy has been debated for over 30 years with up to three species recognised for the region (see Jedensjo et al. this volume). Genetic techniques have been used to determine population structure, social interactions and life history trends in several regions. Long-term studies of live bottlenose dolphins are underway in most states and these yield local abundance estimates, diet composition and life history information. However, few published studies are available on broad scale abundance using aerial or boat-based surveys (Preen et al. 1997, Allen et al. 2012).

Several research centres undertake post-mortems of stranded bottlenose dolphins but with the exception of South Australia, the data from their programs are not summarised in readily available publications. Skin lesions are the subject of ongoing investigations in Victoria and Western Australia. A national wildlife health network includes results of bottlenose dolphin post-mortems.

Published studies on bottlenose dolphins in South Australia have focussed on data obtained from carcasses and strandings i.e. pathology, circumstance of death, life history, distribution, diet, population structure and taxonomy. In at least four locations *T. aduncus* is the subject of ecological studies of identified individuals (Coffin Bay, north coast of Kangaroo Island, Adelaide, Victor Harbor). Two aerial surveys have been carried out to estimate abundance but these are unpublished at this point in time.

The Adelaide Dolphin Sanctuary was gazetted in 2005 and its goal is to conserve and manage *T. aduncus* in an environment impacted by urban development. A system of marine parks was established in South Australia in 2014. It is hoped that this will lead to an increased opportunity for research on *T. aduncus*, including threats to its long-term viability.

South Australian *Tursiops* spp.

Biology

Total body length of adult *T. truncatus* is 2.3–3.1 m and *T. aduncus* is 2.1–2.5 m.

Age has been estimated by incremental layers in the dentine of teeth from 275 *T. aduncus* collected from South Australia. Maximum age is 32 years. Since this is considerably less than maximum age determined in bottlenose dolphins from elsewhere, it needs to be verified by examining growth layers in the cementum. Preliminary studies have shown that the neonatal line forms at about 2 months of age. There are no age estimates for *T. truncatus*.

Tursiops aduncus sexual maturity in males is attained at 12–15 years and in females at 6–14 years. Physical maturity is attained at 12–17 years in both males and females.

Few offshore surveys have been conducted that report dolphin species, therefore knowledge of species distribution relies for the most part on strandings. *Tursiops truncatus* has stranded or washed up along the open ocean coasts and *T. aduncus* in the major gulfs (where it is found throughout the gulfs) and protected bays (Segawa and Kemper 2015). These data imply that *T. truncatus* inhabits the deep-water, offshore environment and that *T. aduncus* is the shallow, inshore species. The fact that only *T. truncatus* has mass stranded (Kemper and Ling 1991, Segawa and Kemper 2015), supports the contention that this species is oceanic. The most western known extent of the distribution of *T. aduncus* in South Australia is Fowler Bay in the Great Australian Bight. However, because the coast to the west is remote and difficult to access, its distribution may extend beyond this point, possibly into Western Australia.

Ecology, and social and genetic structure of *T. aduncus* are the subjects of several PhDs being conducted through Flinders University. Anthropogenic influences are being investigated in two of these studies. A 30-year study of *T. aduncus* near Adelaide is describing movements, behaviour, reproduction, longevity and ecology (Cribb et al. 2008, Kemper et al. 2008, Steiner and Bossley 2008).

Pathology

A comprehensive program of post-mortem examinations has yielded data on 'circumstance of death' for *T. aduncus* and *T. truncatus* from around South Australia (Kemper and Tomo 2011, Kemper et al. 2005). Carcasses (mostly of *T. aduncus*) are opportunistically collected from strandings and bycatch, are subject to thorough necropsy and samples collected for a wide variety of studies. Circumstances of death include intentional killing, entanglement, boat collision, disease, neonatal death and live stranding. Necropsies are important in the identification of probable entanglements (i.e. those that have not been reported as being removed from nets and lines). Disease was found to be a major circumstance of death (about 30% of known circumstance) for *T. aduncus* from Gulf St Vincent (Kemper and Tomo 2011). Many cases involve severe blunt trauma but these do not appear to have been linked to entanglement. Kemper and Tomo (2011) documented many cases of infectious disease in *T. aduncus* from Gulf St Vincent, including pathogenic bacteria such as *Staphylococcus aureus*, *Corynebacterium ulcerans* and *Vibrio* spp. Tomo et al. (2010) described the prevalence of lung nematodes of South Australian dolphins over an 18-year period and concluded that, unlike *Delphinus delphis*, this was not a major circumstance of death for *Tursiops* spp. Skin lesions are the subject of a study in the Adelaide region and preliminary results suggest an increase in incidence during the last decade.

During 2013, an Unusual Mortality Event (UME) occurred in St Vincent Gulf Bioregion (Kemper et al. in prep.). A total of 50 dolphin mortalities were reported, of which at least 41 were *T. aduncus*, over a 7-month period. About 60% of the mortalities had evidence of morbillivirus, as determined by immunohistochemistry (IHC) testing. The event coincided with major environmental perturbation and mass fish mortalities. Morbillivirus was also identified in a single *T. truncatus* from the far southeast of the state but this did not appear to be related to a UME of that species. Genetic evidence for Dolphin Morbillivirus was identified in *Tursiops* spp. and *D. delphis* from South Australia from 2011–2013. A thorough survey is needed of archived tissue to test for IHC evidence of the virus prior to 2013. The only other known dolphin UME for Australia is that of a small event in Perth in 2009 (Stephens et al. 2014).

Diet

Few data are available on the diet of *T. truncatus* in South Australia (Gibbs et al. 2011) because carcasses do not often wash up and of those collected, many have nil stomach contents. The prey of *T. aduncus* were generally demersal species with the most important from the cephalopod families Octopodidae, Sepiidae and Loliginidae, and fish families Carangidae, Clupeidae, Terapontidae and Apogonidae (Kemper and Gibbs 2001, Gibbs et al. 2011). Using ground teeth, Gibbs et al. (2011) compared isotopes ($\delta^{13}C$, $\delta\ ^{15}N$) and found that *T. truncatus* fed at a higher trophic level than *T. aduncus*. In addition, *T. aduncus* collected from northern and southern Spencer Gulf had different isotope signatures, the implications of which are that these 'populations' are ecologically separate to some degree. Bilgmann et al. (2007) also found evidence of population differentiation for *T. aduncus* from South Australia using genetic methods. Management of *T. aduncus* should therefore take population sub-structuring into account.

Threats

Knowledge of the threats to bottlenose dolphins in South Australia is mostly limited to *T. aduncus*. This is largely due to the offshore distribution of *T. truncatus* and the difficulty of assessing abundance and threats in that environment. For the threats discussed below, the impact on populations is not known because population viability analyses have not been conducted. Kemper et al. (2008) and Gibbs and Kemper (2014) discussed the threats to cetaceans in Gulf St Vincent and Spencer Gulf.

Intentional killing (shooting, stabbing) has been reported in several parts of the state, particularly near Adelaide (Kemper et al. 2005). The perpetrators are not known because in most cases the projectiles have been shotgun pellets and these are not traceable to the weapon. Some data are also available that link dolphin killings to fishing practices (Gibbs et al. 2004).

Unintentional anthropogenic mortality is frequently recorded for *T. aduncus* in SA. Entanglement in a variety of industries (shark gill-netting, finfish aquaculture, recreational fishing) is a concern (Kemper and Gibbs 2001, Kemper et al. 2005, Gibbs and Kemper 2014, Segawa and Kemper 2015). Some *T. aduncus* have also died in anti-shark nets set to protect bathers but because beach netting is rare in South Australia, this is unlikely to be a major cause of mortality. There is no evidence that bottlenose dolphin mortalities occur in the SA Sardine Fishery (Hamer et al. 2008). Few entanglements are formally reported by industry but necropsy investigations conclude that many carcasses that wash up are probable entanglements in fishing gear (Table 1). This points to a failure of the regulating agencies to properly inform industry and/or police the issue. In SA, incidental mortality is not an offence but it must be reported to government.

Dolphin entanglements of have been recorded in the shark gill-netting fishery which operates in Commonwealth waters off South Australia and Victoria. Video evidence shows that the majority of mortalities are *Delphinus delphis* but some *Tursiops* sp. (likely *truncatus*) have been recorded (Kemper 2012). In 2011 shark fishing was closed in a zone to the east of Kangaroo Island due to unprecedented dolphin mortalities and a more rigorous system of monitoring has since been introduced.

Long-term and indirect threats are likely to be just as important to the conservation of bottlenose dolphins in SA but these are difficult to monitor since the effects are not readily observed or measured. Inshore species such as *T. aduncus* are under considerable threat because they share the environment with humans. Coastal development for housing and industry degrade inshore habitats (Westphalen et al. 2004) and introduce toxic contaminants into the environment. A series of studies has been conducted on heavy metals in bottlenose dolphins from SA using carcasses necropsied by the SA Museum (Long et al. 1997, Kemper et al. 1994, Lavery et al. 2008, Lavery et al. 2009). These have shown that compared with *T. truncatus* and *D. delphis*, *T. aduncus* is the most at risk, probably because it is resident in the gulfs and its diet includes many benthic species. Lavery et al. (2008) showed a difference in heavy metal concentration in dolphin carcasses between Gulf St Vincent and Spencer Gulf, with maximum levels of liver cadmium (99 mg/kg wet weight) and zinc (453 mg/kg). Lavery et al. (2009) investigated metal concentration, renal damage, metallothionein concentration and bone malformation in *T. aduncus* and concluded that some individuals displayed signs of heavy metal toxicity. Kemper et al. (2014) found preliminary evidence of male reproductive impairment related to heavy metal concentration in *T. aduncus* from Spencer Gulf.

To summarize the threat status of bottlenose dolphins in SA, *T. aduncus* appears to be more at risk than *T. truncatus*. *Tursiops aduncus* that inhabits the gulf region is more likely to be under pressure, particularly north Spencer Gulf (heavy metals, entanglements) and eastern Gulf St Vincent (recreational fishing, boating, habitat degradation, coastal development).

RECOMMENDATIONS

1. There is need for an Australia-wide perspective on the abundance of *T. aduncus*. Live animal studies are underway in at least 9 locations yet these data have not been reviewed or compared. A workshop to assess abundance and distribution is recommended.
2. An aerial survey was conducted in Spencer Gulf in 2005 but its design was not adequate to obtain an overall abundance estimate. New methodology may allow for a re-evaluation of the data to produce an estimate. In light of the threats to this population of *T. aduncus*, this should be a priority for southern Australia.
3. A workshop on threats to *Tursiop* spp. in Australian waters is also recommended. Parties that have first-hand experience with a variety of threats should be invited, as

well as experts from other regions. Mitigation measures, including a discussion of the use of acoustic devices, should be a priority outcome of the workshop.

4. Monitoring mortalities and strandings should be continued in SA and co-ordination and data management in other states improved. A national system (possibly through the National Wildlife Health Network) should be set up to share data, particularly on disease. Such a network should include a wide variety of expertise (e.g. cetacean biologists, pathologists, veterinarians, government wildlife agencies). Material collected from necropsy programs should be housed in a way that it is publicly available into the future.
5. Research funding is needed for programs that investigate the effects, both short and long term, of toxic contaminants on *T. aduncus*. Regional studies should contribute to a national perspective.
6. Transparent systems of monitoring mortalities in fishing and aquaculture gear need to be regularly updated and promoted. As much as possible, carcasses should be collected from the industries involved and funding made available to perform necropsies. The data from these will not only help to mitigate the issue, they will also provide much needed information on the life history and diet of a sector of the population not normally sampled.

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Table 1: Circumstance of death for *Tursiops aduncus* from South Australia. See Segawa and Kemper (2015) for definitions of circumstance. Total known circumstance was 131 carcasses that were necropsied by the SA Museum during 1984–2013.

Disease	Other Natural	Known Entanglement	Probable Entanglement	Intentional Killing	Live Stranded	Other Unintentional	Captured
41 (31%)	21 (16%)	18 (14%)	16 (12%)	13 (10%)	11 (8%)	7 (5%)	4 (3%)